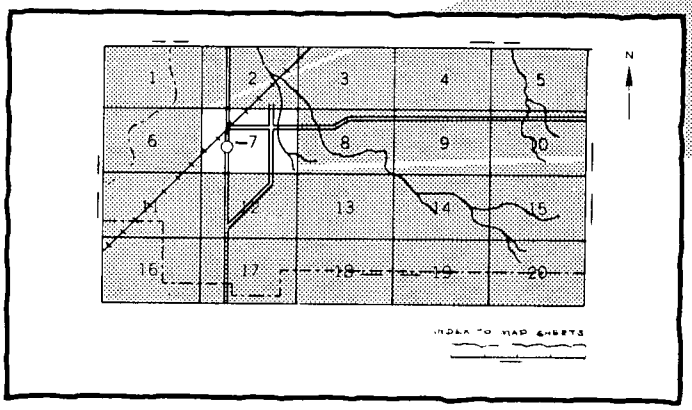
SOIL SURVEY OF

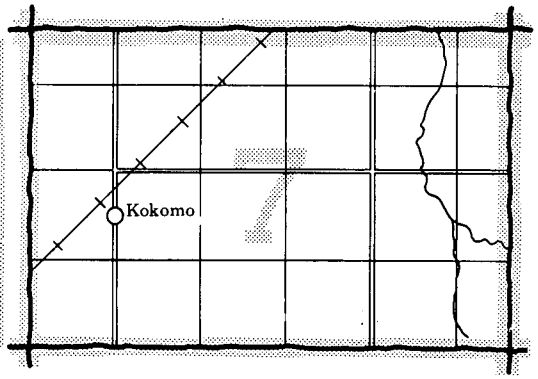
Tulsa County, Oklahoma

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

HOW TO USE

1. Locate your area of interest on the "Index to Map Sheets" (the last page of this publication).





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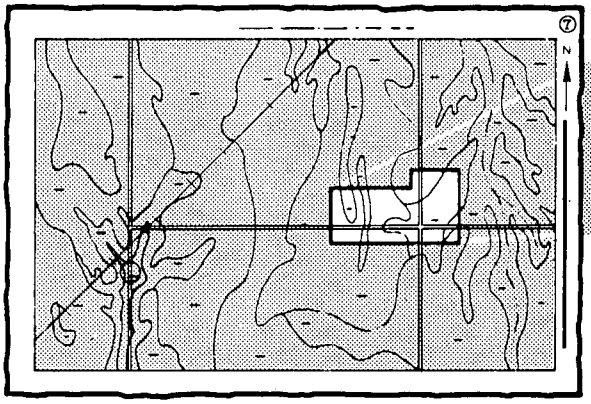
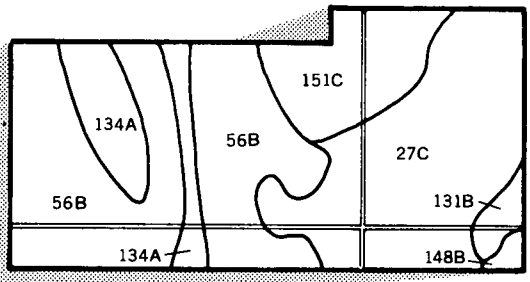
3. Locate your area of interest on the map sheet.





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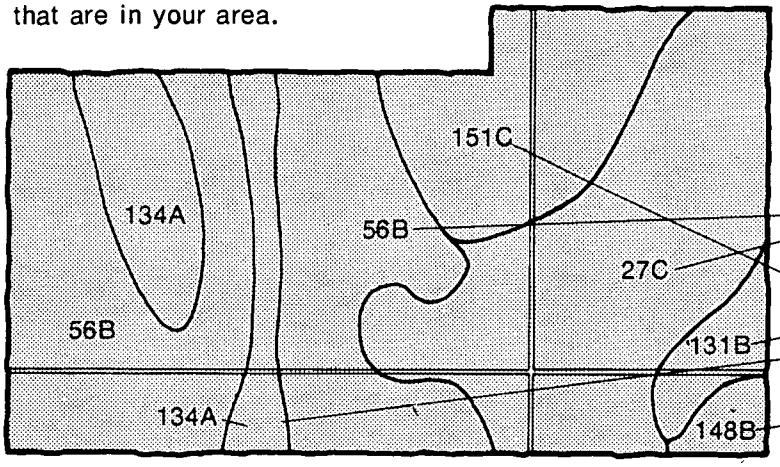

Symbols

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131B
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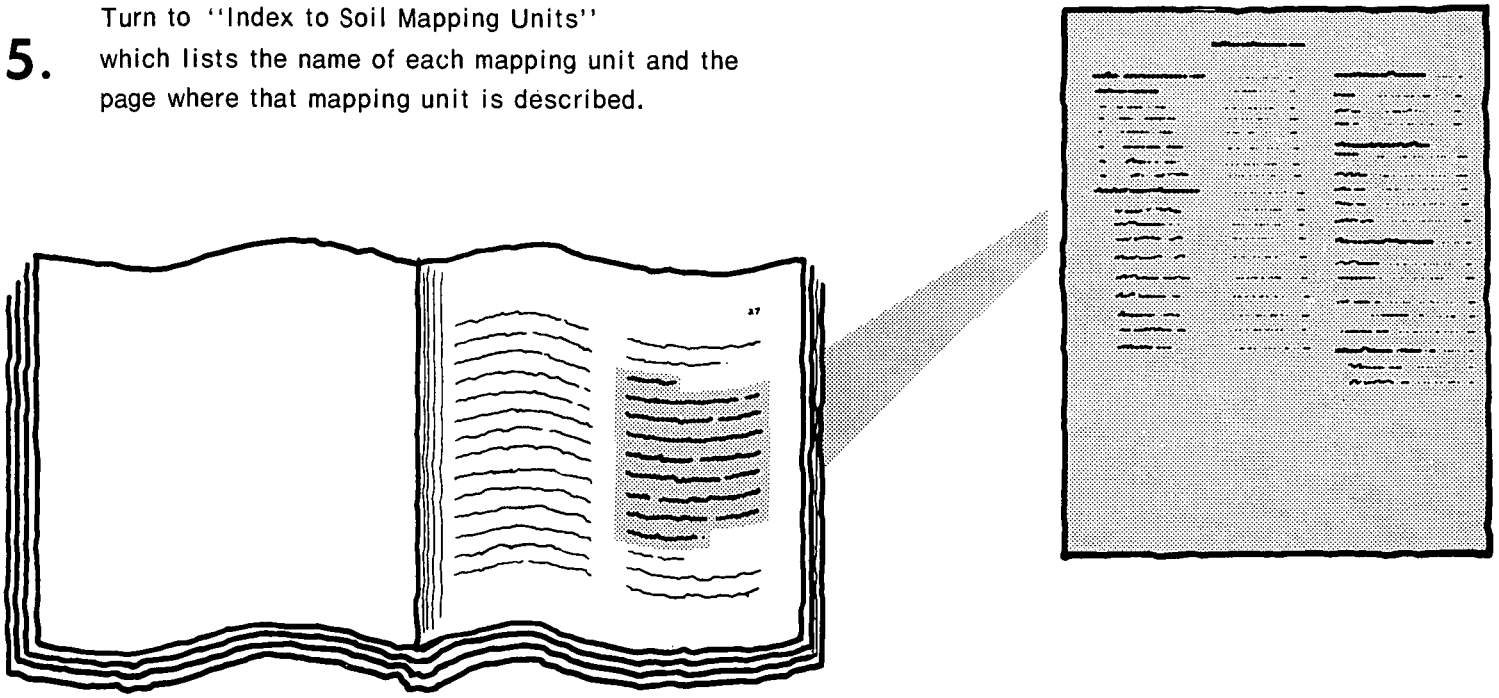
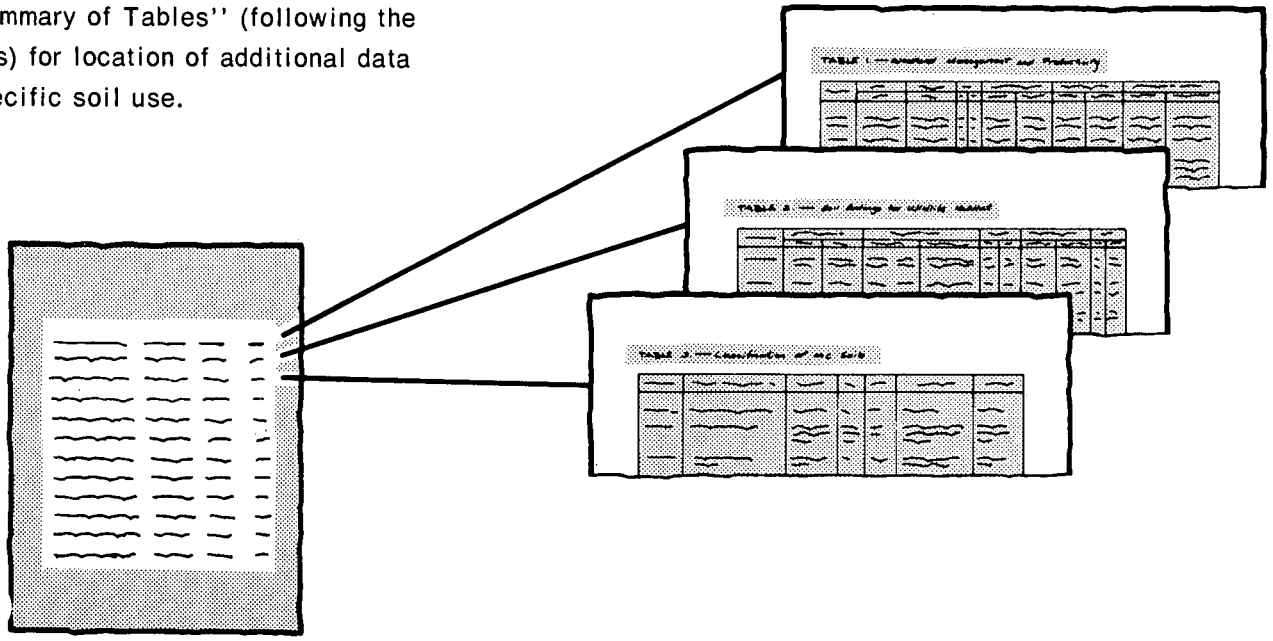
THIS SOIL SURVEY

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



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



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

This is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and agencies of the States, usually the Agricultural Experiment Stations. In some surveys, other Federal and local agencies also contribute. 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 the period 1968-74. Soil names and descriptions were approved in 1975. Unless otherwise indicated, statements in the publication refer to conditions in the survey area in 1975. This 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 Tulsa County Conservation District.

Soil maps in this survey may be copied without permission, but any enlargement of these maps could cause misunderstanding of the detail of mapping and result in erroneous interpretations. Enlarged maps do not show small areas of contrasting soils that could have been shown at a larger mapping scale.

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Foreword

The Soil Survey of Tulsa County contains much information useful in any land-planning program. Of prime importance are the predictions of soil behavior for selected land uses. Also highlighted are limitations or hazards to land uses that are inherent in the soil, improvements needed to overcome these limitations, and the impact that selected land uses will have on the environment.

This soil survey has been prepared for many different users. Farmers, ranchers, foresters, and agronomists can use it to determine the potential of the soil and the management practices required for food and fiber production. Planners, community officials, engineers, developers, builders, and homebuyers can use it to plan land use, select sites for construction, develop soil resources, or identify any special practices that may be needed to insure proper performance. Conservationists, teachers, students, and specialists in recreation, wildlife management, waste disposal, and pollution control can use the soil survey to help them understand, protect, and enhance the environment.

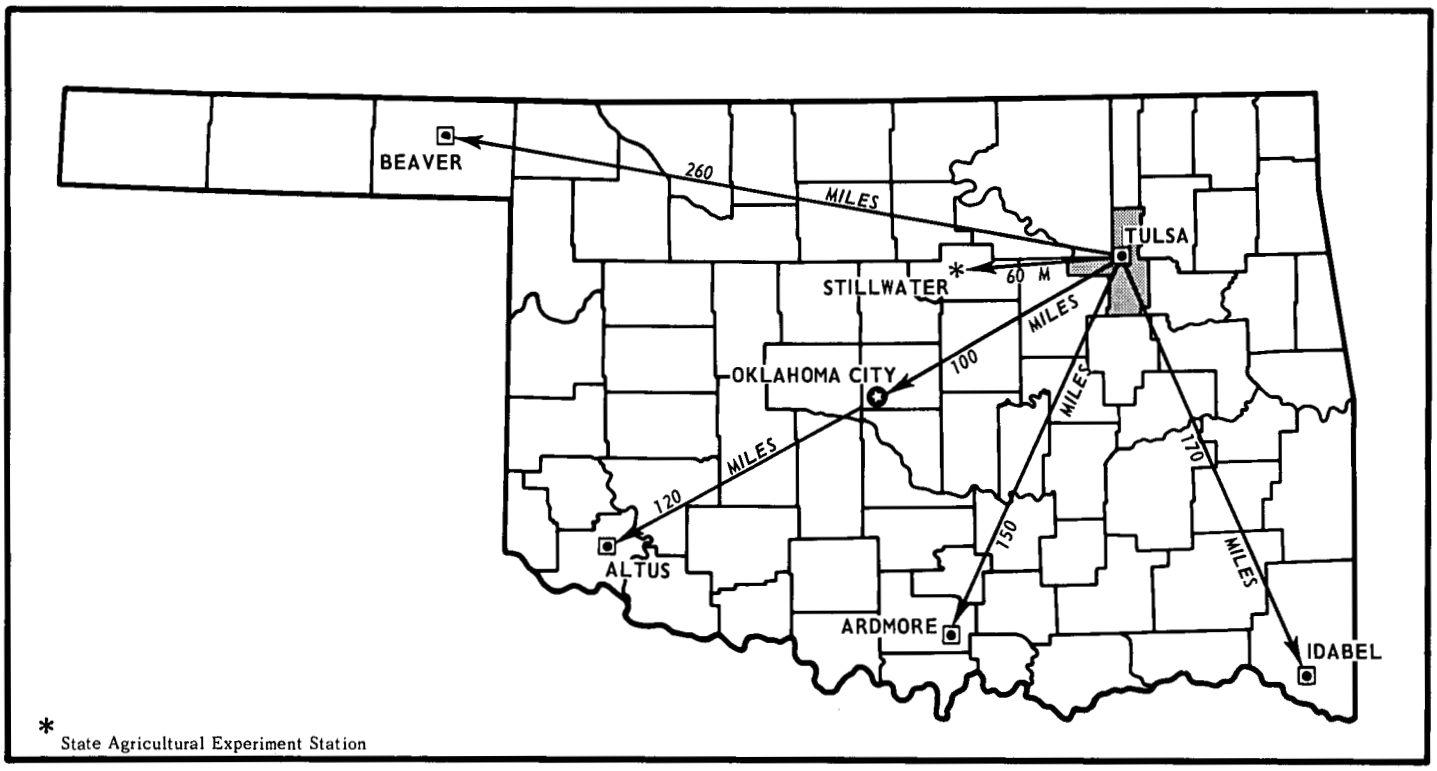
Many people assume that soils are all more or less alike. They are unaware that great differences in soil properties can occur even within short distances. Soils may be seasonally wet or subject to flooding. They may be shallow to bedrock. They may be too unstable to be used as a foundation for buildings or roads. Very clayey or wet soils are poorly suited to 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 kind of soil is shown on detailed soil maps. Each kind of soil in the survey area is described, and much information is given about each soil for specific uses. Additional information or assistance in using this publication can be obtained from the local office of the Soil Conservation Service or the Cooperative Extension Service.

We believe that this soil survey can help bring us a better environment and a better life. Its widespread use can greatly assist us in the conservation, development, and productive use of our soil, water, and other resources.

Roland R. Willis

State Conservationist
Soil Conservation Service



Location of Tulsa County in Oklahoma.

SOIL SURVEY OF TULSA COUNTY, OKLAHOMA

By Everett L. Cole, Donald G. Bartolina, and Bill G. Swafford,
Soil Conservation Service

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

TULSA COUNTY is in the northeastern part of Oklahoma (see facing page). The county is bounded on the west by Osage and Creek Counties; on the north by Pawnee, Osage, and Washington Counties; on the east by Rogers and Wagoner Counties; and on the south by Wagoner and Okmulgee Counties. Tulsa, the county seat, is in the central part of the county. The county has an area of 376,320 acres, or 588 square miles.

General Nature of the County

Additional information about the soil survey area is given in this section. It will be most useful to persons not familiar with Tulsa County. It describes the climate, settlement and development, relief and drainage, natural resources, and transportation and industry.

Climate

The consistent pattern of climate in Tulsa County is one of cold winters and long, hot summers. Heavy rains occur mainly in spring and early in summer, when moist air from the Gulf of Mexico interacts with drier continental air. The annual rainfall is normally adequate for wheat, soybeans, and all other grain crops.

Table 1 gives data on temperature and precipitation for the survey area, as recorded at Tulsa, Oklahoma, for the period 1951 to 1974. 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 is 28 degrees. The lowest temperature on record, -5 degrees, occurred at Tulsa on December 23, 1963. In summer the average temperature is 81 degrees, and the average daily maximum is 91 degrees. The highest temperature, 112 degrees, was recorded on July 14, 1954.

Growing degree days, shown in table 1, are equivalent to "heat units." Beginning in spring, 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.

Of the total annual precipitation, 25 inches, or 64 percent, usually falls during the period April through September, which includes the growing season for most crops. Two years in 10, the April-September rainfall is less than 18 inches. The heaviest 1-day rainfall during the period of record was 7.54 inches at Pawhuska on July 27, 1963. Thunderstorms number about 55 each year; 22 occur in summer.

Average seasonal snowfall is 10 inches. The greatest snow depth at any one time during the period of record was 10 inches. On the average, 3 days have 1 inch of snow on the ground, but the number of days varies greatly from year to year.

The average relative humidity in midafternoon is about 55 percent. Humidity is higher at night in all seasons, and the average at dawn is about 80 percent. The percentage of possible sunshine is 70 percent in summer and 54 percent in winter. Prevailing winds are southerly. Average windspeed is highest, 13 miles per hour, in March.

Tornadoes and severe thunderstorms occur occasionally but are local and of short duration. Damage varies and is spotty. Hailstorms occur at times during the warmer part of the year but in an irregular pattern and in only small areas.

Settlement and Development

Cherokee Indians were the early settlers of the area that now is Tulsa County. Land was allotted to the Indians on the basis of its cash value; the largest allotments were in areas of the rolling, timbered soils. Land could also be leased for farming subject to the supervision of the Indian agency. The sale or lease of the land brought farmers into the county.

Most of these new settlers farmed a small subsistence acreage. Cotton, grain sorghums, peanuts, small grains, and alfalfa hay were the major cash crops; other crops were grown only to feed horses, mules, hogs, chickens,

and beef and milk cattle. Some farmers sold their land because they found that they could not make a living on it. Farmers in other areas acquired these lands, and farm units increased in size. Farmers specialized in certain types of crop and livestock enterprizes to more efficiently manage larger farm units. They became more mechanized, started using irrigation to supplement moisture needs of field crops, and converted old cultivated areas to tame pasture.

One large reservoir was built on the Arkansas River for municipal and industrial purposes. Some industries were established.

Relief and Drainage

The soils of Tulsa County, except for those on the panhandle, are predominantly nearly level through gently sloping; more strongly sloping soils are along drainageways. Soils in the panhandle in the western part of the county are predominantly gently sloping through steep. The general slope is from north to south. The Arkansas and Caney Rivers drain most of the county. Bird, Joe, Polecat, Hominy, Snake, Mingo, and Duck Creeks are the main tributary streams. The rivers and creeks have entrenched to a depth of about 20 to 100 feet.

Landforms in the county include prairies, woodlands, and flood plains. The prairies and woodlands are on divides between nearly level through gently sloping flood plains, which range from 200 feet wide along the smallest streams to about 3 miles wide along some of the rivers. The slopes that extend into the flood plains are strongly sloping through steep.

Natural Resources

The soil is one of the most important natural resources in the county. It produces grass for livestock, timber, crops, and mineral resources that are necessary to sustain a substantial part of the economy in the county.

The water supply for the city of Tulsa comes mostly from Spavinaw and Eucha Lakes in Delaware County, Oklahoma. The water supply for suburban areas of Tulsa and for other towns and communities comes mainly from wells and small reservoirs. Hydroelectric and flood control reservoirs furnish recreation and electricity. Farm ponds supply water for livestock.

Income from the sale of timber has been considerably reduced in recent years. Most of the timber has been culled, and the trees that were left to propagate new stands are of poor quality. The timber is used mostly for lumber.

Pockets of oil are scattered throughout the county. Oil furnishes additional income and provides jobs for the community.

Limestone is the most common surface mineral. It is mined in the east-central part of the county for roads and for industrial and commercial purposes.

Wildlife and game live outside of the metropolitan area. Quail, dove, rabbit, and duck are hunted in season. Fishing is mostly in the Keystone Reservoir, the Arkansas River, and farm ponds.

In the survey area, sand is obtained from the soils adjacent to the Arkansas River. Waterwashed sand is taken from the streambed.

A good mineral resource in the county is bituminous coal. The coal fields, however, are mostly inactive.

The Keystone Reservoir, Arkansas River, and numerous small ponds attract thousands of visitors each year. Visitors are most numerous in the Keystone Reservoir area during the spring and summer.

Transportation and Industry

Railroads, state and federal highways, and county roads form a network of transportation facilities in the county. The Midland Valley and Atchison-Topeka and Santa Fe Railroads transect the county north and south, and the Missouri-Kansas-Texas and St. Louis-San Francisco Railroads furnish transit east and west. U.S. Highway 64 and State Routes 51, 67, 33, and 20 extend east and west across the survey area, and U.S. Highways 169 and 75 and State Routes 11 and 97 are the main north-south roads. U.S. Highway 66 and Interstate Highway 44 cross the county from southwest to northeast. In farm areas, paved county roads provide access to state and Federal highways.

Small grains, sorghum, vegetables, soybeans, timber, and livestock are marketed in the county. Most of the grain is shipped by rail or truck or through the Port of Catoosa. Limestone is mined commercially in the east-central part of the county. Most of the industries are based on coal, oil, recreation, or commerce and are located near Tulsa.

How This Survey Was Made

Soil scientists made this survey to learn what kinds of soil are in the survey area, where they are, and how they can be used. The soil scientists went into the area knowing they likely would locate many soils they already knew something about and perhaps identify some they had never seen before. They observed the steepness, length, and shape of slopes; the size of streams and the general pattern of drainage; the kinds of native plants or crops; the kinds of rock; and many facts about the soils. They dug many holes to expose soil profiles. A profile is the sequence of natural layers, or horizons, in a soil; it extends from the surface down into the parent material, which has been changed very little by leaching or by the action of plant roots.

The soil scientists recorded the characteristics of the profiles they studied, and they compared those profiles with others in counties nearby and in places more distant. Thus, through correlation, they classified and named the soils according to nationwide, uniform procedures.

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

The areas shown on a soil map are called soil mapping units. Some mapping units are made up of one kind of soil, others are made up of two or more kinds of soil, and a few have little or no soil material at all. Mapping units are discussed in the section "Soil Maps for Detailed Planning."

While a soil survey is in progress, samples of soils are taken as needed for laboratory measurements and for engineering tests. The soils are field tested, and their interpretatons are modified as necessary during the course of the survey. New interpretations are added to meet local needs, mainly through field observations of different kinds of soil in different uses under different levels of management. Also, data are assembled from other sources, such as test results, records, field experience, and information available from state and local specialists. For example, data on crop yields under defined practices are assembled from farm records and from field or plot experiments on the same kinds of soil.

But only part of a soil survey is done when the soils have been named, described, interpreted, and delineated on aerial photographs and when the laboratory data and other data have been assembled. The mass of detailed information then needs to be organized so that it is readily useful to different groups of users, among them farmers, managers of rangeland and woodland, engineers, planners, developers and builders, homebuyers, and those seeking recreation.

General Soil Map for Broad Land Use Planning

The general soil map at the back of this publication shows, in color, the soil units for broad land use planning described in this survey. Each soil unit is a unique natural landscape that has a distinct pattern of soils and of relief and drainage features. A unit typically consists of one or more soils of major extent and some soils of minor extent. It is named for the major soils. The kinds of soil in one unit can occur in other soil units, but in a different pattern.

The map provides a broad perspective of the soils and landscapes in the survey area. It provides a basis for comparing the potential of large areas for general kinds of land use. Areas that are generally suitable for certain kinds of farming or other land uses can be identified on the map. Likewise, areas of soils having properties that are distinctly unfavorable for certain land uses can be located.

Because of its small scale, the map does not show the kind of soil at a specific site. Thus, it is not suitable for planning the management of a farm or field or for selecting a site for a road or building or other structure; the kinds of soils in any one soil unit ordinarily differ from place to place in slope, depth, stoniness, drainage, or other characteristics that affect their management.

Land area makes up about 97 percent of the county and water area makes up about 3 percent of the county.

Deep to Moderately Deep, Loamy, Well Drained to Somewhat Poorly Drained Soils on Uplands

The four associations in this group make up 58 percent of Tulsa County. The soils are mainly used for field crops, but some areas are used for tame pasture.

1. Dennis-Bates Association

Deep and moderately deep, very gently sloping through sloping, moderately well drained or well drained, loamy soils that have a loamy or clayey subsoil over clayey sediments or sandstone; on uplands

This association makes up about 29 percent of the county. About 67 percent is Dennis soils, and 5 percent is Bates soils. The remaining soils include Carytown, Coweta, Kanima, Okemah, Parsons, and Radley soils and Pits and Urban Land.

Dennis soils are deep, very gently sloping through gently sloping, and moderately well drained. They have a loamy surface layer and a loamy and clayey subsoil over clayey sediments. They are slowly permeable.

Bates soils are moderately deep, very gently sloping through sloping, and well drained. They have a loamy surface layer and a loamy subsoil over sandstone. They are moderately permeable.

About 40 percent of this association is cultivated, and 50 percent is in tame pasture. The rest is in native grass and urban areas. The main crops are tame pasture plants, small grains, grain sorghum, and soybeans. Some areas are in native grass.

The main management needs are controlling soil loss through erosion and maintaining soil tilth and fertility. A good cropping system with proper residue management is beneficial for all soils under cultivation. Terracing and adding fertilizer to increase plant residue help protect the soil from erosion.

2. Okemah-Parsons Association

Deep, nearly level, moderately well drained and somewhat poorly drained, loamy soils that have a loamy or clayey subsoil; on uplands

This association makes up about 15 percent of the county. About 36 percent is Okemah soils, and 13 percent is Parsons soils. The remaining soils in this association include Carytown, Dennis, and Radley soils and Oil-waste land, Pits, and Urban land.

Okemah soils are deep, nearly level, and moderately well drained. They have a loamy surface layer, the upper part of the subsoil is loamy or clayey, and the lower part of the subsoil is clayey. They are slowly permeable.

Parsons soils are deep, nearly level, and somewhat poorly drained. They have a loamy surface layer and a clayey subsoil. They are very slowly permeable.

About 40 percent of this association is cultivated, and 50 percent is in tame pastures. The rest is in native grass. The main field crops are small grains, grain sorghum, and soybeans.

The main management needs are surface drainage and maintaining soil tilth, water intake, and fertility. A good cropping system with proper residue management is beneficial for these soils. In wet areas draining surfaces by directing the rows is usually sufficient for good plant growth. Excessive tillage needs to be avoided.

3. Okay-Kamie Association

Deep, nearly level through sloping, well drained, sandy or loamy soils that have a loamy subsoil over loamy sediments; on uplands

This association makes up about 7 percent of the county. About 47 percent is Okay soils, and 32 percent is Kamie soils. The remaining soils include Glenpool, Larton, and Tullahassee soils and Urban land and water areas.

Kamie soils are deep, very gently sloping through sloping, and well drained. They have a sandy or loamy surface layer and a loamy subsoil over loamy sediments. These soils are moderately permeable.

Okay soils are deep, nearly level through gently sloping, and well drained. They have a loamy surface layer and a loamy subsoil over loamy sediments.

Most of these soils are used for tame pastures, small grains, grain sorghum, soybeans, and vegetable crops. A few areas are in native grass or woodland.

The main management needs are controlling erosion and maintaining soil tilth and fertility. The soils can be properly managed by using a good cropping system, by residue management, and by contour farming and terraces on slopes exceeding 1 percent.

4. Apperson-Newtonia-Catoosa Association

Deep, very gently sloping and gently sloping, moderately well drained and well drained, loamy soils that have a loamy and clayey subsoil over loamy or clayey sediments or limestone; on uplands

This association makes up about 7 percent of the county. About 24 percent is Apperson soils, 21 percent is Newtonia soils, and 8 percent is Catoosa soils. The remaining soils include Dennis, Kanima, Lula, Radley, and Shidler soils and Pits, Rock outcrop, and Urban land.

Apperson soils are deep, very gently sloping or gently sloping, and moderately well drained. They have a loamy surface layer and a loamy or clayey subsoil over limestone. They are slowly permeable.

Newtonia soils are deep, very gently sloping or gently sloping, and well drained. They have a loamy surface layer and a loamy or clayey subsoil over loamy and clayey sediments. They are moderately permeable.

Catoosa soils are moderately deep, very gently sloping through strongly sloping, and well drained. They have a loamy surface layer and a loamy subsoil over limestone. They are moderately permeable.

About 60 percent of this association is in tame pastures. The main field crops are small grains, grain sorghum, and soybeans. Some areas are in native grasses and are used for range or hay.

The main management needs are to maintain soil tilth and fertility and to protect the soil from erosion. Erosion can be reduced by terracing, contour farming, and fertilizing to increase crop residue. Excessive tillage needs to be avoided.

Deep, Loamy or Clayey, Well Drained to Poorly Drained Soils on Flood Plains

The two associations in this group make up 21 percent of Tulsa County. The soils are mainly used for field crops and tame pastures, but some areas are wooded.

5. Osage-Wynona Association

Deep, nearly level, poorly drained and somewhat poorly drained, loamy or clayey soils that have a loamy or clayey subsoil over loamy or clayey sediments; on flood plains

This association makes up about 12 percent of the county. About 32 percent is Osage soils, and 29 percent is Wynona soils. The remaining soils include Cleora and Radley soils and Urban land.

Osage soils are deep, nearly level, and poorly drained. They have a clayey surface layer and subsoil. They have very slow permeability, and they are flooded occasionally for very brief periods.

Wynona soils are deep, nearly level, and somewhat poorly drained. The surface layer and upper part of the subsoil are loamy and the lower part of the subsoil is loamy or clayey. They have moderately slow permeability and are flooded occasionally for very brief periods.

Most of these soils are used for tame pasture. About 30 percent of this association is farmed to small grains, grain sorghum, and soybeans. About 30 percent of this association is wooded.

The main concerns of management are flooding, wetness, slow water intake, and soil tilth. Planting of spring crops needs to be delayed until after the common flood periods to prevent excessive loss of soil. These soils respond to a good cropping system, drainage, fertilizers, and residue management.

6. Choska-Severn Association

Deep, nearly level, well drained, loamy soils over loamy and sandy material; on flood plains

This association makes up about 9 percent of the county. About 38 percent is Choska soils, and 28 percent is Severn soils. The remaining soils include Kiomatia, Latanier, and Mason soils and Urban land.

Choska soils are deep, nearly level, and well drained. They have a loamy surface layer over loamy and sandy underlying material. These soils are moderately permeable, and they are flooded rarely for very brief periods.

Severn soils are deep, nearly level, and well drained. They have a loamy surface layer over loamy and sandy underlying material. These soils are moderately rapidly permeable, and they are flooded rarely for very brief periods.

Most of the soils in this association are used for soybeans, grain sorghum, small grains, vegetables, and tame pastures. About 35 percent of the association is used for cultivated crops, 30 percent for tame pastures, 10 percent for woodland and wildlife, and 5 percent for urban development.

The main management needs for these soils are maintaining soil structure and fertility. These soils respond to a good cropping system, fertilizers, and residue management.

Shallow to Deep, Loamy or Gravelly to Stony Loamy, Somewhat Excessively Drained to Somewhat Poorly Drained Soils on Uplands

The three associations in this group make up 21 percent of Tulsa County. The soils are mainly used for range grasses, but some areas are used for tame pasture plants.

7. Coweta-Eram Association

Shallow to deep, very gently sloping through moderately steep, somewhat excessively drained to moderately well drained, loamy soils that have a loamy or clayey subsoil over shale or sandstone; on uplands

This association makes up about 11 percent of the county. About 29 percent is Coweta soils, and 30 percent is Eram soils. The remaining acreage is Bates soils, Urban land, and Pits.

The Coweta soils are shallow, very gently sloping through moderately steep, and somewhat excessively drained. They have a loamy surface layer and a loamy subsoil over sandstone. They are moderately rapidly permeable.

Eram soils are deep, gently sloping through moderately steep, and moderately well drained. They have a loamy surface layer and a loamy or clayey subsoil over shale. They are slowly permeable.

About 80 percent of this association is native grass, and 10 percent is tame pasture. The rest of the acreage is cultivated or in urban areas. The main crops are native grass and tame pasture plants. Some areas of Eram soils are cultivated.

The main concerns of management are shallowness of the soil to sandstone or shale, droughtiness, and slope. These soils are not generally suitable for cultivation. Proper grazing, controlling weeds, and protection from fire improve the quality of native grasses. Fertilizing tame pasture plants increases the amount of forage, improves the quality of grass, and protects the soil from erosion.

8. Niotaze-Darnell Association

Moderately deep to shallow, gently sloping through steep, somewhat poorly drained or somewhat excessively drained, gravelly to stony, loamy soils that have a gravelly to stony, clayey or loamy subsoil over shale or sandstone; on uplands

This association makes up about 9 percent of the county. About 64 percent is Niotaze soils, and 22 percent is Darnell soils. The remaining soils are Enders, Hector, and Linker soils and Urban land.

Niotaze soils are moderately deep, gently sloping through steep, somewhat poorly drained, and gravelly to stony. They have a loamy surface layer and a clayey or loamy subsoil over shale. They are slowly permeable.

Darnell soils are shallow, gently sloping through steep, somewhat excessively drained, and gravelly or cobbly. They have a loamy surface layer and a loamy subsoil over sandstone. They are moderately rapidly permeable.

About 75 percent of this association is in woodland and range. Most of the rest is in tame pastures.

The main concerns of management are steep slopes, rockiness, and shallowness of soil to shale or sandstone. Quality of native grasses can be maintained or improved by proper grazing, controlling brush, and protection from fire. Trees on these soils are used for firewood and are not generally suitable for commercial production.

9. Enders-Hector Association

Deep to shallow, very gently sloping through steep, well drained, gravelly to stony, loamy soils that have a gravelly to stony, loamy or clayey subsoil over shale or sandstone; on uplands

This association makes up about 1 percent of the county. About 50 percent is Enders soils, and 30 percent is Hector soils. The remaining soils include Darnell, Eram, Linker, Niotaze, and Radley soils.

Enders soils are deep, gently sloping through steep, and well drained. They have a loamy surface layer and a loamy or clayey subsoil over shale. They are very slowly permeable.

Hector soils are shallow, very gently sloping through steep, well drained, and gravelly to stony. They have a loamy surface layer and a loamy subsoil over sandstone. They are moderately rapidly permeable.

About 85 percent of this association is in woodland and range. Most of the remaining acreage is in tame pastures.

The main concerns of management are steep slopes, rockiness, and shallowness of soil to sandstone. Quality of native grass can be maintained or improved by proper

grazing, controlling brush, and protection from fire. Trees on these soils are used for firewood and are not generally suitable for commercial production.

Soil Maps for Detailed Planning

The kinds of soil (mapping units) shown on the detailed soil maps at the back of this publication are described in this section. The descriptions together with the soil maps can be useful in determining the potential of a soil and in managing it for food and fiber production; in planning land use and developing soil resources; and in enhancing, protecting, and preserving the environment. More information for each soil is given in the section "Use and Management of the Soils."

Preceding the name of each mapping unit is the symbol that identifies the unit on the detailed soil map. Each mapping unit description includes general facts about the soil and a brief description of the soil profile. In each description, the principal hazards and limitations are indicated and the management concerns and practices needed are discussed.

A soil mapping unit represents an area on the landscape and consists mostly of the soil or soils for which the unit is named. Most of the delineations shown on the detailed soil map at the back of this publication are phases of soil series.

Soils that have profiles that are almost alike make up a *soil series*. Except for allowable differences in texture of the surface layer or of the underlying substratum, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement in the profile. A soil series commonly is named for a town or geographic feature near the place where a soil of that series was first observed and mapped. All the soils in the United States having the same series name have essentially the same properties that affect their use and their response to management practices.

Soils of one series can differ in texture of the surface layer or in the underlying substratum and in slope, erosion, stoniness, salinity, wetness, or other characteristic that affects the use of the soils. On the basis of such differences, a soil series is divided into phases. The name of a *soil phase* commonly indicates a feature that affects use or management. For example, Dennis silt loam, 1 to 3 percent slopes is one of several phases within the Dennis series.

Some mapping units are made up of two or more dominant kinds of soil. Two such kinds of mapping units are shown on the soil map of this survey area: complexes, and undifferentiatated groups.

A *soil complex* consists of areas of two or more soils that are so intricately mixed or so small in size that they cannot be shown separately on the soil map. Each area of a complex contains some of each of the two or more dominant soils, and the pattern and proportion are somewhat similar in all areas. Dennis-Carytown complex, 1 to 3 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 there is little value in separating them. The pattern and proportion of the soils are not uniform. An area shown on the map has at least one of the dominant (named) soils or may have all of them. Kiomatia soils is an undifferentiated group in this survey area.

Most mapping units include small, scattered areas of soils other than those that appear in the name of the mapping unit. Some of these soils have properties that differ substantially from those of the dominant soil or soils and thus could significantly affect use and management of the mapping unit. The soils that are included in mapping are recognized in the description of each mapping unit. Some of the more unusual or strongly contrasting soils that are included are identified by a special symbol on the soil map.

Most mapped areas include places that have little or no soil material and support little or no vegetation. Such places are called *miscellaneous areas*; they are delineated on the soil map and given descriptive names. Pits is an example. Some of these areas are too small to be delineated and are identified by a special symbol on the soil map.

The acreage and proportionate extent of each mapping unit are given in table 4, and additional information on properties, limitations, capabilities, and potentials for many soil uses are given for each kind of soil in other tables in this survey. (See "Summary of Tables.") Many of the terms used in describing soils are defined in the Glossary.

Soil Descriptions

1—Apperson silty clay loam, 1 to 3 percent slopes. This is a very gently sloping, moderately well drained, slowly permeable soil on uplands. It is on smooth ridge crests.

In a typical profile the surface layer is black, slightly acid silty clay loam 8 inches thick. The upper 8 inches of the subsoil is black, slightly acid silty clay loam. The middle part of the subsoil is 12 inches of very dark gray, neutral silty clay and 14 inches of very dark grayish brown, mildly alkaline silty clay. The lower part of the subsoil is dark grayish brown, moderately alkaline silty clay. Hard limestone bedrock is at a depth of 52 inches.

Thickness of soil and depth to bedrock is 40 to 60 inches. Available water capacity in the upper 40 inches ranges from 5.5 to 7.5 inches.

About 30 percent of this mapping unit is included areas of soils that are similar to Apperson soils except that they are slightly deeper over limestone, and 10 percent is Okemah silt loam, Dennis silt loam, and Lula silt loam.

The main concerns of using this soil in urban areas are its slow permeability, clayey texture, depth to rock, wetness, high shrink-swell potential, and low strength. This soil is well suited to lawn grasses, flowers, some shrubs, and many garden plants. It has moderate limitations for

paths, trails, and camp, picnic, or playground areas mainly because the surface layer is too clayey. Because of the high shrink-swell potential and low strength, this soil has severe limitations for dwellings, commercial buildings, roads, and streets. It also has severe limitations for septic tank filter fields and trench-type sanitary landfills because limestone bedrock is encountered in excavation. The clayey subsoil causes high corrosivity on uncoated steel pipe.

This soil is suited to the commonly grown crops in the county, including small grains, grain sorghums, soybeans, introduced grasses, and native grasses.

Soil management is needed to maintain fertility and tilth and to control loss of soil through erosion. Cropping systems need to provide for the return of adequate amounts of residue to the soil. Erosion can be reduced by contour farming, terracing, and managing crop residue. Vegetative cover is needed during winter and spring to help keep the soil from eroding. Fertilizer increases plant growth and provides additional crop residue for erosion control. Terracing, contour farming, and using cover crops are especially needed where row crops are grown. Excessive tillage needs to be avoided. Capability unit IIe-1; no woodland suitability subclass; Loamy Prairie range site.

2—Apperson silty clay loam, 3 to 5 percent slopes. This is a gently sloping, moderately well drained, slowly permeable soil on uplands. It is on smooth side slopes.

In a typical profile the surface layer is black, medium acid silty clay loam 12 inches thick. The upper 6 inches of the subsoil is black, slightly acid silty clay loam. The middle part of the subsoil is 10 inches of black, neutral silty clay and 16 inches of very dark grayish brown, mildly alkaline silty clay. The lower part of the subsoil is olive brown, moderately alkaline silty clay. Hard limestone bedrock is at a depth of 52 inches.

Thickness of soil and depth to bedrock is 40 to 60 inches. Available water capacity in the upper 40 inches ranges from 5.5 to 7.5 inches.

About 10 percent of this mapping unit is included areas of Dennis silt loam and Lula silt loam, and 20 percent is soils that are similar to Apperson soils except that they are thicker.

The main concerns of using this soil in urban areas are its slow permeability, clayey texture, depth to rock, wetness, high shrink-swell potential, and low strength. This soil is well suited to lawn grasses, flowers, some shrubs, and many garden plants. It has moderate limitations for paths, trails, and camp, picnic, or playground areas mainly because the surface layer is too clayey. Because of the high shrink-swell potential and low strength, this soil has severe limitations for dwellings, commercial buildings, roads, and streets. It is also poorly suited to septic tank filter fields and trench-type sanitary landfills because limestone bedrock is encountered in excavation. The clayey subsoil causes high corrosivity on uncoated steel pipe.

This soil is used mostly for tame pasture, wheat, sorghum, and soybeans. Some areas are in native grass.

The main concerns of soil management are controlling soil erosion and maintaining soil fertility and tilth. Terracing, contour farming, and using crop residue help control erosion. Crop residue should be returned to the soil, and minimum tillage is needed. Rowcropping needs to be avoided unless small grains predominate in the rotation to protect the soil from water erosion. Tame pasture grasses with legumes or native grasses are the best protection against erosion. Capability unit IIIe-1; no woodland suitability subclass; Loamy Prairie range site.

3—Bates loam, 1 to 3 percent slopes. This is a very gently sloping, well drained, moderately permeable soil on uplands. It is on broad, smooth ridge crests.

In a typical profile the surface layer is very dark grayish brown, neutral loam 10 inches thick. The upper 14 inches of the subsoil is dark brown, slightly acid clay loam. The lower 10 inches of the subsoil is mottled dark brown and yellowish brown, slightly acid clay loam. The underlying material is yellowish, soft, acid sandstone with thin layers of interbedded silty shale. It is rippable.

Thickness of the soil and depth to bedrock ranges from 20 to 40 inches. Available water capacity ranges from about 3.0 to 7.0 inches.

About 5 percent of this mapping unit is included areas of Dennis silt loam, and about 15 percent is Coweta soils. In a few areas, a soil that is similar to Bates loam but that has a fine sandy loam surface layer is also included.

In urban areas the main concerns of using this soil are depth to rock, soil texture, and moderate shrink-swell potential. This soil is well suited to garden plants, most shrubs, flowers, and lawn grasses. It has slight limitations for paths and trails, and camp and picnic areas and moderate limitations for playground areas. It has moderate limitations for dwellings, commercial buildings, roads, and streets because of the shrink-swell potential. This soil is moderately well suited to concrete pipe because of soil reaction. This soil has severe limitatons for septic tank filter fields, sewage lagoons, and trench-type sanitary landfills. Excavation into rippable bedrock is necessary.

This soil is suited to the commonly grown crops in the county, including wheat, grain sorghum, soybeans, introduced grasses, and native grasses.

Soil management is needed to maintain fertility and tilth and to control loss of soil through erosion. Cropping systems need to provide for the return of adequate amounts of residue to the soil. Erosion can be reduced by contour farming, terracing, and managing crop residue. Vegetative cover is needed during winter and spring to help keep the soil from eroding. Fertilizer increases plant growth and provides additional crop residue for erosion control. Terracing, contour farming, and using cover crops are especially needed where row crops are grown. Excessive tillage needs to be avoided. Capability unit IIe-1; no woodland suitability subclass; Loamy Prairie range site.

4—Bates-Coweta complex, 3 to 5 percent slopes. This is a complex of the well drained, moderately permeable Bates soil and the well drained to somewhat excessively

drained, moderately permeable Coweta soil. These gently sloping soils are on broad, smooth ridge crests and side slopes of uplands. They occur in a distinct pattern; 60 percent of the acreage is Bates soil on side slopes, and 30 percent is Coweta soils on ridgecrests. The rest is Dennis silt loam on side slopes and soils that are similar to Bates soils except that the surface layer is thinner and is mixed with the upper part of the subsoil.

In a typical profile the surface layer of the Bates soil is dark brown, slightly acid loam 9 inches thick. The upper 12 inches of the subsoil is dark brown and brown, slightly acid clay loam. The lower 11 inches of the subsoil is strong brown, slightly acid clay loam. The underlying material is yellowish, soft, acid sandstone with thin interbedding of silty shale. It is rippable.

Thickness of the soil and depth to bedrock ranges from 20 to 40 inches. Available water capacity ranges from about 3.0 to 7.0 inches.

In a typical profile of the Coweta soil the surface layer is dark brown, slightly acid loam 7 inches thick. The subsoil is 9 inches of brown, medium acid loam. The underlying material is pale brown, soft sandstone interbedded with shale. It is rippable.

The soil thickness and depth to sandstone ranges from 10 to 20 inches. Available water capacity above sandstone ranges from 1.0 to 3.0 inches.

The main concerns of using these soils in urban areas are depth to bedrock, soil texture, and moderate shrink-swell potential. These soils are well suited to most shrubs, flowers, garden plants, and lawn grasses. They have slight limitations for paths, trails, and camp and picnic areas. These soils have moderate limitations for dwellings, commercial buildings, roads, and streets, and the main soil features to consider are the shrink-swell potential and depth to rock. Soil reaction needs to be considered in areas where these moderately well suited soils are used for concrete pipe. These soils have severe limitations for septic tank filter fields, sewage lagoons, and trench-type sanitary landfills. Excavation into rippable bedrock is necessary.

These soils are used mostly for tame pasture, wheat, grain sorghum, and soybeans. Some are in native grass.

The main concerns in management are controlling erosion, improving water intake, and maintaining soil structure and fertility. Fertilizing to obtain large amounts of crop residue helps to improve water intake and maintain soil tilth and fertility. Terracing, contour farming, and using close-growing crops are needed to control erosion. All crop residue should be returned to the soil, and minimum tillage needs to be used. Rowcropping should be avoided to prevent excessive loss of soil by erosion. Native grasses or tame pasture plants are the best protection against erosion. Capability unit IVe-1; no woodland suitability subclass; Bates part in Loamy Prairie range site, Coweta part in Shallow Prairie range site.

5—Catoosa silt loam, 1 to 3 percent slopes. This is a very gently sloping, well drained, moderately permeable soil on uplands. It is on broad, smooth ridge crests.

In a typical profile the surface layer is dark brown, slightly acid silt loam 10 inches thick. The upper 5 inches of the subsoil is dark reddish brown, medium acid silty clay loam. The lower part of the subsoil is dark reddish brown, slightly acid silty clay loam. Hard limestone is at a depth of 28 inches.

The thickness of the soil and depth to bedrock ranges from 20 to 40 inches. Available water capacity in the upper 40 inches ranges from 3.0 to 7.0 inches.

About 10 percent of this mapping unit is included areas of soils that are less than 20 inches deep over limestone: 5 percent is Lula silt loam, and 5 percent is small areas of eroded soils.

The main concerns of using this soil in urban areas are the depth to bedrock, low strength, moderate shrink-swell potential, soil texture, and slope. This soil is well suited to garden plants, flowers, and most shrubs. It has slight limitations for paths, trails, and picnic or camp areas. Because of the depth to rock, it has moderate limitations for commercial buildings or playground areas. Soil texture is the main soil feature to consider where uncoated steel or concrete pipe is used. The soil is moderately well suited to this use. This soil has severe limitations for septic tank filter fields, sewage lagoons, trench type sanitary landfills, dwellings with basements, and roads or streets.

This soil is suited to the commonly grown crops in the county, including wheat, grain sorghum, soybeans, introduced grasses, and native grasses.

Soil management is needed to maintain fertility and soil tilth and to control erosion. Cropping systems need to provide for the return of adequate amounts of residue to the soil. Erosion can be reduced by contour farming, terracing, and managing crop residue. Vegetative cover is needed during winter and spring to help keep the soil from eroding. Fertilizer increases plant growth and provides additional crop residue for erosion control. Terracing, contour farming, and using cover crops are especially needed where row crops are grown. Excessive tillage needs to be avoided. Capability unit IIe-1; no woodland suitability subclass; Loamy Prairie range site.

6—Catoosa-Rock outcrop complex, 1 to 8 percent slopes. This complex consists of the well drained, moderately permeable Catoosa soil and Rock outcrop in an intricate pattern on very gently sloping through sloping ridge crests and side slopes on uplands. This complex is 60 percent Catoosa soil and 15 percent Rock outcrop. The rest is Lula and Shidler soils and soils that are similar to Catoosa soils except that limestone is at a depth of slightly less than 20 inches.

In a typical profile the Catoosa soil has a surface layer of dark brown, medium acid silt loam 7 inches thick. The upper 5 inches of the subsoil is dark reddish brown, medium acid silty clay loam. The lower part of the subsoil is reddish brown, medium acid silty clay loam that grades to red, medium acid silty clay loam at a depth of 20 inches. Hard limestone is at a depth of 28 inches.

The thickness of the soil and depth to bedrock is 20 to 40 inches. Available water capacity between depths of 20 and 40 inches ranges from 3.0 to 7.5 inches.

Rock outcrop consists of bare limestone bedrock or bedrock thinly mantled with less than 4 inches of material. The limestone crops out from a few inches to about 2 feet above the surface.

The main concerns of using this soil complex in urban areas are the depth to bedrock, low strength, moderate shrink-swell potential, soil texture, slope, and the outcrops of rock. This soil complex is moderately well suited to garden plants, flowers and most shrubs. It has moderate limitations for paths and trails. This soil complex has severe limitations for septic tank filter fields, sewage lagoons, trench-type sanitary landfills, dwellings, commercial buildings, roads, streets, pipes, and picnic, camp, and playground areas because of rock outcrops and depth to bedrock.

This complex is used mostly for grazing; but a few areas are in tame pasture.

The main concerns in management are rockiness and shallowness to rock. This complex is not generally suitable for cultivation. The quality of native grasses can be maintained or improved by proper grazing, protection against fire, and controlling weeds. Fertilizing tame pasture plants increases production and improves quality. The use of machinery on tame pastures is limited in the Rock outcrop part of this complex. Capability unit VIIs-1; no woodland suitability subclass; Catoosa part in Loamy Prairie range site, Rock outcrop not placed in a range site.

7—Choska very fine sandy loam. This is a nearly level, well drained, moderately permeable soil. It is on broad areas of flood plains that are flooded rarely for very brief periods.

In a typical profile the surface layer is dark reddish brown, slightly acid very fine sandy loam 14 inches thick. The next layer is 11 inches of yellowish red, neutral very fine sandy loam. The next layer is 10 inches of dark reddish brown, moderately alkaline silt loam. The lower layer is yellowish red, moderately alkaline very fine sandy loam.

The depth to bedrock is more than 60 inches. Available water capacity in the upper 40 inches ranges from 5.0 to 6.6 inches.

About 10 percent of this mapping unit is included areas of Severn very fine sandy loam, and 5 percent is Latanier clay.

The main concern of management of this soil in urban areas is flooding. The soil is well suited to trees, shrubs, flowers, and lawn grasses. It has slight limitations for paths and trails in recreational areas. Because flooding is rare, this soil along the Arkansas River has moderate limitations for dwellings, commercial buildings, camp areas, picnic areas, playground areas, and roads or streets. It is moderately well suited to garden plants. It has severe limitations for septic tank filter fields, sewage lagoons, or sanitary landfills because of permeability and, in some areas, the shallow depths to the water table.

This soil is suited to all crops commonly grown in the area. The main crops are wheat, grain sorghum, soybeans, vegetable crops and tame pasture plants. This soil is also suitable for woodland.

Soil management is needed to maintain soil tilth and fertility. Most crops that produce large amounts of residue can be grown continuously where the soil is well managed and most of the crop residue is returned to the soil. Fertilizing helps to maintain organic matter content, good structure, and fertility. Minimum tillage needs to be used. Capability unit I-1; woodland suitability subclass 2o; no range site.

8—Choska-Severn-Urban land complex. These are nearly level soils on flood plains. The soils in this complex are in such an intricate pattern with buildings, streets, and roads that it is impractical to separate them from the Urban land. This complex is 40 percent Choska soils, 30 percent Severn soils, and 25 percent Urban land. The hazard of flooding on the Choska and Severn soils has been reduced by the Keystone Dam, but these soils are still flooded rarely for very brief periods. Minor soils are in the Radley, Latanier, Wynona, and Kiomatia series.

In a typical profile the Choska soil has a surface layer of dark reddish brown, slightly acid very fine sandy loam 14 inches thick. The next layer is 11 inches of yellowish red, neutral very fine sandy loam. The next layer is 10 inches of dark reddish brown, moderately alkaline silt loam. The lower layer is yellowish red, moderately alkaline very fine sandy loam.

The depth to bedrock is more than 60 inches. Available water capacity in the upper 40 inches ranges from 4.0 to 6.6 inches.

In a typical profile the Severn soil has a surface layer of reddish brown, mildly alkaline very fine sandy loam 8 inches thick. The next layer, to a depth of 28 inches, is reddish brown, moderately alkaline very fine sandy loam. Below this, to a depth of 48 inches, is yellowish red, moderately alkaline very fine sandy loam. The lower layer is reddish brown, moderately alkaline very fine sandy loam.

The depth to bedrock is more than 60 inches. Available water capacity in the upper 40 inches ranges from 4.0 to 6.5 inches.

In about 30 percent of the area of this mapping unit, however, the soils have been modified by excavating, filling, and grading. In excavated areas, the Choska and Severn soils are loamy. In fill areas, the material is usually loamy and about 20 inches thick.

The soils in this complex are used mostly for urban development. The main industrial development is along the west side of the Arkansas River.

The main concern of management of this soil complex is flooding. The soils are well suited to trees, shrubs, flowers, and lawn grasses. They have slight limitations for paths and trails in recreational areas.

Because flooding is rare, these soils along the Arkansas River have moderate limitations for dwellings, commercial buildings, camp areas, picnic areas, playground areas, and roads or streets. They are moderately well suited to garden plants. They have severe limitations for septic

tank filter fields, sewage lagoons, or sanitary landfills because of permeability and, in some areas, the shallow depth to the water table. No capability unit or range site, Choska and Severn parts in woodland suitability subclass 2o, Urban land not placed in woodland suitability subclass.

9—Cleora fine sandy loam. This is a nearly level, well drained, moderately rapidly permeable soil. It is on broad, smooth flood plains and is flooded occasionally for very brief periods.

In a typical profile the surface layer is dark brown, slightly acid fine sandy loam 11 inches thick. The next layer is 20 inches of brown, slightly acid fine sandy loam. The underlying material is dark brown, slightly acid fine sandy loam.

Depth to bedrock is more than 60 inches. Available water capacity in the upper 40 inches ranges from about 4.0 to 6.0 inches.

About 20 percent of this mapping unit is included areas of a soil that is similar to Cleora soils except that they are reddish brown and yellowish red in the lower part of the profile.

The main concern of management of this soil in urban areas is flooding. The soil is well suited to trees, shrubs, flowers, and lawn grasses. It has slight limitations for paths and trails in recreational areas. Because of flooding this soil is only moderately well suited to garden plants. It has moderate limitations for picnic and playground areas. It has severe limitations for dwellings, commercial buildings, camp areas, roads or streets, septic tank filter fields, sewage lagoons, and sanitary landfills because of flooding.

This soil is used mostly for wheat, soybeans, grain sorghum, tame pasture plants, and woodland.

The main concern in management is flooding and maintenance of soil tilth. Close growing crops are needed during late fall, winter, and spring to prevent excessive loss of soil during flooding. The planting of spring crops needs to be delayed until after the normal flood period. Most crops that produce large amounts of residue can be grown continuously where the soil is fertilized to achieve maximum residue, which is returned to the soil. Maintenance of the organic matter content of this soil contributes to good soil tilth and intake of water. Minimum tillage needs to be used. Tame pasture or woodland protects this soil best during flooding. Capability unit IIw-1; woodland suitability subclass 2o; no range site.

10—Coweta-Bates complex, 2 to 6 percent slopes. This is a complex of the well drained to somewhat excessively drained, moderately permeable Coweta soil and the well drained, moderately permeable Bates soil. These very gently sloping to sloping soils are on broad, smooth ridge crests and on side slopes of uplands. They occur in a distinct pattern; 60 percent of the acreage is Coweta soils on ridge crests and 35 percent is Bates soils on side slopes. The rest is Eram soils.

In a typical profile the Coweta soil has a surface layer of very dark grayish brown, slightly acid loam 6 inches thick. The subsoil is 11 inches of brown, medium acid clay loam. The underlying material is pale brown, slightly acid, soft sandstone interbedded with thin layers of shale. It is rippable.

The soil thickness and depth to sandstone ranges from 10 to 20 inches. Available water capacity above sandstone ranges from 1.0 to 3.0 inches.

In a typical profile, the Bates soil has a surface layer of very dark grayish brown, slightly acid loam 9 inches thick. The upper part of the subsoil is 3 inches of dark brown, medium acid loam and 6 inches of dark brown, medium acid clay loam. The lower part of the subsoil is 7 inches of brown, medium acid gravelly clay loam. The underlying layer is yellowish, soft sandstone. It is rippable.

Thickness of the soil and depth to bedrock ranges from 20 to 40 inches. Available water capacity ranges from 3.0 to 7.0 inches.

The main concerns of using these soils in urban areas are depth to bedrock, soil texture, and moderate shrink-swell potential. These soils are well suited to most shrubs, flowers, garden plants, and lawn grasses. They have slight limitations for paths, trails, and camp and picnic areas. In areas where these soils are used for dwellings, commercial buildings, roads, and streets, they have moderate limitations, and the main soil features to consider are the shrink-swell potential and depth to rock. Soil reaction needs to be considered in areas where these soils are used for concrete pipe. The soils are moderately well suited to this use. These soils have severe limitations for septic tank filter fields, sewage lagoons, and trench-type sanitary landfills. Excavation into rippable bedrock is necessary.

The soils in this complex are used mainly for native grass. A few areas are in tame pasture plants.

The main concerns of management are shallowness of soil to sandstone or shale, droughtiness, and slope. This soil complex is not generally suitable for cultivation. Quality of native grass can usually be improved by proper grazing, controlling weeds, and protection from fire. Fertilizing tame pasture plants increases the amount of forage, improves the quality of grass, and protects the soil from erosion. Capability unit VIe-2; no woodland suitability subclass; Coweta part in Shallow Prairie range site, Bates part in Loamy Prairie range site.

11—Coweta-Eram-Urban land complex, 3 to 12 percent slopes. These are gently sloping to strongly sloping soils on prairie uplands. The soils in this complex are in such an intricate pattern with buildings, streets, and roads that it is impractical to separate them from Urban land. The Coweta soils are on ridge crests and side slopes, and the Eram soils are in strongly sloping areas. This complex is 30 percent Coweta soils, 20 percent Eram soils, and 30 percent Urban land. Minor soils are in the Bates, Dennis, and Okemah series.

In a typical profile the Coweta soil has a surface layer of very dark grayish brown, slightly acid loam 6 inches thick. The subsoil is 11 inches of brown, medium acid clay loam. The underlying material is pale brown, slightly acid, soft sandstone interbedded with thin layers of shale. It is rippable.

The soil thickness and depth to bedrock ranges from 10 to 20 inches. Available water capacity above sandstone ranges from 1.0 to 3.0 inches.

In a typical profile the Eram soil has a surface layer of very dark brown, slightly acid silty clay loam 14 inches thick. The upper part of the subsoil is 9 inches of very dark grayish brown, medium acid silty clay loam. The lower part of the subsoil is 11 inches of dark grayish brown, medium acid silty clay loam. The underlying material is gray and olive shale. It is rippable.

Thickness of soil and depth to shale is 20 to 40 inches. Available water capacity in the upper 20 to 40 inches of soil ranges from 3.0 to 7.0 inches.

In about 60 percent of the area of this mapping unit, however, the soils have been modified by excavating, filling, and grading. In excavated areas, the Coweta soils are loamy and have considerable amounts of gravel- and cobble-sized fragments of sandstone. The Eram soils are loamy and clayey and have large amounts of shale. In fill areas the material is usually loamy and about 1 to 3 feet thick.

The soils in this complex are used mostly for urban development. Minor areas are used for industry.

The main concerns of management of these soils are the shallow depth to sandstone, high shrink-swell clays, rockiness, and strong slopes. These soils are well suited to lawn grasses, flowers, most shrubs, and garden plants. They have slight limitations for paths and trails in recreational areas. In areas where the depth to sandstone is shallow, the soils have moderate limitations for underground utilities, dwellings, commercial buildings, and roads or streets. These soils have moderate limitations for camp and picnic areas because of the strong slopes. Because these soils are shallow and clayey in shale areas, they are poorly suited to trees and have severe limitations for septic tank filter fields, sanitary landfills, sewage lagoons, or playground areas if slopes exceed about 7 percent. In shale areas the soils have severe limitations for roads or streets, dwellings, commercial buildings, and underground utilities. No capability unit, woodland suitability subclass, or range site.

12—Dennis silt loam, 1 to 3 percent slopes. This is a very gently sloping, moderately well drained, slowly permeable soil on uplands. It is on broad, smooth ridge crests and side-slopes.

In a typical profile the surface layer is very dark grayish brown, slightly acid or medium acid silt loam 15 inches thick. The upper 10 inches of the subsoil is dark yellowish brown, medium acid silty clay loam. The middle part of the subsoil is 10 inches of dark brown, medium acid silty clay and 12 inches of mottled brownish, yellowish, and grayish, medium acid silty clay to a depth of 47 inches. The lower part of the subsoil is coarsely mottled grayish and reddish, medium acid silty clay.

Thickness of the soil and depth to bedrock is more than 60 inches. Available water capacity in the upper 40 inches ranges from 5.5 to 9.5 inches.

About 5 percent of this mapping unit is included areas of Bates loam, and about 20 percent is soils that are similar to Dennis soils except that the surface layer is more than 15 inches thick. Small spots of eroded soils are also included.

The main concerns of management of these soils in urban areas are the slow permeability, wetness, high shrink-swell potential, and the texture and acidity of the subsoil. These soils are well suited to lawn grasses, flowers, most shrubs, and garden plants. They have slight limitations for picnic areas or paths and trails in recreational areas. They have moderate limitations for sewage lagoons, camp areas, and playgrounds mainly because of gentle slopes and surface wetness. These soils have severe limitations for dwellings, septic tank filter fields, commercial buildings, and roads or streets because of the slow permeability and high shrink-swell potential of the clayey subsoil. The clayey texture and acidity of the subsoil cause high corrosivity on uncoated steel and concrete.

This soil is suited to the commonly grown crops in the county, including wheat, grain sorghum, soybeans, introduced grasses, and native grasses.

Soil management is needed to maintain fertility and soil tilth and to control erosion. Cropping systems need to provide for the return of adequate amounts of residue to the soil. Erosion can be reduced by contour farming, terracing, and managing crop residue. Vegetative cover is needed during winter and spring to help keep the soil from eroding. Using fertilizer increases plant growth and provides additional crop residue for erosion control. Terracing, contour farming, and using cover crops are especially needed where row crops are grown. Excessive tillage needs to be avoided. Capability unit IIe-1; no woodland suitability subclass; Loamy Prairie range site.

13—Dennis silt loam, 3 to 5 percent slopes. This is a gently sloping, moderately well drained, slowly permeable soil on uplands. It is on broad smooth ridge crests and side slopes.

In a typical profile the surface layer is very dark grayish brown, medium acid silt loam 12 inches thick. The upper 4 inches of the subsoil is dark brown, medium acid silty clay loam. The middle part of the subsoil is 30 inches of brown, strongly acid silty clay loam that grades to yellowish brown, slightly acid clay at a depth of 24 inches. The lower part of the subsoil to a depth of 66 inches is coarsely mottled brownish, reddish, and grayish, mildly alkaline clay loam.

Thickness of the soil and depth to bedrock is more than 60 inches. Available water capacity in the upper 40 inches ranges from 5.5 to 9.5 inches.

About 15 percent of this mapping unit is included areas of Bates loam and Coweta soils, and about 20 percent is areas of soils that are similar to Dennis soils except that they do not have gray mottles in the upper 20 inches of the subsoil. Small spots of eroded soils are also included.

The main concerns of using this soil in urban areas are the slow permeability, wetness, high shrink-swell potential, and the texture and acidity of the subsoil. This soil is

well suited to lawn grasses, flowers, most shrubs, and garden plants. It has slight limitations for picnic areas or paths and trails in recreational areas. It has moderate limitations for sewage lagoons and for camp and playground areas because of slope and surface wetness. This soil has severe limitations for dwellings, septic tank filter fields, commercial buildings, roads, and streets because of the slow permeability and high shrink-swell potential of the subsoil. The loamy and clayey texture and acidity of the subsoil cause corrosivity on uncoated steel and concrete.

This soil is used mostly for tame pasture, native grasses, and field crops, including wheat, grain sorghum, and soybeans.

The main concerns of management are controlling erosion and maintaining soil fertility and tilth. Terracing, contour farming, and using crop residue are needed to control erosion. Crop residue should be returned to the soil, and minimum tillage needs to be used. Rowcropping needs to be avoided unless small grains predominate in the rotation to protect the soil from water erosion. Tame pasture grasses with legumes or native grasses are the best protection against erosion. Capability unit IIIe-1; no woodland suitability subclass; Loamy Prairie range site.

14—Dennis silt loam, 2 to 5 percent slopes, eroded. This is a very gently sloping through gently sloping, moderately well drained, slowly permeable soil on uplands. It is on broad, smooth side slopes.

Part of the original surface layer has been removed by erosion in about 60 percent of the area. In about 25 percent of the area, the surface layer and the upper part of the subsoil have been mixed by tillage. Rills caused by water erosion are common throughout the area. A few gullies are present.

In a typical profile the surface layer is dark brown, medium acid silt loam 6 inches thick. The upper 4 inches of the subsoil is dark brown, strongly acid clay loam. The middle part of the subsoil is 34 inches of dark yellowish brown, slightly acid clay loam that grades to coarsely mottled, yellowish brown and gray, slightly acid loam at a depth of 26 inches. The lower part of the subsoil to a depth of 66 inches is coarsely mottled, yellowish brown and gray, mildly alkaline clay loam.

Thickness of the soil and depth to bedrock is more than 60 inches. Available water capacity in the upper 40 inches ranges from 5.5 to 9.5 inches.

About 15 percent of this mapping unit is included areas of Bates loam and Coweta soils, and about 20 percent is soils that are similar to Dennis soils but that do not have gray mottles in the upper 20 inches of the subsoil.

The main concerns of using this soil in urban areas are the slow permeability, wetness, high shrink-swell potential, and the texture and acidity of the subsoil. This soil is well suited to lawn grasses, flowers, most shrubs, and garden plants. It has slight limitations for picnic areas or paths and trails in recreational areas. It has moderate limitations for sewage lagoons and camp and playground areas because of slope and surface wetness. This soil has severe limitations for dwellings, septic tank filter fields, commercial buildings, roads, and streets because of the slow permeability and high shrink-swell potential of the subsoil. The loamy and clayey texture and acidity of the subsoil cause corrosivity on uncoated steel and concrete.

This soil is used mostly for tame pastures. In a few areas, the soil is planted to wheat, grain sorghum, and soybeans.

The main concerns in management are protecting the soil from accelerated erosion and maintaining soil fertility and tilth. A cropping system using mostly small grains and adequate amounts of fertilizer for maximum residue is needed to control water erosion. Row crops should be avoided to prevent excessive loss of soil. Terraces, waterways, and contour farming also protect the soil. Tame pasture grasses and legumes with additions of fertilizer are the best protection against soil erosion. Capability unit IIIe-2; no woodland suitability subclass; Loamy Prairie range site.

15—Dennis-Carytown complex, 1 to 3 percent slopes. This is a complex of the moderately well drained, slowly permeable Dennis soil and the poorly drained, very slowly permeable Carytown soil. These soils are very gently sloping and are on side slopes on uplands. The complex is 70 percent Dennis soils and 20 percent Carytown soils. The rest is Parsons soils.

In a typical profile the Dennis soil has a surface layer of very dark grayish brown, slightly acid silt loam 14 inches thick. The upper 4 inches of the subsoil is dark brown, medium acid silty clay loam. The middle part of the subsoil is 16 inches of brown, medium acid silty clay and 20 inches of dark yellowish brown, slightly acid silty clay. The lower part of the subsoil to a depth of 66 inches is coarsely mottled, reddish brown and gray, mildly alkaline silty clay.

Thickness of the combined surface layer and subsoil and depth to bedrock is more than 60 inches. Available water capacity in the upper 40 inches ranges from 5.5 to 9.5 inches.

In a typical profile, the Carytown soil has a surface layer of very dark grayish brown, slightly acid silt loam 9 inches thick. The subsurface layer is grayish brown, slightly acid silt loam 3 inches thick. The upper 14 inches of the subsoil is very dark gray, medium acid silty clay. The middle part of the subsoil is 21 inches of very dark grayish brown, mildly alkaline silty clay. The lower part of the subsoil to a depth of 64 inches is coarsely mottled dark gray and olive brown silty clay.

Thickness of soil and depth to bedrock is more than 60 inches. Available water capacity in the upper 40 inches ranges from 4.5 to 6.0 inches. Sodium content is high.

The main concerns in using these soils in urban areas are wetness, very slow permeability, slope, the clayey and acid subsoil, low strength, and high shrink-swell potential. These soils have slight limitations for sewage lagoons in nearly level areas. These soils have moderate limitations for picnic areas, paths, and trails, and wetness is the main soil feature to consider. Proper structural design to com-

pensate for high shrink-swell potential and low strength is especially needed for these soils which have severe limitations in areas where they are used for dwellings, commercial buildings, roads, and streets. A large septic tank filter field is needed to compensate for the very slow permeability and wetness of the Carytown soil. The clayey subsoil is the main soil feature to consider in areas where these soils are used for trench type sanitary landfills and concrete or uncoated steel pipes.

The main crops grown on these soils are wheat, grain sorghum, and soybeans. A large acreage is in tame pasture plants.

The main concerns of management are controlling erosion, slow intake of water in areas of Carytown soils, and maintaining soil tilth and fertility. Erosion can be reduced by terracing and contour farming. Fertilizing to increase crop residue maintains or improves water intake, soil tilth, and soil fertility. Using cover crops, terracing, and contour farming are especially needed where row crops are grown. Addition of manure and chemical amendments such as gypsum improve soil structure and water intake on the Carytown silt loam part of this complex. Excessive tillage needs to be avoided. Capability unit IIIs-1; no woodland suitability subclass; Dennis part in Loamy Prairie range site, Carytown part in Shallow Claypan range site.

16—Dennis-Radley complex, 0 to 12 percent slopes. This is a complex of the moderately well drained, slowly permeable Dennis soil and the moderately well drained, moderately permeable Radley soil. These soils are in drainageways that are 180 feet to 600 feet wide and 10 to 40 feet below the surrounding prairie uplands. The Dennis soil makes up 60 percent of this complex and is on the very gently sloping through sloping parts of the drainageways. The frequently flooded Radley soil makes up 30 percent and is on the nearly level flood plain part of the drainageway. The rest of this complex is Apperson, Bates, Okemah, Osage, and Wynona soils and a soil that is similar to the Dennis soil except that it has a thinner surface layer where slopes exceed 8 percent.

In a typical profile the Dennis soil has a surface layer of brown, slightly acid silt loam 8 inches thick. The upper 6 inches of the subsoil is dark brown, slightly acid silty clay loam. The middle part of the subsoil is 10 inches of olive brown, medium acid silty clay and 14 inches of coarsely mottled, light gray and yellowish brown, medium acid silty clay. The lower part of the subsoil to a depth of 60 inches is coarsely mottled, light gray and yellowish brown, mildly alkaline clay.

Thickness of the soil and depth to bedrock is more than 60 inches. Available water capacity in the upper 40 inches ranges from 5.5 to 9.5 inches.

In typical profiles the Radley soil has a surface layer of very dark grayish brown, slightly acid silt loam to a depth of 10 inches. The next layer, to a depth of 20 inches, is dark brown, medium acid silt loam. The underlying material to a depth of 60 inches is brown, medium acid silty clay loam.

Depth to bedrock is more than 60 inches. Available water capacity in the upper 40 inches ranges from 7.0 to 8.5 inches.

The main concerns in using these soils in urban areas are flooding, slope, slow permeability, wetness, high shrink-swell potential, and the texture and acidity of the subsoil. These soils are poorly suited to most urban uses since they have strong slopes or are flooded. The clayey subsoil and low acidity of the Dennis soil causes high corrosivity on concrete or uncoated steel.

This complex is used mostly for range and woodland. A few areas are in tame pasture plants.

The main concerns of management are the strong slopes and the hazard of flooding. The native grasses can be maintained or improved by controlling brush, using suitable grazing practices, and preventing fire. In woodland areas thinning, weeding, and selectively harvesting the hardwoods increase timber production. In tame pasture areas, fertilizing and proper grazing help to provide a grass-mulch cover, which protects the soils from erosion during floods. Capability unit VIe-1; Dennis soil not in a woodland suitability subclass; Radley part in woodland suitability subclass 2o; Dennis part in Loamy Prairie range site; Radley part not in a range site.

17—Dennis-Urban land complex, 0 to 5 percent slopes. These are nearly level to gently sloping soils on prairie uplands. The soils are in such an intricate pattern with buildings, streets, and roads that it is impractical to separate then from the Urban land. This complex is 30 percent Dennis soils and 40 percent Urban land. Minor soils in this complex are in the Okemah and Carytown series.

In a typical profile the Dennis soil has a surface layer of brown, slightly acid silt loam 8 inches thick. The upper 6 inches of the subsoil is dark brown, slightly acid silty clay loam. The middle part of the subsoil is 10 inches of olive brown, medium acid silty clay and 14 inches of coarsely mottled, light gray and yellowish brown, medium acid silty clay. The lower part of the subsoil to a depth of 60 inches is coarsely mottled, light gray and yellowish brown, mildly alkaline clay.

Thickness of the soil and depth to bedrock is more than 60 inches. Available water capacity in the upper 40 inches ranges from 5.5 to 9.5 inches.

In about 30 percent of the area of this mapping unit, however, the soils have been modified by excavating, filling, and grading. In excavated areas the surface layer is clayey. The fill material is usually loamy material that has been hauled in from other areas.

The soils in this complex are used mostly for urban development, including industry.

The main concerns of management of these soils are the slow permeability, wetness, high shrink-swell potential, and the texture and acidity of the subsoil. These soils are well suited to lawn grasses, flowers, most shrubs, and garden plants. They have slight limitations for picnic areas or paths and trails in recreational areas. They have moderate limitations for sewage lagoons, camp areas, and

playgrounds mainly because of gentle slopes and surface wetness. The soils in this complex have severe limitations for dwellings, septic tank filter fields, commercial buildings, and roads or streets because of the slow permeability and high shrink-swell potential of the clayey subsoil. The clayey texture and low acidity of the subsoil cause high corrosivity on uncoated steel and concrete. No capability unit, woodland suitability subclass, or range site.

18—Enders-Hector complex, 5 to 30 percent slopes. This is a complex of the well drained, very slowly permeable Enders soils and the well drained, moderately rapidly permeable Hector soil. These sloping to steep soils are on side slopes and narrow ridge crests. This complex is 60 percent Enders soils, 20 percent Hector soils, and 10 percent Linker soils. The rest consists of a soil that is similar to Hector soils except that the sandstone can be augered.

In a typical profile the Enders soil has a surface layer of very dark grayish brown, strongly acid loam in the upper 2 inches. The lower 6 inches of the surface layer is brown, strongly acid loam. The upper 2 inches of the subsoil is yellowish red, very strongly acid clay loam. The middle part of the subsoil is 28 inches of yellowish red, very strongly acid clay. The lower part of the subsoil is 6 inches of mottled yellowish brown, very pale brown, and yellowish red, very strongly acid clay. The underlying material is mottled yellowish brown, very pale brown, and yellowish red, very strongly acid, weathered shale. It is rippable.

Soil thickness and depth to shale ranges from 40 to 60 inches. Available water capacity in the upper 40 inches ranges from 6.5 to 7.5 inches.

In a representative profile the Hector soil has a surface layer of dark grayish brown, medium acid stony loam 3 inches thick. The subsurface layer is yellowish brown, strongly acid stony loam 4 inches thick. The subsoil is yellowish red, very strongly acid loam. Hard sandstone is at a depth of 18 inches.

Thickness of the soil and depth to sandstone is 10 to 20 inches. Available water capacity above sandstone ranges from 1.0 to 2.5 inches.

The main concerns of using these soils in urban areas are depth to bedrock, slope, stones, very slow permeability, high shrink-swell potential, low strength, and low acidity. The main soil features to consider are the stone content and the low acidity in areas where these soils are moderately well suited to trees, shrubs, flowers, and lawn grasses. These soils have severe limitations for septic tank filter fields, sewage lagoons, trench type sanitary landfills, dwellings, commercial buildings, and roads and streets. Depth to bedrock must be considered in excavating. The acidity of the subsoil causes uncoated steel and concrete pipe to corrode.

The soils in this complex are mainly used for native grass. These soils support small stands of hardwoods.

The main concerns of management are steep slopes, rockiness, and shallowness of soil to shale or sandstone. This soil complex is not suitable for cultivation. Proper grazing, controlling brush, and protecting the grass from fire improve the quality of grass and protect these soils from erosion. Rockiness and steep slopes restrict the use of most types of machinery in land management. Trees are used mostly for firewood; they have little value for commercial production. Capability unit VIIs-2; woodland suitability subclass 5x; Enders part in Sandy Savannah range site, Hector part in Shallow Savannah site.

19—Eram silty clay loam, 3 to 5 percent slopes. This is a gently sloping, moderately well drained, slowly permeable soil on uplands. It is on smooth ridge crests and side slopes.

In a typical profile the surface layer is very dark brown, slightly acid silty clay loam 14 inches thick. The upper part of the subsoil is 9 inches of very dark grayish brown, medium acid silty clay loam. The lower part of the subsoil is 11 inches of dark grayish brown, medium acid silty clay loam. The underlying material is gray and olive shale. It is rippable.

Thickness of soil and depth to shale is 20 to 40 inches. Available water capacity in the upper 20 to 40 inches of soil ranges from 3.0 to 7.0 inches.

About 10 percent of this mapping unit is included areas of Apperson silty clay loam, Bates loam, and Dennis silt loam. Also included are a few areas of eroded soils.

The main concerns in using this soil in urban areas are wetness, slow permeability, the silty clay loam surface layer, depth to shale, low strength, and high shrink-swell potential. This soil is moderately well suited to garden plants, shrubs, flowers, and lawn grasses. This soil has moderate limitations for paths, trails, and picnic, playground, and camp areas; the silty clay loam surface layer and surface wetness are the main soil features that limit recreational use. This soil has severe limitations for dwellings, commercial buildings, roads, and streets because of low strength and high shrink-swell potential. Proper structural design is needed. The main soil feature to consider is the depth to shale in areas where this soil is used for septic tank filter fields, sewage lagoons, and trench-type sanitary landfills. The clayey subsoil causes uncoated steel and concrete pipe to corrode.

This soil is used mostly for tame pastures. Some areas are in wheat, grain sorghum, soybeans, and native grasses.

The main concerns in management are controlling erosion, improving water intake, and maintaining soil tilth and fertility. Fertilizing to obtain large amounts of crop residue helps to improve water intake and maintain soil tilth and fertility. Terracing, contour farming, and using close-growing crops help control erosion. All crop residue should be returned to the soil, and minimum tillage needs to be used. Rowcropping should be avoided to prevent excessive erosion. Native grasses or tame pasture plants are the best protection against erosion. Capability unit IVe-1; no woodland suitability subclass; Loamy Prairie range site.

20—Eram-Coweta complex, 5 to 15 percent slopes. This is a complex of the moderately well drained, slowly permeable Eram soil and the well drained to somewhat excessively drained, moderately permeable Coweta soil. These sloping to moderately steep soils are on ridge crests and side slopes of uplands. This complex is 50 percent Eram soils on side slopes and 35 percent Coweta soils on ridge crests. Other soils in this complex are soils that are thicker than Eram or Coweta soils, and soils that are similar to Eram soils but are shallower over shale. Small areas of sandstone outcrops are present.

In a typical profile the Eram soil has a surface layer of very dark grayish brown, slightly acid silty clay loam 12 inches thick. The upper part of the subsoil is 6 inches of dark grayish brown, medium acid silty clay loam. The lower part of the subsoil is 8 inches of yellowish brown, medium acid silty clay loam. The underlying material is olive gray, rippable shale.

Thickness of soil and depth to shale is 20 to 40 inches. Available water capacity between depths of 20 and 40 inches ranges from 3.0 to 7.0 inches.

In a typical profile the Coweta soil has a surface layer of very dark grayish brown, slightly acid loam 11 inches thick. The subsoil is 6 inches of brown, medium acid clay loam. The underlying material is soft, rippable sandstone.

Thickness of soil and depth to sandstone is 10 to 20 inches. Available water capacity within a depth of 10 to 20 inches ranges from 1.0 to 3.0 inches.

The main concerns of management of these soils in urban areas are the shallow depth to sandstone, high shrink-swell clays, rockiness, and strong slopes. These soils are well suited to lawn grasses, flowers, most shrubs, and garden plants. They have slight limitations for paths and trails in recreational areas. The soils have moderate limitations for underground utilities, dwellings, commercial buildings, and roads or streets where the soils are underlain at a shallow depth by sandstone. These soils have moderate limitations for camp and picnic areas because of strong slopes. Because the soils are shallow and clayey in shale areas, they are poorly suited to trees and have severe limitations for septic tank filter fields, sanitary landfills, sewage lagoons, or playground areas where slopes exceed about 7 percent. In shale areas the soils have severe limitations for roads or streets, dwellings, commercial buildings, and underground utilities.

The soils in this complex are mainly used for native grass. A few areas are in tame pasture plants.

The main concerns of management are shallowness of soil to sandstone or shale, droughtiness, and slope. This soil complex is not generally suitable for cultivation. Quality of native grass can usually be improved by proper grazing, controlling weeds, and protection from fire. Fertilizing tame pasture plants increases the amount of forage, improves the quality of grass, and protects the soil from erosion. Capability unit VIe-2; no woodland suitability subclass; Eram part in Loamy Prairie range site, Coweta part in Shallow Prairie range site.

21—Glenpool loamy fine sand, 3 to 15 percent slopes. This is a gently sloping to moderately steep, somewhat excessively drained, rapidly permeable soil on uplands. It is in broad areas of side slopes.

In a typical profie the surface layer is very dark grayish brown, medium acid loamy fine sand 4 inches thick. The subsurface layer is brown, medium acid fine sand 37 inches thick. The upper part of the subsoil is 7 inches of strong brown, medium acid loamy fine sand. The middle part of the subsoil is 7 inches of red, strongly acid, loamy fine sand. The lower part of the subsoil to a depth of 80 inches is reddish yellow, strongly acid loamy fine sand.

The depth to bedrock and thickness of soil is more than 60 inches. Available water capacity in the upper 40 inches ranges from 2.5 to 4.5 inches.

About 25 percent of this mapping unit is areas of soils that are similar to Glenpool soils except that the surface layer is slightly thicker, and soils that are similar to Glenpool soils except that they have common pockets of clean sand grains in the lower part of the subsoil.

The main concerns of using this soil in urban areas are rapid permeability, sandy surface layer, slope, and soil acidity. Trees, shrubs, flowers, lawn grasses, and many garden plants are well suited to this soil. The sandy surface layer and slope are soil features to consider when planning for paths, trails, and camp, picnic, or playground areas on this soil, which has moderate limitations for these uses.

Modification of the slope or special structural design on this soil is needed where septic tank filter fields, dwellings, commercial buildings, roads, and streets are placed. The soil has moderate limitation for these uses. This soil has severe limitations for sewage lagoons or trench-type sanitary landfills because of seepage. Proper structural design to compensate for soil acidity is needed for uncoated steel or concrete pipe.

This soil is used mostly for native range and woodland. A few areas are in tame pastures. Proper grazing, controlling brush, and protecting the soil from fire contribute to better native grass and woodland. Weeding, thinning, and selectively cutting the woodland helps to improve the quality of trees. Fertilizing and proper grazing improve tame pasture plants and help control erosion. Capability unit VIe-4; woodland suitability subclass 4s; Deep Sand Savannah range site.

22—Hector-Linker complex, 1 to 5 percent slopes. This is a complex of well drained, moderately rapidly permeable Hector soil and the well drained, moderately permeable Linker soil. These very gently sloping through gently sloping soils are on ridge crests and side slopes.

The complex is 45 percent Hector soils, 30 percent Linker soils, 15 percent Enders soils, and 10 percent soils that are similar to Hector soils except that the underlying sandstone can be augered.

In a typical profile the Hector soil has a surface layer of very dark grayish brown, slightly acid loam 2 inches thick. The subsurface layer is 7 inches of grayish brown, medium acid gravelly loam. The subsoil is yellowish

brown, strongly acid gravelly loam. Hard sandstone is at a depth of 15 inches.

Thickness of the soil and depth to sandstone is 10 to 20 inches. Available water capacity above the sandstone ranges from 1.0 to 2.5 inches.

In a typical profile the Linker soil has a surface layer of very dark grayish brown, slightly acid loam 2 inches thick. The subsurface layer is grayish brown, strongly acid loam 3 inches thick. The upper part of the subsoil is 7 inches of reddish brown, strongly acid loam. The middle part of the subsoil is 14 inches of yellowish red, strongly acid sandy clay loam. The lower part of the subsoil is yellowish red, strongly acid gravelly sandy clay loam. Hard sandstone is at a depth of 31 inches.

Thickness of the soil and depth to sandstone is 20 to 40 inches. Available water capacity above the sandstone ranges from 4.0 to 7.5 inches.

The main concerns of using these soils in urban areas are depth to bedrock, stones, and acidity. These soils have moderate limitations for trees, shrubs, flowers, and lawn grasses. The main soil features to consider for these uses are the stones and low acidity. In excavating, depth to bedrock must be considered in areas where these soils are used for septic tank filter fields, sewage lagoons, trench type sanitary landfills, dwellings, commercial buildings, and roads and streets. These soils have severe limitations for these uses. They are poorly suited to uncoated steel and concrete pipe because of acidity.

The soils in this complex are mainly used for native grasses and tame pasture plants. The soils support small amounts of hardwoods.

The main concerns of management are steep slopes, rockiness, and shallowness of soil to shale or sandstone. This complex is not generally suitable for cultivation. Quality of native grass can be maintained or improved by proper grazing, controlling brush, and protection from fire. Fertilizing tame pasture plants increases production, improves the quality of grass, and protects the soil from erosion. Rockiness and shallow soil depth to sandstone limit the use of certain types of machinery in tame pasture management. Trees on these soils are used for firewood and are not generally used for commercial production. Capability unit VIe-3; woodland suitability subclass 5d; Linker part in Sandy Savannah range site, Hector part in Shallow Savannah range site.

23—Kamie loamy fine sand, 3 to 8 percent slopes. This is a gently sloping through sloping, well drained, moderately permeable soil on uplands. It is on broad side slopes above drainageways.

In a typical profile the surface layer is dark brown, neutral loamy fine sand 6 inches thick. The subsurface layer is 12 inches of brown, slightly acid loamy fine sand. The subsoil is 46 inches of yellowish red, medium acid sandy clay loam.

Thickness of soil and depth to bedrock is more than 60 inches. Available water capacity in the upper 40 inches ranges from 4.5 to 7.0 inches.

About 5 percent of this mapping unit is included areas of Okay loam, and 20 percent is soils that are similar to Kamie soils except that they have a loamy fine sand surface layer more than 20 inches thick. Also included are a few small spots of eroded soils.

The main concerns in using this soil in urban areas are slope and soil acidity. This soil is well suited to trees, garden plants, shrubs, and flowers. It has slight limitations for paths, trails, and camp or picnic areas. It has slight limitations for septic tank filter fields, trench-type sanitary landfills, dwellings, commercial buildings, roads, and streets. Slope is the main soil feature to consider for sewage lagoons or playground areas. Soil acidity is a concern on this soil where it is used for uncoated steel or concrete pipe. This soil is moderately well suited to this use.

This soil is used mainly for tame pasture plants, wheat, grain sorghum, and soybeans. A few areas have been planted to trees or range plants.

Management is needed to control erosion and improve fertility. Fertilizing to obtain large amounts of crop residue is desirable. Crop residue helps reduce loss of soil by soil blowing and water erosion. Contour farming, stripcropping, cover cropping, and managing crop residue are necessary to control erosion and improve soil fertility. Rowcropping can be practiced where the soil is fertilized, residue is managed, and a cover crop is used. Excessive tillage needs to be avoided. Tame pasture, range, or woodland provides the best protection against erosion. Capability unit IVe-2; woodland suitability subclass 3o; Deep Sand Savannah range site.

24—Kamie fine sandy loam, 1 to 3 percent slopes. This is a very gently sloping, well drained, moderately permeable soil on uplands. It is on broad ridge crests above drainageways.

In a typical profile the surface layer is dark brown, slightly acid fine sandy loam 8 inches thick. The subsurface layer is 8 inches of brown, slightly acid fine sandy loam. The subsoil to a depth of 66 inches is yellowish red, medium acid sandy clay loam.

Thickness of soil and depth to bedrock is more than 60 inches. Thickness of surface and subsurface layers ranges from 8 to 20 inches. Available water capacity in the upper 40 inches ranges from 4.5 to 7.0 inches.

About 15 percent of this mapping unit is included areas of Okay loam and Kamie loamy fine sand, and about 15 percent is areas of soils that are similar to Kamie soils except that they have common pockets of clean sand grains in the lower part of the subsoil.

The main concerns in using this soil in urban areas are slope and acidity. The soil is well suited to trees, garden plants, shrubs, and flowers. It has slight limitations for paths, trails, and camp or picnic areas. It also has slight limitations for septic tank filter fields, trench-type sanitary landfills, dwellings, commercial buildings, roads, and streets. Slope is the main soil feature to consider for sewage lagoons or playground areas. Soil acidity is a concern on this soil where it is used for uncoated steel or

concrete pipe. The soil is moderately well suited to this use.

This soil is used mainly for tame pasture plants, wheat, grain sorghum, vegetable crops, and soybeans. It is also suited to range or woodland plants.

The main concerns of soil management are controlling soil erosion and maintaining soil tilth and fertility. Terracing is needed where the soil is eroding. Fertilizing increases plant growth and provides more crop residue to help maintain soil tilth, fertility, and uptake of water. Contour farming in sloping areas, stripcropping, and using crop residue can be used to control soil erosion. Winter cover crops following row crops furnish additional soil protection against wind and water action. Minimum tillage is needed. Capability unit IIe-2; woodland suitability subclass 3o; Sandy Savannah range site.

25—Kamie-Urban land complex, 1 to 8 percent slopes. These are very gently sloping through sloping soils on timbered uplands. The soils are in such an intricate pattern with buildings, roads, and streets that it is impractical to separate them from the Urban land.

This complex is 50 percent Kamie soils and 30 percent Urban land. Okay soils make up a small acreage of the complex.

In a typical profile the Kamie soil has a surface layer of dark brown, slightly acid fine sandy loam 8 inches thick. The subsurface layer is 8 inches of brown, slightly acid fine sandy loam. The subsoil to a depth of 66 inches is yellowish red, medium acid sandy clay loam.

Thickness of soil and depth to bedrock is more than 60 inches. Thickness of surface and subsurface layers ranges from 8 to 20 inches. Available water capacity in the upper 40 inches ranges from 4.5 to 7.0 inches.

In about half the acreage of this mapping unit, however, the soils have been modified by excavation, filling, and grading. Fill material is loamy and usually comes from excavated areas of these soils.

The soils in this complex are used for urban development, including industry.

The main concerns in using these soils in urban areas are slope and soil acidity. These soils are well suited to trees, garden plants, shrubs, and flowers. They have slight limitations for paths, trails, and camp or picnic areas. They also have slight limitations for septic tank filter fields, trench-type sanitary landfills, dwellings, commercial buildings, roads, and streets. This soil is moderately well suited to uncoated steel or concrete pipe. No capability unit or range site, Kamie part in woodland suitability subclass 3o, Urban land not placed in woodland suitability subclass.

26—Kanima soils, 3 to 50 percent slopes. These are gently sloping to very steep, well drained, moderately permeable Kanima soils and slowly permeable soils that are similar to Kanima soils except that they have a shaly clay profile. These soils are in strip-mined areas on crests and side slopes of parallel ridges on uplands (fig. 1). In some areas the ridges have been leveled.

In a typical profile the surface layer is dark brown, moderately alkaline shaly silty clay loam 3 inches thick. The underlying material is olive gray, neutral very shaly silty clay loam. It is rippable.

The depth to bedrock is more than 60 inches. Available water capacity in the upper 40 inches ranges from 4.0 to 6.0 inches.

The main concerns of using these soils in urban areas are slope and the loamy profile. These loamy soils are moderately well suited to concrete pipe. They are poorly suited to trees, shrubs, flowers, lawn grasses, and garden plants. Steep and very steep slopes limit the use of these soils for dwellings, commercial buildings, roads, streets, and all kinds of recreational and sanitary facilities. The soils have severe limitations for these uses.

This soil is used mainly for grazing. In most areas the soil supports lower quality grasses, shrubs, and trees.

The main concerns in management are steep slopes, the hazard of erosion, droughtiness of the soil, and soil tilth and fertility. Management that establishes or improves and maintains stands of vegetative cover is needed. Land leveling, establishing desirable vegetative cover, controlling grazing, and fertilizing may be needed. Capability unit VIIs-3; no woodland suitability subclass or range site.

27—Kiomatia soils. These are nearly level, well drained, rapidly permeable Kiomatia loamy fine sand and moderately rapidly permeable soils that are similar to Kiomatia soils except that they are predominantly fine sandy loam or loam in the upper 40 inches. These soils are on flood plains that are flooded frequently for brief periods. About 70 percent of the mapped area is Kiomatia loamy fine sand.

In a typical profile the Kiomatia soil has a surface layer of dark brown, moderately alkaline loamy fine sand 10 inches thick. The next layer is 6 inches of reddish brown, moderately alkaline very fine sandy loam. The lower layer is light brown, moderately alkaline fine sand.

The depth to bedrock is more than 60 inches. Available water capacity in the upper 40 inches of soil ranges from about 2.0 to 4.0 inches.

The main concerns of using these soils in urban areas are frequent flooding and the loamy fine sand surface layer. These soils are well suited to trees and shrubs. They have moderate limitations for paths and trails because of flooding and the loamy fine sand surface layer. These frequently flooded soils are poorly suited to garden plants, flowers, and lawn grasses. They have severe limitations for dwellings, commercial buildings, roads, streets, and most types of recreational and sanitary facilities.

These soils are used mainly for grazing. A few areas are in tame pasture plants.

The main concerns in management are frequent flooding, the hazard of erosion, and soil fertility. The quality of native grasses can be maintained or improved by following suitable grazing practices, controlling brush, and protecting the soil from fire. Weeding, thinning, and selective

cutting are good practices to use on woodland. Fertilizing tame pasture plants and using proper grazing help to maintain soil fertility and control erosion. Capability unit Vw-1; woodland suitability subclass 2o; no range site.

28—Larton-Glenpool complex, 0 to 3 percent slopes. This is a complex of the well drained, moderately permeable Larton soil and the somewhat excessively drained, rapidly permeable Glenpool soil. These nearly level and very gently sloping soils are on and between ridge crests that are 2 to 6 feet high and 100 to 400 feet apart. This complex is 80 percent Larton soils in the areas between the small ridge crests and 20 percent Glenpool soils on the ridge crests.

In a typical profile the Larton soil has a surface layer of dark brown, slightly acid loamy fine sand 11 inches thick. The subsurface layer is 19 inches of brown, medium acid loamy fine sand. The subsoil to a depth of 66 inches is yellowish red, medium acid sandy clay loam.

The soil thickness and depth to sandstone is more than 60 inches. Available water capacity in the upper 40 inches ranges from 2.5 to 5.0 inches.

In a typical profile the Glenpool soil has a surface layer of dark brown, medium acid loamy fine sand 4 inches thick. The subsurface layer is 42 inches of light brown, medium acid loamy fine sand. The upper part of the subsoil is 8 inches of strong brown, strongly acid loamy fine sand. The middle part of the subsoil is 12 inches of yellowish red, very strongly acid loamy fine sand. The lower part of the subsoil to a depth of 73 inches is yellowish red, strongly acid loamy fine sand.

Thickness of soil and depth to bedrock is more than 60 inches. Available water capacity in the upper 40 inches ranges from 3.0 to 4.5 inches.

The main concerns in using these soils in urban areas are rapid permeability, the sandy surface layer, slope and soil acidity. These soils are well suited to trees, shrubs, flowers, lawn grasses, and many garden plants. They have slight limitations for septic tank filter fields, trench type sanitary landfills, dwellings, commercial buildings, roads, streets, and most recreational facilities. These soils have moderate limitations for sewage lagoons; seepage of waste material is the main limitation. Proper structural design to compensate for soil acidity is needed for uncoated steel or concrete.

The soils in this complex are mainly used for grain sorghum, soybeans, wheat, tame pasture plants, timber, and native grasses.

Management is needed to control erosion and maintain soil fertility. Most crops that produce large amounts of plant residue can be grown continuously where the residue is returned to the soil. Fertilizing increases plant growth and provides more plant residue to reduce the loss of soil from soil blowing. Stripcropping and planting winter cover crops following row crops also protect the soil. Minimum tillage needs to be used. Capability unit IIIe-3; woodland suitability subclass 3o; Deep Sand Savannah range site.

29—Latanier clay. This is a nearly level, somewhat poorly drained, very slowly permeable soil. It is on flood plains that are subject to flooding occasionally for brief periods.

In a representative profile the surface layer is dark reddish brown, moderately alkaline clay 11 inches thick. The subsoil is 21 inches of dark reddish brown, moderately alkaline clay. The underlying material to a depth of 42 inches is dark reddish brown, moderately alkaline silty clay loam. Below this it is reddish brown, moderately alkaline fine sandy loam.

The depth to bedrock is more than 60 inches. Available water capacity in the upper 40 inches ranges from about 7.5 to 8.5 inches.

About 5 percent of this mapping unit is included areas of soils that are similar to Latanier soils except that they are flooded frequently for brief periods. About 20 percent is included soils that are similar to Latanier soils except that they have a less clayey surface layer and soils that are similar to Latanier soils except that they have a clayey subsoil at a depth of more than 40 inches.

The main concerns of using this soil in urban areas are occasional flooding, the clayey texture, wetness, and high shrink-swell potential. Trees, shrubs, most flowers, and some garden plants are well suited to this soil. Proper structural design to compensate for high shrink-swell potential, flooding, and wetness is especially needed where the soil is used for dwellings, commercial buildings, roads, and streets. The soil has severe limitations for these uses. Flooding is the main concern in areas where this soil is used for septic tank filter fields, sewage lagoons, and trench-type sanitary landfills. This soil has severe limitations for paths, trails, and camp and picnic or playground areas.

Most of this soil is used for tame pasture plants. The main field crops are wheat, grain sorghum, and soybeans. A few areas are in woodland.

The main concerns of management in cultivated areas are flooding, surface wetness, slow water intake, and soil tilth. Close-grown crops are needed during late fall, winter, and spring to prevent excessive loss of soil during flooding. The planting of spring crops needs to be delayed until after the common flood periods. Most crops can be grown continuously where the soil has been fertilized to achieve maximum residue to return to the soil. Large amounts of residue help maintain organic matter and contribute to good soil tilth and intake of water. When this soil is wet, tillage or grazing breaks down soil structure and reduces water intake. A drainage system that includes row arrangement for drainage reduces surface wetness and allows for better crop growth. Capability unit IIIw-1; woodland suitability subclass 3w; no range site.

30—Lula silt loam, 1 to 3 percent slopes. This is a very gently sloping, well drained, moderately permeable soil on uplands. It is on broad, smooth ridge crests.

In a representative profile the surface layer is dark reddish brown, medium acid silt loam 14 inches thick. The

upper part of the subsoil is 5 inches of dark reddish brown, medium acid silty clay loam. The lower part of the subsoil is dark red, medium acid silty clay loam. Hard limestone bedrock is at a depth of 54 inches.

Thickness of soil and depth to bedrock ranges from 40 to 60 inches. Available water capacity in the upper 40 inches ranges from about 4.5 to 6.5 inches.

Included with this soil in mapping are small areas of Newtonia silt loam and Catoosa silt loam.

The main concerns of using this soil in urban areas are the depth to bedrock, low strength, moderate shrink-swell potential, soil texture, and slope. This soil is well suited to garden plants, flowers, and most shrubs. It has slight limitations for paths, trails, and most picnic, playground, and camp areas. Because of the depth to rock, it has moderate limitations for septic tank filter fields, sewage lagoons, trench-type sanitary landfills, and dwellings with basements.

Proper structural design to compensate for the low strength and moderate shrink-swell potential is especially needed where this soil is used for dwellings, commercial buildings, roads, and streets.

This soil is suited to the commonly grown crops in the county, including wheat, grain sorghum, soybeans, introduced grasses, and native grasses.

Soil management is needed to maintain fertility and soil tilth and to control loss of soil through erosion. Cropping systems need to provide for the return of adequate amounts of residue to the soil. Erosion can be reduced by contour farming, terracing, and managing crop residue. Vegetative cover is needed during winter and spring to help keep the soil from eroding. Fertilizer increases plant growth and provides additional crop residue for erosion control. Terracing, contour farming, and using cover crops are especially needed where row crops are grown. Excessive tillage needs to be avoided. Capability unit IIe-1; no woodland suitability subclass; Loamy Prairie range site.

31—Mason silt loam. This is a nearly level, well drained and moderately well drained soil that has moderately slow permeability. It is on flood plains and is flooded rarely for very brief periods.

In a representative profile the surface layer is very dark grayish brown, neutral silt loam 13 inches thick. The upper part of the subsoil is 24 inches of very dark grayish brown, slightly acid silty clay loam. The lower part of the subsoil is 19 inches of dark brown, slightly acid silty clay loam. The underlying material is dark brown, neutral silty clay loam.

Thickness of the soil is 40 to more than 60 inches, and depth to bedrock exceeds 60 inches. Available water capacity in the upper 40 inches of soil ranges from 6.5 to 8.0 inches.

About 30 percent of this mapping unit is included areas of soils that are similar to Mason soils except that they are reddish in the lower part of the subsoil.

The main concern of management of this soil in urban areas is flooding. The soil is well suited to trees, shrubs, flowers, and lawn grasses. It has slight limitations for paths and trails in recreational areas.

Because flooding is rare this soil in areas along the Arkansas River has moderate limitations for dwellings, commercial buildings, camp areas, picnic areas, playground areas, roads or streets, and garden plants. It has severe limitations for septic tank filter fields, sewage lagoons, or sanitary landfills because of permeability.

This soil is suited to all crops commonly grown in the area. The main crops are wheat, grain sorghum, soybeans, vegetable crops, and tame pasture plants. This soil is also suitable for range plants.

Soil management is needed to maintain soil tilth and fertility. Most crops that produce large amounts of residue can be grown continuously where the soil is well managed and most of the crop residue is returned to the soil. Fertilizing helps to maintain organic matter content, good tilth, and fertility. Minimum tillage is needed. Capability unit I-1; woodland suitability subclass 3o; no range site.

32—Newtonia silt loam, 1 to 3 percent slopes. This is a very gently sloping, well drained, moderately permeable soil on uplands. It is on broad, smooth ridge crests.

In a representative profile the surface layer is dark brown, slightly acid silt loam 11 inches thick. The upper 7 inches of the subsoil is dark reddish brown, medium acid silt loam. The middle part of the subsoil is 28 inches of dark reddish brown, strongly acid silty clay loam that grades to dark red, medium acid silty clay loam at a depth of 26 inches. The lower part of the subsoil to a depth of 62 inches is red, slightly acid silty clay loam.

The soil is more than 60 inches deep to bedrock. Available water capacity in the upper 40 inches ranges from 6.0 to 7.5 inches.

About 10 percent of this mapping unit is included areas of Catoosa silt loam, 5 percent is Dennis silt loam, and 10 percent is a soil that is similar to Newtonia soils except that it has a lighter colored surface layer.

The main concerns in using this soil in urban areas are moderate permeability, slope, excessive clay, and high shrink-swell potential. This soil is well suited to garden plants, flowers, lawn grasses, shrubs, and most trees. It has slight limitations for most recreational facilities. Slope is the main soil feature to consider in areas where this soil, which has moderate limitations, is used for sewage lagoons or septic tank filter fields. This moderately well suited soil is too clayey to be used for uncoated steel or concrete pipe. It is also too clayey and has severe limitations for easy excavation and movement of equipment in areas where it is used for trench-type sanitary landfills. Good structural design to compensate for high shrink-swell potential is especially needed where this soil is used for dwellings, commercial buildings, roads, and streets.

This soil is suited to the commonly grown crops in the county, including wheat, grain sorghum, soybeans, introduced grasses, and native grasses.

Soil management is needed to maintain fertility and soil tilth and to control loss of soil through erosion. Cropping systems need to provide for the return of adequate amounts of residue to the soil. Erosion can be reduced by

contour farming, terracing, and managing crop residue. Vegetative cover is needed during winter and spring to help keep the soil from eroding. Fertilizer increases plant growth and provides additional crop residue for erosion control. Terracing, contour farming, and using cover crops are especially needed where row crops are grown. Excessive tillage needs to be avoided. Capability unit IIe-1; no woodland suitability subclass; Loamy Prairie range site.

33—Newtonia silt loam, 3 to 5 percent slopes. This is a gently sloping, well drained, moderately permeable soil on uplands. It is on broad side slopes.

In a representative profile the surface layer is very dark grayish brown, slightly acid silt loam 12 inches thick. The upper part of the subsoil is 5 inches of dark brown, slightly acid silty clay loam. The middle part of the subsoil is 27 inches of dark reddish brown, medium acid silty clay loam that grades to yellowish red, medium acid silty clay loam at a depth of 30 inches. The lower part of the subsoil to a depth of 72 inches is yellowish red, medium acid silty clay.

Thickness of soil and depth to bedrock is more than 60 inches. Available water capacity in the upper 40 inches of soil ranges from about 6.0 to 7.5 inches.

About 10 percent of this mapping unit is included areas of Lula silt loam and Dennis silt loam, and 5 percent is small areas of eroded soils and soils that are similar to Newtonia soils except that the surface layer is lighter colored.

The main concerns in using this soil in urban areas are moderate permeability, slope, excessive clay, and high shrink-swell potential. This soil is well suited to garden plants, flowers, lawn grasses, shrubs, and most trees. It has slight limitations for most recreational facilities. Slope is the main soil feature to consider in areas where this soil is used for sewage lagoons or septic tank filter fields. The soil has moderate limitations for these uses. The soil is too clayey for and poorly suited to easy excavation and movement of equipment in areas where it is used for trench-type sanitary landfills. Proper structural design to compensate for high shrink-swell potential is especially needed where this soil is used for dwellings, commercial buildings, roads, and streets. It has severe limitations for these uses.

This soil is used mostly for tame pasture, wheat, sorghum, and soybeans, Some areas are in native grass.

The main concern of soil management is controlling erosion and maintaining soil fertility and soil tilth. Terracing, contour farming, and using crop residue are needed to control erosion. Crop residue should be returned to the soil, and minimum tillage needs to be used. Rowcropping needs to be avoided unless small grains are predominant in the rotation of crops to protect the soil from water erosion. Tame pasture grasses and legumes or native grasses are the best protection against erosion. Capability unit IIIe-1; no woodland suitability subclass; Loamy Prairie range site.

34—Niotaze-Darnell complex, 3 to 15 percent slopes. This is a complex of the somewhat poorly drained, slowly permeable Niotaze soil and the well drained to somewhat excessively drained, moderately rapidly permeable Darnell soil. These gently sloping to moderately steep soils are on ridge crests and side slopes of uplands. This complex is 65 percent Niotaze soil on side slopes and 25 percent Darnell soil on ridge crests. Similar soils that are deeper than the Darnell and Niotaze soils and small areas of sandstone outcrops make up the rest of the complex.

In a typical profile the Niotaze soil has a surface layer of dark brown, medium acid gravelly and cobbly fine sandy loam 5 inches thick. The subsurface layer is 6 inches of brown, medium acid gravelly and cobbly fine sandy loam. The upper part of the subsoil is 16 inches of reddish brown, strongly acid clay. The lower part of the subsoil is 7 inches of mottled red and light olive brown, very strongly acid clay. The underlying material is rippable, stratified shale.

Thickness of soil and depth to shale is 20 to 40 inches. Available water capacity between depths of 20 and 40 inches ranges from 3.0 to 6.0 inches.

In a typical profile the Darnell soil has a surface layer of dark grayish brown, medium acid gravelly and cobbly fine sandy loam 4 inches thick. The subsoil is 11 inches of yellowish red, strongly acid fine sandy loam. The underlying material is rippable sandstone similar in color and reaction to the subsoil.

Soil thickness and depth to sandstone ranges from 10 to 20 inches. Available water capacity in the upper 20 inches ranges from 1.0 to 2.5 inches.

The main concerns of management of these soils in urban areas are depth to bedrock, permeability, moderately steep to steep slopes, rockiness, and wetness. These soils are well suited to lawn grasses, flowers, shrubs, trees, and most garden plants. They have moderate limitations for shallow excavations and roads or streets mainly because of shallowness of soil, rockiness, and wetness. The soils in this complex have severe limitations for septic tank absorption fields, sewage lagoons, sanitary landfills, dwellings, camp areas, playgrounds, and picnic areas because of rockiness, depth to bedrock, permeability, wetness, and moderately steep slopes. Depth to bedrock is the main limitation in using these soils for uncoated steel and concrete pipe.

The soils in this complex are mainly used for native grasses and tame pasture plants. The soils support small stands of hardwoods.

The main concerns of management are steep slopes, rockiness, and shallowness of soil to shale or sandstone. This soil complex is not generally suitable for cultivation. Quality of native grass can be maintained or improved by proper grazing, controlling brush, and protection from fire. Fertilizing tame pasture plants increases production, improves the quality of grass, and protects the soil from erosion. Rockiness and shallow depth to sandstone limit the use of certain types of machinery in tame pasture management. Trees on these soils are used for firewood and have little commercial value. Capability unit VIe-3; woodland suitability subclass 5o; Niotaze part in Sandy

Savannah range site, Darnell part in Shallow Savannah range site.

35—Niotaze-Darnell complex, 15 to 25 percent slopes. This is a complex of the somewhat poorly drained, slowly permeable Niotaze soil and the well drained to somewhat excessively drained, moderately rapidly permeable Darnell soil. These moderately steep to steep soils are on ridge crests and side slopes of uplands. This complex is 75 percent Niotaze soil on side slopes and 25 percent Darnell soil on ridge crests. There are small areas of sandstone outcrops.

In a typical profile the Niotaze soil has a surface layer of very dark grayish brown, medium acid gravelly and cobbly fine sandy loam 5 inches thick. The subsurface layer is 7 inches of brown, strongly acid gravelly and cobbly fine sandy loam. The upper part of the subsoil is 16 inches of mottled reddish brown and brown, very strongly acid clay. The lower part of the subsoil is 7 inches of mottled yellowish red, light olive brown, and gray, very strongly acid clay. The underlying material is rippable, stratified, grayish shale.

Thickness of soil and depth to shale is 20 to 40 inches. Available water capacity between depths of 20 and 40 inches ranges from 3.0 to 6.0 inches.

In a typical profile the Darnell soil has a surface layer of dark brown, medium acid fine sandy loam 4 inches thick. The subsoil is 11 inches of brown, strongly acid fine sandy loam. The underlying material is rippable sandstone similar in color and reaction to the subsoil.

Soil thickness and depth to sandstone ranges from 10 to 20 inches. Available water capacity within the upper 20 inches ranges from 1.0 to 2.5 inches.

The main concerns of management of these soils in urban areas are depth to bedrock, permeability, moderately steep to steep slopes, rockiness, and wetness. These soils are well suited to lawn grasses, flowers, shrubs, trees, and most garden plants. They have moderate limitations for shallow excavations and roads or streets mainly because of shallowness of soil, rockiness, and wetness. The soils in this complex have severe limitations for septic tank absorption fields, sewage lagoons, sanitary landfills, dwellings, camp areas, playgrounds, and picnic areas because of rockiness, depth to bedrock, permeability, wetness, and moderately steep to steep slopes. Depth to bedrock is the main limitation in using these soils for uncoated steel and concrete pipe. They are poorly suited for this use.

The soils in this complex are mainly used for native grass. These soils support small stands of hardwoods.

The main concerns of management are steep slopes, rockiness, and shallowness of soil to shale or sandstone. This complex is not suitable for cultivation. Proper grazing, controlling brush, and protecting the grass from fire improve the quality of grass and protect these soils from erosion. Rockiness and steep slopes restrict the use of most types of machinery in land management. Trees are used mostly for firewood and have little commercial value. Capability unit VIIs-2; woodland suitability subclass 5x; Niotaze part in Sandy Savannah range site, Darnell part in Shallow Savannah range site.

36—Niotaze-Darnell complex, 25 to 45 percent slopes. This is a complex of the somewhat poorly drained, slowly permeable Niotaze soil and the well drained to somewhat excessively drained, moderately rapidly permeable Darnell soil. These steep soils are on ridge crests and side slopes of uplands. This complex is 50 percent Niotaze soil on side slopes and 25 percent Darnell soil on ridge crests. Small areas of soils that are similar to Niotaze soils but that are deeper, make up 15 percent of the complex, and rock outcrops and a soil that is similar to Darnell soils but that has hard sandstone make up the rest.

In a typical profile the Niotaze soil has a surface layer of brown, medium acid, gravelly and cobbly fine sandy loam 4 inches thick. The subsurface layer is 9 inches of grayish brown, strongly acid, gravelly and cobbly fine sandy loam. The upper part of the subsoil is 11 inches of reddish brown, very strongly acid clay. The lower part of the subsoil is 8 inches of mottled olive brown and reddish brown, very strongly acid clay. The underlying material is soft, rippable, stratified shale.

Thickness of soil and depth to shale is 20 to 40 inches. Available water capacity between depths of 20 and 40 inches ranges from 3.0 to 6.0 inches.

In a typical profile the Darnell soil has a surface layer of dark grayish brown, medium acid, gravelly and cobbly fine sandy loam 3 inches thick. The subsoil is 9 inches of reddish brown, strongly acid, gravelly and cobbly fine sandy loam. The underlying material is rippable sandstone that is similar in color and reaction to the subsoil.

Soil thickness and depth to sandstone ranges from 10 to 20 inches. Available water capacity within the upper 20 inches rangs from 1.0 to 2.5 inches.

The main concerns of management of these soils in urban areas are depth to bedrock, permeability, moderately steep to steep slopes, rockiness, and wetness. These soils are well suited to lawn grasses, flowers, shrubs, trees, and most garden plants. They have moderate limitations for shallow excavations and roads or streets mainly because of shallowness of soil, rockiness, and wetness. The soils in this complex have severe limitations for septic tank absorption fields, sewage lagoons, sanitary landfills, dwellings, camp areas, playgrounds, and picnic areas because of rockiness, depth to bedrock, permeability, wetness, and steep slopes. Depth to bedrock is the main limitation in using these soils for uncoated steel and concrete pipe.

The main concerns of management are steep slopes, rockiness, and shallowness of soil to shale or sandstone. These soils are not suitable for cultivation. Proper grazing, controlling brush, and protecting the grass from fire improve the quality of grass and protect these soils from erosion. Rockiness and steep slopes restrict the use of most types of machinery in land management. Trees are used mostly for firewood and have little commercial value. Capability unit VIIs-4; woodland suitability subclass 5x; Savannah Breaks range site.

37—Niotaze-Darnell-Urban land complex, 3 to 25 percent slopes. These are gently sloping to steep soils on timbered uplands. The soils in this complex are in such an intricate pattern with buildings, streets, and roads that it is impractical to separate them from the Urban land. Niotaze soils are on side slopes, and Darnell soils are on ridge crests. This complex is 55 percent Niotaze soils, 25 percent Darnell soils, 20 percent Urban land, and small areas of sandstone outcrops.

In a typical profile the Niotaze soil has a surface layer of brown, medium acid, gravelly and cobbly fine sandy loam 4 inches thick. The subsurface layer is 9 inches of grayish brown, strongly acid, gravelly and cobbly fine sandy loam. The upper part of the subsoil is 11 inches of reddish brown, very strongly acid clay. The lower part of the subsoil is 8 inches of mottled olive brown and reddish brown, very strongly acid clay. The underlying material is soft rippable, stratified shale.

Thickness of soil and depth to shale is 20 to 40 inches. Available water capacity between depths of 20 and 40 inches ranges from 3.0 to 6.0 inches.

In a typical profile the Darnell soil has a surface layer of dark grayish brown, medium acid, gravelly and cobbly fine sandy loam 3 inches thick. The subsoil is 9 inches of reddish brown, strongly acid, gravelly and cobbly fine sandy loam. The underlying material is rippable sandstone that is similar in color and reaction to the subsoil.

Soil thickness and depth to sandstone ranges from 10 to 20 inches Available water capacity within the upper 20 inches ranges from 1.0 to 2.5 inches.

About 70 percent of the acreage of these soils, however, has been modified by excavating, filling, and grading. In excavated areas, Niotaze soils are clayey and shaly and Darnell soils are loamy with considerable amounts of gravel- and cobble-sized fragments of sandstone. In fill areas the material is usually loamy and is 1 to 3 feet thick.

The soils in this complex are used for urban development, including small industrial areas.

The main concerns of management of these soils in urban areas are depth to bedrock, permeability, moderately steep to steep slopes, rockiness, and wetness. These soils are well suited to lawns, grasses, flowers, shrubs, trees, and most garden plants. They have moderate limitations for shallow excavations and roads or streets mainly because of shallowness, rockiness, and wetness. The soils in this complex have severe limitations for septic tank absorption fields, sewage lagoons, sanitary landfills, dwellings, camp areas, playgrounds, and picnic areas because of rockiness, depth to bedrock, permeability, wetness, and moderately steep to steep slopes. Depth to bedrock is the main limitation in using these poorly suited soils for uncoated steel and concrete pipe. No capability unit or range site, Niotaze and Darnell parts in woodland suitability subclass 5x, Urban land not placed in a woodland suitability subclass.

38—Oil-waste land. Oil-waste land consists of areas where liquid wastes, principally oil and salt water, have accumulated. It includes slush pits and adjacent uplands and bottom lands. It is in all parts of the county near oil drilling or refining operations. Areas are usually about 3 acres in size but range from 1/2 acre to 70 acres. Slope is 0 to 5 percent. Surface runoff is rapid, and erosion is a severe hazard.

Oil-waste land is unsuitable for farming or urban use. Some of it could be reclaimed, but the cost would be high because surface drainage from higher areas would have to be diverted. Rainwater could be impounded to help leach out soluble salts. A mulch of hay or straw would reduce evaporation and thus help prevent salt accumulations on the surface.

Very little vegetation grows on these areas. Salt-tolerant pasture plants could be grown if they were seeded in the middle of the rainy season when salt accumulations on the surface are reduced. Capability unit VIIIs-1; no woodland suitability subclass or range site.

39—Okay loam, 0 to 1 percent slopes. This is a nearly level, well drained, moderately permeable soil on uplands. It is on broad, smooth ridge crests.

In a typical profile the surface layer is dark brown, slightly acid loam 15 inches thick. The upper 5 inches of the subsoil is brown, slightly acid loam. The middle part of the subsoil is 22 inches of reddish brown, medium acid clay loam. The lower part of the subsoil is 7 inches of yellowish red, medium acid clay loam. The underlying material is yellowish red, strongly acid loam.

Soil thickness is 40 inches to more than 60 inches, and the depth to bedrock is more than 60 inches. Available water capacity to a depth of 40 inches ranges from 6.0 to 8.0 inches.

About 10 percent of this mapping unit is included areas of Kamie fine sandy loam and Mason silt loam.

The main concerns in using this soil in urban areas are moderate permeability and soil acidity. Trees, garden plants, shrubs, flowers, paths, trails, and camp, playground, or picnic areas are well suited to this soil. The soil has slight limitations for septic tank filter fields, trench-type sanitary landfills, dwellings, commercial buildings, roads, and streets. Moderate permeability is the main soil feature to consider when planning to use this soil for sewage lagoons. Soil acidity is the main concern on this soil where it is used for uncoated steel or concrete pipe.

This soil is used mostly for field crops and tame pasture plants. Wheat, vegetables, soybeans, and grain sorghum are the main crops suited to this soil.

Controlling erosion and maintaining soil tilth and fertility are the main management concerns on this soil. This soil can be used for continuous clean-tilled crops where it has been adequately fertilized and crop residue has been returned to the soil. Proper management of crop residue helps maintain soil tilth and improve water intake. In a few areas, diversion terraces on long slopes are used to prevent excessive sheet erosion. Capability unit I-2; no woodland suitability subclass; Loamy Prairie range site.

40—Okay loam, 1 to 3 percent slopes. This gently sloping, well drained, moderately permeable soil is on uplands.

In a typical profile the surface layer is dark brown, slightly acid loam 12 inches thick. The upper 6 inches of the subsoil is dark brown, slightly acid loam. The middle part of the subsoil is 28 inches of reddish brown, slightly acid clay loam. The lower part of the subsoil is 24 inches of reddish brown loam.

Soil thickness is 40 inches to more than 60 inches, and the depth to bedrock is more than 60 inches. Available water capacity to a depth of 40 inches ranges from 6.0 to 8.0 inches.

About 15 percent of this mapping unit is included areas of a soil that is similar to Okay soils except that it has a dark grayish brown and reddish brown surface layer, and 10 percent is a soil that is similar to Okay soils except that it has a fine sandy loam surface layer.

The main concerns in using this soil in urban areas are slope and soil acidity. The soil is well suited to trees, garden plants, shrubs, and flowers. It has slight limitations for paths, trails, and camp or picnic areas. It has slight limitations for septic tank filter fields, trench-type sanitary landfills, dwellings, commercial buildings, roads, and streets. Slope is the most restricting feature for sewage lagoons or playground areas. Soil acidity is a concern on this soil where it is used for uncoated steel or concrete pipe.

This soil is suited to the commonly grown crops in the county, including wheat, grain sorghum, soybeans, vegetables, introduced grasses, and native grasses.

Soil management is needed to maintain fertility and soil tilth and to help control erosion. Cropping systems need to provide for the return of adequate residue to the soil. Erosion can be reduced by contour farming, terracing, and managing crop residue. Vegetative cover is needed during winter and spring to help keep the soil from eroding. Fertilizer increases plant growth and provides additional crop residue for erosion control. Terracing, contour farming, and using cover crops are especially needed where row crops are grown. Excessive tillage needs to be avoided. Capability unit IIe-1; no woodland suitability subclass; Loamy Prairie range site.

41—Okay loam, 3 to 5 percent slopes. This is a gently sloping, well drained, moderately permeable soil on uplands. It is on broad, smooth side slopes.

In a representative profile the surface layer is dark brown, slightly acid loam 11 inches thick. The upper 8 inches of the subsoil is dark brown, medium acid loam. The middle part of the subsoil is 10 inches of reddish brown, strongly acid clay loam. The lower part of the subsoil is 15 inches of yellowish red, strongly acid clay loam. The underlying material is yellowish red, medium acid loam.

Soil thickness is 40 inches to more than 60 inches, and the depth to bedrock is more than 60 inches. Available water capacity to a depth of 40 inches ranges from 6.0 to 8.0 inches.

About 10 percent of this mapping unit is included areas of Kamie loamy fine sand and Newtonia silt loam. Also included are a few spots of eroded soils.

The main concerns in using this soil in urban areas are slope and soil acidity. This soil is well suited to trees, garden plants, shrubs, and flowers. It has slight limitations for paths, trails, and camp or picnic areas. It also has slight limitations for septic tank filter fields, trench-type sanitary landfills, dwellings, commercial buildings, roads, and streets. Slope is the most restricting soil feature for sewage lagoons or playground areas. Soil acidity is a concern where this soil is used for uncoated steel or concrete pipe.

This soil is used mostly for tame pasture, wheat, grain sorghum, and soybeans. Some areas are in native grass.

The main concerns of soil management are controlling erosion and maintaining soil fertility and soil tilth. Terracing, contour farming, and using crop residue are needed to help control erosion. Crop residue should be returned to the soil, and minimum tillage needs to be practiced. Rowcropping needs to be avoided unless small grains are predominant in the rotation of crops to protect the soil from erosion. Tame pasture grasses and legumes or native grass provide the best protection against erosion. Capability unit IIIe-1; no woodland suitability subclass; Loamy Prairie range site.

42—Okay loam, 2 to 5 percent slopes, eroded. This is a very gently sloping to gently sloping, well drained, moderately permeable soil on uplands. It is on broad side slopes above drainageways.

Part of the original surface layer has been removed by erosion in about 50 percent of the area. In about 30 percent of the area, the surface layer and the upper part of the subsoil have been mixed by tillage. Rills are common throughout the area, and a few gullies are present.

In a representative profile the surface layer is dark brown, slightly acid loam 8 inches thick. The upper 4 inches of the subsoil is dark reddish brown, slightly acid loam. The remainder of the subsoil, to a depth of 53 inches, is yellowish red, medium acid sandy clay loam. The underlying material is yellowish red, strongly acid fine sandy loam.

Soil thickness is 40 inches to more than 60 inches, and the depth to bedrock is more than 60 inches. Available water capacity to a depth of 40 inches ranges from 6.0 to 8.0 inches.

About 5 percent of this mapping unit is included areas of Kamie fine sandy loam, and 5 percent is areas of soils that are similar to Okay soils except that pockets of clean sand grains make up more than 5 percent of the lower part of the subsoil.

The main concerns in using this soil in urban areas are slope and acidity. The soil is well suited to trees, garden plants, shrubs, and flowers. It has slight limitations for paths, trails, and camp or picnic areas. It also has slight limitations for septic tank filter fields, trench-type sanitary landfills, dwellings, commercial buildings, roads, and streets. Slope is the most restrictive soil feature for

sewage lagoons or playground areas. Soil acidity is a concern on this moderately well suited soil where it is used for uncoated steel or concrete pipe.

This soil is used mostly for tame pastures. In a few areas, the soil is cropped to wheat, grain sorghum, and soybeans.

The main concern in management is protecting the soil from accelerated erosion and maintaining soil fertility and tilth. A cropping system that uses mostly small grains and adequate amounts of fertilizer for maximum residue is needed to control water erosion. Row crops should be avoided in order to prevent excessive loss of soil. Terraces, waterways, and contour farming also protect the soil. Tame pasture grasses and legumes with additions of fertilizer are the best protection against erosion. Capability unit IIIe-2; no woodland suitability subclass; Loamy Prairie range site.

43—Okemah silt loam, 0 to 1 percent slopes. This is a nearly level, moderately well drained, slowly permeable soil. It is on broad, smooth uplands.

In a representative profile the surface layer is very dark grayish brown, medium acid silt loam 9 inches thick. The next layer is 11 inches of very dark brown, slightly acid or neutral silt loam. The upper part of the subsoil is 8 inches of very dark grayish brown, mildly alkaline silty clay and 20 inches of coarsely mottled dark yellowish brown, light olive brown, and grayish brown, mildly alkaline silty clay. The lower part of the subsoil is coarsely mottled dark grayish brown, grayish brown, and strong brown, moderately alkaline silty clay.

The thickness of the soil and depth to bedrock is more than 60 inches. Available water capacity in the upper 40 inches of the soil ranges from 6.5 inches to 7.5 inches.

About 15 percent of this mapping unit is included areas of Apperson silty clay loam, Carytown silt loam, and Dennis silt loam; and 20 percent is soils that are similar to Okemah soils except that they do not have coarser mottles in the lower part of the subsoil.

The main concerns of using this soil in urban areas are slow permeability, wetness, high shrink-swell potential, and the texture and acidity of the subsoil. This soil is well suited to lawn grasses, flowers, most shrubs, and garden plants. It has slight limitations for sewage lagoons and for picnic areas or paths and trails in recreational areas. It has moderate limitations for camp and playground areas because of surface wetness. This soil has severe limitations for dwellings, septic tank filter fields, commercial buildings, and roads and streets because of the slow permeability and high shrink-swell potential of the subsoil. The loamy and clayey texture and acidity of the subsoil cause corrosivity on uncoated steel and concrete.

This soil is used mainly for field crops and tame pasture plants. Wheat, soybeans, and grain sorghum are the main crops suited to this soil.

Controlling erosion and maintenance of soil tilth and fertility are the main management concerns. This soil can be used continuously for clean-tilled crops where it is adequately fertilized and crop residue is returned to the soil. Proper management of crop residue helps maintain soil tilth and improve water intake. In a few areas, diversion terraces on long slopes are used to prevent excessive sheet erosion. Capability unit I-2; no woodland suitability subclass; Loamy Prairie range site.

44—Okemah-Parsons-Carytown complex, 0 to 1 percent slopes. This is a complex of the moderately well drained, slowly permeable Okemah soil; the somewhat poorly drained, very slowly permeable Parsons soil; and the poorly drained, very slowly permeable Carytown soil. These nearly level soils are on smooth uplands. This complex is 50 percent Okemah soils, 30 percent Parsons soils, and 20 percent Carytown soils.

In a typical profile the Okemah soil has a surface layer of very dark grayish brown, slightly acid silt loam 17 inches thick. The upper 37 inches of the subsoil is very dark grayish brown, slightly acid or neutral silty clay loam. The lower part of the subsoil to a depth of 66 inches is mottled very dark grayish brown and yellowish red, mildly alkaline silty clay.

The thickness of the soil and depth to bedrock is more than 60 inches. Available water capacity in the upper 40 inches of the soil ranges from 6.5 inches to 7.5 inches.

In a typical profile the Parsons soil has a surface layer of very dark grayish brown, slightly acid silt loam 8 inches thick. The subsurface layer is 6 inches of dark grayish brown, slightly acid silt loam. The upper 9 inches of the subsoil is very dark gray, slightly acid clay. The middle part of the subsoil is 29 inches of dark gray and gray, slightly acid clay. The lower part of the subsoil to a depth of 74 inches is gray, mildly alkaline clay.

Thickness of soil and depth to bedrock is more than 60 inches. Available water capacity in the upper 40 inches ranges from 6.0 to 8.5 inches.

In a typical profile the Carytown soil has a surface layer of dark grayish brown, medium acid silt loam 7 inches thick. The upper 7 inches of the subsoil is very dark grayish brown, neutral silty clay. The middle part of the subsoil is 9 inches of dark yellowish brown, slightly acid silty clay and 28 inches of olive brown, slightly acid silty clay. The lower part of the subsoil to a depth of 64 inches is mottled yellowish brown, dark grayish brown, and olive brown, moderately alkaline silty clay.

Thickness of soil and depth to bedrock is more than 60 inches. Available water capacity in the upper 40 inches ranges from 4.5 to 6.0 inches. Sodium content is high.

The main concerns in using these soils in urban areas are wetness, very slow permeability, slope, the clayey and acid subsoil, low strength, and high shrink-swell potential. These soils have slight limitations for sewage lagoons in nearly level areas. Wetness is the most restrictive soil feature for picnic areas, paths, and trails. The soils have moderate limitations for these uses. Proper structural design to compensate for high shrink-swell potential and low strength is especially needed for these soils, which have severe limitations, where they are used for dwellings, commercial buildings, roads, and streets. A large septic tank filter field is needed to compensate for

the very slow permeability and wetness of the Carytown soil. The clayey subsoil is the most restrictive soil feature for trench-type sanitary landfills and concrete or uncoated steel pipes.

The main crops are wheat, grain sorghum, and soybeans. A sizable acreage is in tame pasture plants.

The main concerns of management are wetness, intake of water, and soil tilth and fertility. A good cropping system that includes proper residue management is beneficial to the soil. Fertilizing to increase crop residue maintains or improves soil fertility, soil tilth, and water intake. Row direction for surface drainage in wet areas increases crop production and amounts of residue. Additions of manure and chemical amendments such as gypsum improve soil structure and intake of water on the Carytown silt loam. Excessive tillage needs to be avoided. Capability unit IIs-1; no woodland suitability subclass; Okemah part in Loamy Prairie range site, Parsons part in Claypan Prairie range site, and Carytown part in Shallow Claypan range site.

45—Osage silty clay. This is a nearly level, poorly drained, very slowly permeable soil. It is on broad, smooth flood plains entrenched with a few narrow, shallow sloughs. It is flooded occasionally and for very brief periods.

In a typical profile the surface layer is black, medium acid silty clay 18 inches thick. The subsoil is very dark gray, medium acid or slightly acid silty clay.

Thickness of the soil is more than 40 inches, and depth to bedrock is more than 60 inches. Available water capacity in the upper 40 inches of soil ranges from about 5.5 to 7.0 inches.

About 10 percent of this mapping unit is included areas of Wynona silty clay loam and Radley silt loam. Old sloughs make up a small part of the area.

The main concerns for using this soil in urban areas are occasional flooding, clayey profile, wetness, and high shrink-swell potential. Trees, shrubs, most flowers, and some garden plants are well suited to this soil. Proper structural design to compensate for high shrink-swell potential, flooding, and wetness is especially needed on this soil where it is used for dwellings, commercial buildings, roads, and streets. The soil has severe limitations for those uses. Flooding is the main concern in areas where this soil is used for septic tank filter fields, sewage lagoons, and trench-type sanitary landfills. This soil has severe limitations for paths, trails, and camp, picnic, or playground areas.

Most of this soil is used for tame pasture plants. The main field crops are wheat, grain sorghum, and soybeans. A few areas are in woodland.

The main concerns of management in cultivated areas are flooding, surface wetness, slow water intake, and maintenance of soil tilth. Close-grown crops are needed during late fall, winter, and spring to prevent excessive loss of soil during flooding. The planting of spring crops needs to be delayed until after the common flood period. Most crops can be grown continuously where the soil has been fertilized for maximum crop residue. Large amounts of residue help maintain organic matter and contribute to good soil tilth and intake of water. When this soil is wet, tillage or grazing breaks down soil structure and reduces water intake. A drainage system coupled with arranging rows for drainage reduces surface wetness for better crops. Capability unit IIIw-1; woodland suitability subclass 4w; no range site.

46—Pits. Pits are mostly in the areas of Shidler, Catoosa, and Lula soils from which limestone fragments have been excavated. A small acreage of Pits is in sandy and loamy areas of Larton, Kamie, and Okay soils, from which base material has been taken for building roads, foundations, and other similar structures.

Pits have no distinct soil profile. They range from about 5 acres to 400 acres in size and from a few feet to 100 feet in depth.

The areas are of limited use for agricultural or urban use. They support little to moderate amounts of vegetation and can be lightly grazed or used for wildlife habitat. Some Pits areas contain water. No capability unit, woodland suitability subclass, or range site.

47—Radley silt loam. This is a deep, nearly level, moderately well drained, moderately permeable soil. It is on flood plains that are occasionally flooded for very brief periods.

In a representative profile the surface layer is dark brown, neutral silt loam 10 inches thick. The subsoil is 8 inches of brown, neutral silt loam. The underlying material is brown, neutral silt loam.

Depth to bedrock is more than 60 inches. Available water capacity in the upper 40 inches ranges from 6.5 to 8.5 inches.

About 10 percent of this mapping unit is included areas of Wynona silty clay loam and Osage silty clay.

The main concern of using this soil in urban areas is flooding. Because of flooding, this soil is moderately well suited to garden plants and has moderate limitations for picnic and playground areas. It has severe limitations for all types of pipes, dwellings, commercial buildings, camp areas, roads or streets, septic tank filter fields, sewage lagoons, and sanitary landfills because of flooding.

This soil is used mostly for wheat, soybeans, grain sorghum, tame pasture plants, and woodland.

The main concerns in management are flooding and soil tilth. Close-growing crops are needed during late fall, winter, and spring to prevent excessive loss of soil during flooding. The planting of spring crops needs to be delayed until after the normal flood period. Most crops that produce large amounts of residue can be grown continuously where the soil is fertilized for maximum crop residue. Maintenance of organic matter content contributes to good soil tilth and intake of water. Minimum tillage needs to be used. Tame pasture or woodland provides the best protection against flooding. Capability unit IIw-1; woodland suitability subclass 2o; no range site.

48—Radley soils. These are nearly level, moderately well drained, moderately permeable Radley soils and

Cleora and Wynona soils. These soils are on flood plains 100 to 400 feet wide and are entrenched with meandering stream channels 2 to 10 feet deep and 10 to 60 feet wide. They are flooded frequently for brief periods.

This complex is about 60 percent Radley silt loam, about 25 percent Wynona silty clay loam, and about 15 percent Cleora fine sandy loam.

In a typical profile Radley soils have a surface layer of very dark grayish brown, neutral silt loam 14 inches thick. The subsoil is 20 inches of brown, slightly acid silty clay loam. The underlying material is dark grayish brown, slightly acid silt loam.

Depth to bedrock is more than 60 inches. Available water capacity in the upper 40 inches ranges from 6.5 to 8.5 inches.

The main concern in using these soils in urban areas is frequent flooding. Trees, shrubs, paths, and trails are well suited on these soils. Flooding limits the use of these moderately well suited soils for flowers and lawn grasses. These soils are poorly suited for garden plants. They have moderate limitations for picnic areas and severe limitations for camp and playground areas, dwellings, commercial buildings, roads, streets, pipes, and most types of sanitary facilities because they are subject to frequent flooding.

This soil is used mostly for tame pasture and woodland. It is not generally suitable for cultivation.

The main concern of management is the frequent flooding. This soil produces high-quality hardwoods where the trees are thinned, weeded, and selectively harvested. Fertilizing and proper grazing help control erosion by flooding. Brush control is needed to obtain high yields. Capability unit Vw-2; woodland suitability subclass 2o; no range site.

49—Severn very fine sandy loam. This is a deep, well drained soil that has moderately rapid permeability. It is on broad, smooth to slightly undulating flood plains that are flooded rarely for very brief periods.

In a typical profile the surface layer is reddish brown, mildly alkaline very fine sandy loam 8 inches thick. The next layer to a depth of 28 inches is reddish brown, moderately alkaline very fine sandy loam. Below this, to a depth of 48 inches, is yellowish red, moderately alkaline very fine sandy loam. The lower layer is reddish brown, moderately alkaline very fine sandy loam.

The depth to bedrock is more than 60 inches. Available water capacity in the upper 40 inches ranges from 4.0 to 6.5 inches.

About 10 percent of this mapping unit is included areas of Choska very fine sandy loam, and about 5 percent is Latanier clay.

The main concern of management of this soil in urban areas is flooding. This soil is well suited to trees, shrubs, flowers, and lawn grasses. It has slight limitations for paths and trails in recreational areas.

Because flooding is rare this soil along the Arkansas River has moderate limitations for dwellings, commercial buildings, camp areas, picnic areas, playground areas, roads, or streets. It is moderately well suited to garden plants. It has severe limitations for septic tank filter fields, sewage lagoons, or sanitary landfills because of permeability and, in some areas, the depth to the water table.

This soil is suited to all crops commonly grown in the area. The main crops are wheat, grain sorghum, soybeans, vegetable crops, and tame pasture plants. This soil is also suitable for trees.

Soil management is needed to maintain soil tilth and fertility. Most crops that produce large amounts of residue can be grown continuously where the soil is well managed and most of the crop residue is returned to the soil. Fertilizing helps to maintain organic matter content, good tilth, and fertility. Diversion terraces can be used to help control overhead water. Minimum tillage needs to be used. Capability unit I-1; woodland suitability subclass 2o; no range site.

50—Shidler-Rock outcrop complex, 1 to 12 percent slopes. This complex of the well drained, moderately permeable Shidler soil and Rock outcrop is on ridge crests and side slopes of the uplands. Slopes are very gentle through strong. This complex is 65 percent Shidler soil and 30 percent Rock outcrop. The rest is Catoosa and Apperson soils.

In a typical profile the surface layer is black, mildly alkaline silty clay loam that grades to very dark brown, moderately alkaline silty clay loam at a depth of about 9 inches. Hard gray limestone is at a depth of 16 inches.

The thickness of the soil and depth to hard limestone ranges from 4 to 20 inches. Available water capacity ranges from 0.6 inch to 4.0 inches. The Rock outcrop part of this complex consists of bare limestone bedrock or thinly mantled bedrock at a depth of less than 4 inches. The limestone crops out from a few inches to about 2 feet above the surface.

The main concerns of using this soil complex in urban areas are the depth to bedrock, low strength, moderate shrink-swell potential, soil texture, slope, and rock outcrops. This soil complex is moderately well suited to garden plants, flowers, and most shrubs. It has moderate limitations for paths and trails. This soil complex has severe limitations for septic tank filter fields, sewage lagoons, trench-type sanitary landfills, dwellings, commercial buildings, roads, streets, pipes, and picnic, camp, and playground areas because of rock outcrop and depth to bedrock.

The soils in this complex are used primarily for grazing. Rock outcrop is intricately mixed with the soil in a pattern that severely limits the use of this complex for field crops or tame pasture grasses. The native grasses need to be protected from fire and properly grazed to obtain the most production. Capability unit VIIs-5; no woodland suitability subclass; Shidler part in Very Shallow range site, Rock outcrop part not placed in a range site.

51—Tullahassee fine sandy loam. This is a nearly level, somewhat poorly drained, rapidly permeable soil. This soil is on flood plains, 150 to 500 feet wide, that are

entrenched with shallow, meandering stream channels. It is flooded frequently for very brief periods.

In a representative profile the surface layer is dark brown, slightly acid fine sandy loam 8 inches thick. The next layer is 13 inches of dark grayish brown, slightly acid fine sandy loam. The lower layer to a depth of 64 inches is brown, slightly acid fine sandy loam that grades to dark grayish brown, slightly acid fine sandy loam at a depth of 45 inches.

Depth to bedrock is more than 60 inches. Available water capacity in the upper 40 inches ranges from 4.0 to 6.0 inches. The water table is at a depth of 2 to 3 feet from November through May.

About 10 percent of this mapping unit is included areas of Cleora fine sandy loam.

The main concerns of using this soil in urban areas are flooding and wetness. This soil is well suited to trees and shrubs. Flooding and surface wetness limit the use of this moderately well suited soil for lawn grasses and flowers. It has moderate limitations for paths and trails. This soil is poorly suited to garden plants because of flooding. It has severe limitations for camp and playground areas, dwellings, commercial buildings, roads, streets, pipes, and most types of sanitary facilities.

This soil is used most for tame pasture and woodland. It is not generally suitable for cultivation.

The main concerns of management are frequent flooding and the high water table. This soil produces high-quality hardwoods where trees are thinned, weeded, and selectively harvested. It is well suited to tame pasture plants that require moisture. Fertilizing and proper grazing of tame pasture plants help control erosion by flooding. Brush control is needed to obtain high yields. Capability unit Vw-3; woodland suitability subclass 3w; no range site.

52—Urban land. The areas designated as Urban land on soil maps are within the city boundary of Tulsa. Urban land is composed of areas that are more than 75 percent covered with dwellings, commercial buildings, concrete, paved roads, airport runways, fair buildings, and other similar structures. Slopes are 0 to 8 percent and the areas are more than 40 acres in size. Included in mapping are other soils that are less than 75 percent covered with permanent structures. Areas of these included soils are less than 40 acres in size. No capability unit, woodland suitability subclass; no range site.

53—Wynona silty clay loam. This is a nearly level, somewhat poorly drained soil that has slow permeability. It is on smooth flood plains that are entrenched with a few shallow, narrow sloughs. This soil is flooded occasionally for very brief periods (fig. 2).

In a typical profile the surface layer is very dark brown, mildly alkaline silty clay loam 10 inches thick. The lower 13 inches of the surface layer is black, slightly acid silty clay loam. The upper part of the subsoil is 19 inches of very dark gray, slightly acid silty clay loam. The lower part of the subsoil to a depth of 64 inches is very dark gray, neutral silty clay loam.

Soil thickness ranges from 40 inches to more than 60 inches, and the depth to bedrock is more than 60 inches. Available water capacity in the upper 40 inches ranges from 7.0 to 8.5 inches.

About 10 percent of this mapping unit is included areas of Osage silty clay and Radley silt loam, and about 10 percent is small areas of soils that are similar to Wynona soils except that they are dark brown and olive brown in the lower part of the profile.

The main concerns of using this soil in urban areas are flooding, wetness, and low strength. This soil is well suited to trees, shrubs, flowers, lawn grasses, and garden plants. It has moderate limitations for picnic areas, paths, and trails. Wetness and flooding are concerns for those uses. Flooding contributes to these soils having severe limitations for camp and playground areas, septic tank filter fields, sewage lagoons, trench-type sanitary landfills, dwellings, commercial buildings, roads, and streets.

This soil is used mostly for wheat, soybeans, grain sorghum, tame pasture plants, and trees.

The main concerns in management are control of flooding and maintenance of soil tilth. Close grown crops are needed during late fall, winter, and spring to prevent excessive loss of soil during flooding. The planting of spring crops needs to be delayed until after the normal flood period. Most crops that produce large amounts of residue can be grown continuously where the soil is fertilized for maximum crop residue. Maintenance of the organic matter content of this soil contributes to good tilth and intake of water. Minimum tillage needs to be used. Tame pasture or trees protect this soil best during flooding. Capability unit IIw-1; woodland suitability subclass 3w; no range site.

54—Wynona-Urban land complex. These are nearly level soils on flood plains. The soils in this complex are in such an intricate pattern with buildings, streets, and roads that it is impractical to separate them from the Urban land. This complex is 45 percent Wynona soils and 20 percent Urban land. These soils flood occasionally for very brief periods. Minor soils are in the Osage, Radley, and Cleora series.

In a typical profile the surface layer of Wynona soils is very dark brown, mildly alkaline silty clay loam 10 inches thick. The lower 13 inches of the surface layer is black, slightly acid silty clay loam. The upper part of the subsoil is 10 inches of very dark gray, slightly acid silty clay loam. The lower part of the subsoil to a depth of 64 inches is very dark gray, neutral silty clay loam.

Soil thickness ranges from 40 inches to more than 60 inches, and the depth to bedrock is more than 60 inches. Available water capacity in the upper 40 inches ranges from 7.0 to 8.5 inches.

In about 30 percent of the acreage of this mapping unit, the soils have been modified by excavating, filling, and grading. In excavated and filled areas, the surface layer is a mixture of loamy and clayey material.

The soils in this complex are used mostly for urban development, mainly picnic areas, playground areas, houses, roads, and streets.

The main concerns of using this soil in urban areas are flooding, wetness, and low strength. This soil is well suited to trees, shrubs, flowers, lawn grasses, and garden plants. It has moderate limitations for picnic areas, paths, and trails. Wetness and flooding are concerns for these uses. These soils have severe limitations for camp and playground areas, septic tank filter fields, sewage lagoons, trench-type sanitary landfills, dwellings, commercial buildings, roads, and streets because of flooding and other unfavorable soil features. No capability unit, or range site, Wynona part in woodland suitability subclass 3w, Urban land part not placed in a woodland suitability subclass.

Use and Management of the Soils

JAMES O. THOMAS, district conservationist, Soil Conservation Service, helped prepare this section.

The soil survey is a detailed inventory and evaluation of the most basic resource of the survey area—the soil. It is useful in adjusting land use, including urbanization, to the limitations and potentials of natural resources and the environment. Also, it can help avoid soil-related failures in uses of the land.

While a soil survey is in progress, soil scientists, conservationists, engineers, and others keep extensive notes about the nature of the soils and about unique aspects of behavior of the soils. These notes include data on erosion, drought damage to specific crops, yield estimates, flooding, the functioning of septic systems, and other factors affecting the productivity, potential, and limitations of the soils under various uses and management. In this way, field experience and measured data on soil properties and performance are used as a basis for predicting soil behavior.

Information in this section is useful in planning use and management of soils for crops and pasture, rangeland, and woodland, and as sites for buildings, highways and other transportation systems, sanitary facilities, parks and other recreation facilities, and wildlife habitat. From the data presented, the potential of each soil for specified land uses can be determined, soil limitations to these land uses can be identified, and costly failures in houses and other structures, caused by unfavorable soil properties, can be avoided. A site where soil properties are favorable can be selected, or practices that will overcome the soil limitations can be planned.

Planners and others using the soil survey can evaluate the impact of specific land uses on the overall productivity of the survey area or other broad planning area and on the environment. Productivity and the environment are closely related to the nature of the soil. Plans should maintain or create a land-use pattern in harmony with the natural soil.

Contractors can find information that is useful in locating sources of sand and gravel, roadfill, and topsoil. Other information indicates the presence of bedrock, wetness, or very firm soil horizons that cause difficulty in excavation.

Health officials, highway officials, engineers, and many other specialists also can find useful information in this soil survey. The safe disposal of wastes, for example, is closely related to properties of the soil. Pavements, sidewalks, campsites, playgrounds, lawns, and trees and shrubs are influenced by the nature of the soil.

Crops and Pasture

THEODORE B. LEHMAN, conservation agronomist, Soil Conservation Service, helped prepare this section.

The major management concerns when using the soils for crops and pasture are described in this section. In addition, the crops or pasture plants best adapted to the soil, including some not commonly grown in the survey area, are discussed; the system of land capability classification used by the Soil Conservation Service is explained; and the predicted yields of the main crops are presented for each soil.

This section provides information about the overall agricultural potential and needed practices in the survey area for those in the agribusiness sector, equipment dealers, drainage contractors, fertilizer companies, processing companies, planners, conservationists, and others. For each kind of soil, information about management is presented in the section "Soil Maps for Detailed Planning." When making plans for management systems for individual fields or farms, check the detailed information given in the description of each soil.

The soils in Tulsa County can potentially produce more food. In addition to the reserve productive capacity represented by land not presently cultivated, food production could also be increased considerably by extending the latest crop production technology to all cropland in the county. This soil survey can greatly facilitate the application of such technology.

Acreage in crops has gradually been decreasing as more and more land is used for urban development and for pasture. The use of this soil survey to help make land use decisions that will influence the future role of farming in the county is discussed in the section "General Soil Map for Broad Land Use Planning."

Soil erosion is the major concern on cropland in Tulsa County. If the slope is more than 1 percent, erosion is a hazard. Apperson, Bates, Catoosa, Dennis, Lula, and Newtonia soils, for example, have slopes of 1 percent or more.

Loss of the surface layer through erosion is damaging for two reasons. First, productivity is reduced as the surface layer is lost and part of the subsoil is incorporated into the plow layer. This is especially damaging on soils that have a clayey subsoil, such as Apperson, Dennis, Okemah, and Parsons soils. Erosion also reduces productivity on soils that tend to be droughty, such as Shidler and Carytown soils. Second, soil erosion on farmland results in sedimentation in streams and rivers. Control of erosion on farms minimizes sedimentation in tributaries and improves the quality of water for municipal use, for recreation, and for fish and wildlife.

Erosion control practices provide protective surface cover, reduce runoff, and increase infiltration. A cropping system that keeps vegetative cover on the soil for extended periods can hold soil erosion losses to amounts that will not reduce the productive capacity of the soils. On livestock farms, which require pasture and hay, the legume and grass forage crops in the cropping system reduce erosion on sloping land, provide nitrogen, and improve tilth for the following crop.

Slopes are so short and irregular that contour tillage or terracing is not practical in most areas of the Larton and Glenpool soils. On these soils, cropping sytems that provide substantial vegetative cover are required to control erosion unless minimum tillage is practiced. Minimizing tillage and leaving crop residues on the surface help to increase infiltration and reduce the hazards of runoff and erosion. These practices can be adapted to most soils in the survey area, but they are more difficult to use successfully on the eroded soils and on the soils that have a clayey surface layer, such as Latanier and Osage soils. No-tillage is effective in reducing erosion on sloping land and can be adapted to most soils in the survey area. It is more difficult to practice successfully, however, on soils with a clayey surface layer.

Terraces and diversions reduce the length of slope and reduce runoff and erosion. They are most practical on deep, well drained soils that have regular slopes, such as Apperson and Dennis soils. Some soils are less suitable because of irregular slopes, excessive wetness, a clayey subsoil which would be exposed in terrace channels, or bedrock at a depth of less than 40 inches.

Contouring and contour stripcropping are suitable erosion control practices in the survey area. They are best adapted to soils with smooth, uniform slopes, including most areas of the Apperson, Bates, Catoosa, Eram, Kamie, Lula, Newtonia, Okay, and Okemah soils.

Soil blowing is a hazard on the sandy Larton and Glenpool soils. It can damage these soils in a few hours if winds are strong and the soils are dry and bare of vegetation or surface mulch. Maintaining vegetative cover, surface mulch, or rough surfaces minimizes soil blowing on these soils.

Soil drainage is the major management need on some of the soils used for crops and pasture in the survey area. Some soils are naturally so wet that the production of crops common to the area is generally reduced. These are the poorly drained Osage soils and the somewhat poorly drained Latanier and Wynona soils. Artificial drainage is needed in most of the wetter areas.

Soil fertility is naturally low in the Darnell, Enders, Glenpool, Hector, Kamie, Larton, Linker, and Niotaze soils of the uplands. The other soils on uplands are medium or high in natural fertility. The soils on flood plains, such as Choska and Severn soils, are naturally higher in plant nutrients than most soils on uplands.

Many soils on uplands are naturally acid, and if they have never been limed, they require applications of ground limestone to raise the pH sufficiently for good growth of crops that grow best on nearly neutral soils. Available phosphorus and potash are needed in most of these soils. On all soils additions of lime and fertilizer should be based on the results of soil tests, on the need of the crop, and on the expected level of yields. The County Extension Service can help in determining the kinds and amounts of fertilizer and lime to apply.

Soil tilth is an important factor in the germination of seeds and in the infiltration of water into the soil. Soils with good tilth are granular and porous.

Most of the soils used for crops in the survey area have a loamy surface layer. Generally the structure of such soils is weak, and intense rainfall causes the formation of crust on the surface. The crust when dry is hard and nearly impervious to water. Once the crust forms, it reduces infiltration and increases runoff. Regular additions of crop residues, manure, and other organic material can help to improve soil structure and to reduce crust formation.

The Latanier and Osage soils are clayey, and tilth is a concern because the soils often stay wet until late spring. If they are plowed when wet, they tend to be very cloddy when they dry, and good seedbeds are difficult to prepare. Fall plowing generally results in good tilth in the spring.

Field crops suited to the soils and climate of the survey area include many that are not now commonly grown. Grain sorghum and, to an increasing extent, soybeans, are the row crops. Wheat and oats are the common close-growing crops.

Special crops grown commercially in the survey area are sweet corn, green beans, spinach, cabbage, and tomatoes. In addition, large areas can be adapted to other special crops, such as small fruits, tree fruits, onions, lettuce, and other vegetables. Deep soils that have good natural drainage are especially well suited to many vegetables and small fruits. In the survey area Choska, Kamie, Mason, Okay, and Severn soils are the main soils used for vegetables. Latest information and suggestions for growing special crops can be obtained from local offices of the County Extension Service and the Soil Conservation Service.

Minimum tillage means that the least number of field operations necessary for planting crops are carried out. Where soils are to be cropped, they should be worked to prepare a seedbed, to control weeds, and to provide a place for the growth of plant roots. Excessive tillage breaks down tilth and speeds up the decomposition of organic matter. The soils then tend to puddle and crust at the surface, take in less water and air, and store less moisture for plant growth.

Minimum tillage is accomplished by using a long-term cropping system with perennial grasses or deep-rooted legumes, using herbicides instead of cultivation for weed control, and reducing the number of operations in preparing the seedbed, planting, and cultivating.

Crop residue left on the surface during winter and spring or worked partly into the surface is necessary to

protect soils from erosion. Organic matter, or humus, supplied in crop residue improves the tilth of the surface layer. The improved tilth then increases infiltration and storage of water, reduces the hazard of erosion, and helps to prevent crusting.

The main objectives in using soil-improving crops are maintaining or improving the physical condition and the productivity of the soil, and controlling erosion, weeds, insects and diseases. A cropping system that improves the soil includes crops that produce large amounts of residue.

Crop residue and weeds are the largest source of organic material for maintenance of soil fertility and tilth. This residue needs the addition of fertilizer to prevent a shortage of this nutrient for the succeeding crop.

Crops that do not help to control erosion, improve soil structure, or build up the organic matter content are soil-depleting crops. Minimum use of these crops is made in a good cropping system. Clean-tilled crops, if the forage is removed for tillage or cut low for bundle feed or hay, and soybeans cut for hay, are soil-depleting if most of the top growth is removed each year.

Cover crops usually consist of small grain with vetch grown to improve the soil and protect it from erosion and are followed by such crops as grain sorghum or soybeans. Small grain and vetch are suitable cool-season cover crops.

Grassed waterways consist principally of broad, flat-bottomed channels seeded or sodded with perennial plants, commonly bermudagrass or native grasses. Grassed waterways are needed for terrace outlets to provide for safe disposal of excess water. They are also used with diversion terraces and in natural drainageways.

Management of Soils for Tame Pasture Plants

General guidelines for managing soils for tame pasture plants are described in this section. Those desiring more detailed information about management of soils can refer to the section "Soil Maps for Detailed Planning."

Much of the acreage in Tulsa County is in tame pasture plants. The trend is to convert cropland and woodland to pasture. To a lesser degree, range is also being converted to pasture.

The principal grass is improved bermudagrass. Some of the better pastures of bermudagrass are overseeded with legumes, which provide additional nutrients that increase the quality and quantity of forage.

Some bermudagrass pastures are overseeded with fescue grass. This grass mixture is especially adapted to soils on flood plains, where additional moisture is available. It provides grazing in nearly all months and furnishes added protein for livestock during the months when bermudagrss is dormant.

Fescue is an important grass in the county. It provides a sufficient quantity of forage on soils that have large amounts of available moisture. Fescue is used in the pasture program with other forages to furnish grazing and additional protein during late fall and spring. To maintain a vigorous stand, it needs to be fertilized in early spring and early fall, and it should not be grazed during summer.

Some areas of cropland are used for forage plants that supplement the permanent grasses. Small grains in the pasture program provide grazing and additional protein for livestock during late fall and spring. They need to be seeded and fertilized in late summer or early fall to obtain the maximum amount of forage. Small grains can be grazed until maturity or livestock can be removed in spring to allow the plants to grow a seed crop for harvest. Wheat, oats, barley, and rye are the main small grains used for grazing.

Forage sorghum is also used in some cropland areas to supplement the permanent grasses. It can be used in the pasture program to provide grazing during summer, or the forage can be harvested for hay. In some areas forage sorghum is allowed to grow until frost, and it is grazed in winter. If sorghum is grown, fertilizer needs to be added to the soil to achieve maximum growth.

The kind of soil and plant must be considered in good tame pasture management. Good pastures can be achieved by maintaining the desired kind and stand of plants. Plants must have vigor to obtain a proper balance in the stand. Grazing needs to be compatable with the kind of growth of pasture plants.

Proper grazing and rotational grazing will help lengthen the life of most tame pasture plants. Deferred grazing during the time that tame pasture plants are under the most stress is beneficial. This allows the plants to regain vigor by helping to maintain a large root system where food can be stored for the next growing season. Total production of forage will be increased.

Fertilizer that contains the proper elements contributes to more vigorous pasture plants. This helps to increase forage production and lengthen the lifespan of the plants. Nutrients can be added by using commercial fertilizers or legumes that furnish nitrogen to the plants. The acidity of the soil needs to be adjusted to the kinds of plants desired in the stand. Large amounts of fertilizer are needed in areas where legumes are not grown with the grass.

The desired kind of pasture plants can be maintained in the stand only by controlling the invasion of undesirable plants. Weeds need to be controlled. Brush control is essential on soils on which trees grow. A mowing or spraying program properly used will help reduce weeds and brush.

A pasture program needs to be planned so forage will be available during each month of the year. A study of the growth habits of the different plants is necessary to assure adequate forage each month. The months in which various kinds of forage plants grow are indicated in figure 3. The percentage of growth for each kind of plant is illustrated in a graph. For example, bermudagrass reaches 20 percent of its yearly growth for grazing during the month of June.

Soils vary in their capacity to produce forage for grazing. The Severn soil produces more forage than the Bates soil primarily because it furnishes more available moisture to the plant. The total yearly production of various kinds of pasture plants on each soil is given in animal unit months (AUM) in Table 5. For example, bermudagrass on Bates loam, 1 to 3 percent slopes, will furnish grazing for one animal unit for 6 months during the year.

In planning a pasture program, one must consider the total yearly production of the pasture plant in AUM (as given in table 5) and the growth of the plant within a certain month (as shown in figure 3). As illustrated in figure 3, bermudagrass furnished 20 percent of its annual forage during June; it therefore provides grazing for 1.2 animals on the Bates soil in June since its yearly production is 6 AUM (20 percent X 6 AUM = 1.2 AUM). A 50-acre pasture would furnish grazing for 60 animals (50 acres X 1.2 AUM = 60 AUM) during June. Personnel in the Soil Conservation Service or in the County Extension Office can help plan a total pasture program for your farm.

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 6. 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. Absence of an estimated yield indicates that the crop is not suited to or not commonly grown on the soil or that a given crop is not commonly irrigated.

The estimated yields were based mainly on the experience and records of farmers, conservationists, and extension agents. Results of field trials and demonstrations and available yield data from nearby counties were also considered.

The yields were estimated assuming that the latest soil and crop management practices were used. Hay and pasture yields were estimated for the most productive varieties of grasses and legumes climatically suited to the area and the soil. A few farmers may be obtaining average yields higher than those shown in table 6.

The management needed to achieve the indicated yields of the various crops depends on the kind of soil and the crop. Such management provides drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate tillage practices, including time of tillage and seedbed preparation and tilling when soil moisture is favorable; 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 residues, barnyard manure, and green-manure crops; harvesting crops with the smallest possible loss; and timeliness of all fieldwork.

For yields of irrigated crops, it is assumed that the irrigation system is adapted to the soils and to the crops grown; that good quality irrigation water is uniformly applied in proper amounts as needed; and that tillage is kept to a minimum.

The estimated yields reflect the productive capacity of the soils 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 6 are grown in the survey area, but estimated yields are not included because the acreage of these crops is small. The local offices of the Soil Conservation Service and the Cooperative Extension Service can provide information about the management concerns and productivity of the soils for these crops.

Capability Classes, Subclasses, and Capability Units

Capability classes and subclasses show, in a general way, the suitability of soils for most kinds of field crops. The soils are classed according to their limitations when they are used for field crops, the risk of damage when they are used, and the way they respond to treatment. The grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils; does not take into consideration possible but unlikely major reclamation projects; and does not apply to rice, cranberries, horticultural crops, or other crops that require special management. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for rangeland, for forest trees, or for engineering purposes.

In the capability system, all kinds of soil are grouped at three levels: capability class, subclass, and unit. These levels are defined in the following paragraphs. A survey area may not have soils of all classes.

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; they are defined as follows:

Class I soils have few limitations that restrict their use.

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

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

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

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use.

Class VI soils have severe limitations that make them generally unsuitable for cultivation.

Class VII soils have very severe limitations that make them unsuitable for cultivation.

Class VIII soils and landforms have limitations that nearly preclude their use for commercial crop production.

CAPABILITY SUBCLASSES are soil groups within one class; they are designated by adding a small letter, *e*, *w*, *s*, or *c*, to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is too cold or too dry. There is no subclass c in Tulsa County.

In class I there are no subclasses because the soils of this class have few limitations. Class V contains only the subclasses indicated by *w*, *s*, or *c* because the soils in class V are subject to little or no erosion, though they have other limitations that restrict their use to pasture, rangeland, woodland, wildlife habitat, or recreation.

The capability unit is identified in the description of each soil mapping unit in the section "Soil Maps for Detailed Planning." Capability units are soil groups within the subclasses. The soils in one capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity. Thus, the capability unit is a convenient grouping for making many statements about management of soils. Capability units are generally designated by adding an Arabic numeral to the subclass symbol, for example, IIe-2 or IIIe-2.

Following are descriptions of the capability units in Tulsa County.

Unit I-1.—Deep, nearly level, well drained and moderately well drained very fine sandy loams and silt loams on flood plains.

Unit I-2.—Deep, nearly level, well drained and moderately well drained, loams and silt loams on uplands.

Unit IIe-1.—Deep and moderately deep, very gently sloping, well drained and moderately well drained loams, silt loams, and silty clay loams on uplands.

Unit IIe-2.—Deep, very gently sloping, well drained, fine sandy loams on uplands.

Unit IIw-1.—Deep, nearly level, well drained and somewhat poorly drained fine sandy loams, silt loams, and silty clay loams on flood plains.

Unit IIs-1.—Deep, nearly level, moderately well drained through poorly drained silt loams on uplands.

Unit IIIe-1.—Deep, gently sloping, well drained and moderately well drained loams, silt loams, and silty clay loams on uplands.

Unit IIIe-2.—Deep, very gently sloping through gently sloping, well drained and moderately well drained loams and silt loams on uplands.

Unit IIIe-3.—Deep, nearly level through very gently sloping, well drained and somewhat excessive drained loamy fine sands on uplands.

Unit IIIw-1.—Deep, nearly level, somewhat poorly drained and poorly drained clays and silty clays on flood plains.

Unit IIIs-1.—Deep, very gently sloping, moderately well drained and poorly drained silt loams on uplands.

Unit IVe-1.—Shallow through deep, gently sloping, moderately well drained through somewhat excessively drained loams and silty clay loams on uplands.

Unit IVe-2.—Deep, gently sloping through sloping, well drained loamy fine sands on uplands.

Unit Vw-1.—Deep, nearly level, well drained loamy fine sands on flood plains.

Unit Vw-2.—Deep, nearly level, moderately well drained silt loams on flood plains.

Unit Vw-3.—Deep, nearly level, somewhat poorly drained fine sandy loams on flood plains.

Unit VIe-1.—Deep, nearly level through strongly sloping, moderately well drained silt loams on uplands and flood plains.

Unit VIe-2.—Shallow through deep, very gently sloping through moderately steep, somewhat excessively drained through moderately well drained loams and silty clay loams on uplands.

Unit VIe-3.—Shallow and moderately deep, very gently sloping through moderately steep, well drained through somewhat poorly drained loams and gravelly and cobbly fine sandy loams on uplands.

Unit VIe-4.—Deep, gently sloping through moderately steep, somewhat excessively drained loamy fine sands on uplands.

Unit VIIs-1.—Moderately deep, very gently sloping through sloping, well drained silt loams and rock outcrop on uplands.

Unit VIIs-2.—Shallow through deep, sloping through steep, well drained through somewhat poorly drained fine sandy loams, loams, stony loams, and gravelly and cobbly fine sandy loams on uplands.

Unit VIIs-3—Deep, gently sloping through very steep, well drained silty clay loams on uplands.

Unit VIIs-4.—Shallow and moderately deep, steep, somewhat excessively drained through somewhat poorly drained gravelly and cobbly fine sandy loams on uplands.

Unit VIIs-5.—Shallow, very gently sloping through strongly sloping, well drained silty clay loams and rock outcrop on uplands.

Unit VIIIs-1.—Areas that have limitations that preclude their use for commercial plants and restrict their use to recreation or wildlife purposes.

Range

ERNEST C. SNOOK, range conservationist, Soil Conservation Service, helped prepare this section.

This section contains information about use of the soils for range. Range is land on which the natural plant community is composed principally of grasses, grasslike plants, forbs, and shrubs valuable for grazing and is in sufficient quantity to justify grazing use.

About 11 percent of the soils in Tulsa County are in native range on which domestic animals graze. The range is usually grazed throughout the year, but the forage is supplemented by protein and hay or tame pasture.

During the dormant season of the grasses, protein and hay are used to supplement the livestock operation.

Table 7 shows, for each kind of soil, the name of the range site; the total annual production of vegetation in favorable, normal, and unfavorable years; the characteristic vegetation; and the expected percentage of each species in the composition of the potential natural plant community. Soils not listed cannot support a natural plant community of predominately grasses, grasslike plants, forbs, or shrubs suitable for grazing or browsing. The following are explanations of column headings in Table 7.

A *range site* is a distinctive kind of rangeland that differs from other kinds of rangeland in its ability to produce a characteristic natural plant community. Soils that produce a similar kind, amount, and proportion of range plants are grouped into range sites (fig. 4). For those areas where the relationship between soils and vegetation has been established, range sites can be interpreted directly from the soil map. Properties that determine the capacity of the soil to supply moisture 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.

Potential production refers to the amount of vegetation that can be expected to grow annually on well-managed rangeland that is supporting the potential natural plant community. It is expressed in pounds per acre of air-dry vegetation for favorable, normal, and unfavorable years. In a favorable year the amount and distribution of precipitation and the temperatures are such that growing conditions are substantially better than average; in a normal year these conditions are about average for the area; in an unfavorable year, growing conditions are well below average, generally because of low available soil moisture.

Dry weight refers to the total air-dry vegetation produced per acre each year by the potential natural plant community. Vegetation that is highly palatable to livestock and vegetation that is unpalatable are included. Some of the vegetation can also be grazed extensively by wildlife.

Common plant names of grasses, grasslike plants, forbs, and shrubs that make up most of the potential natural plant community on each soil are listed by common name. Under *Composition*, the expected proportion of each species is presented as the percentage, in air-dry weight, of the total annual production of herbaceous and woody plants. Because only major species are listed, percentages do not necessarily total 100. The amount that can be used as forage depends on the kinds of grazing animals and on the grazing season. Generally all of the vegetation produced is not used.

Range management requires, in addition to knowledge of the kinds of soil and the potential natural plant community, an evaluation of the present condition of the range vegetation in relation to its potential. Range condition is determined by comparing the present plant community with the potential natural plant community on a particular range site. The more closely the existing community resembles the potential community, the better the range condition. The objective in range management is to control grazing so that the plants growing on a site are about the same in kind and amount as the potential natural plant community for that site. Such management generally results in the maximum production of vegetation, conservation of water, and control of erosion. Sometimes, however, a range condition somewhat below the potential meets grazing needs, provides wildlife habitat and protects soil and water resources.

The major management concern on most rangeland is control of grazing so that the kinds and amounts of plants that make up the potential natural plant community are reestablished. Forage production is approximately half of that originally produced because the natural vegetation in many parts of the survey area has been greatly depleted by continued excessive use. Much of the acreage that was once open grassland is now covered with brush, weeds, and cactus. Soil blowing occurs on sandy soils that are not adequately covered.

Manipulating or reducing undesirable brush species and minimizing soil blowing are important management concerns. Sound range management based on soil survey information and other rangeland inventory information is the basis for maintaining or improving forage production.

Woodland Management and Productivity

Originally about 37 percent of Tulsa County was wooded. Now trees cover about 12 percent of the county. The value of the wood products is substantial, though it is below its potential. Other valued uses of woodland areas are for grazing, wildlife, recreation, natural beauty and conservation of soil and water. This section explains how soils affect tree growth and management in the county. In table 8 potential productivity and management concerns of the soils are listed.

Table 8 contains information useful to woodland owners or forest managers planning use of soils for wood crops. Mapping unit symbols for soils suitable for wood crops are listed, and the ordination (woodland suitability) symbol for each soil is given. All soils bearing the same ordination symbol require the same general kinds of woodland management and have about the same potential productivity.

The first part of the *ordination symbol*, a number, indicates the potential productivity of the soils for important trees. The number 1 indicates very high productivity; 2, high; 3, moderately high; 4, moderate; and 5, low. The second part of the symbol, a letter, indicates the major kind of soil limitation. The letter *x* indicates stoniness or rockiness; *w*, excessive water in or on the soil; *t*, toxic substances in the soil; *d*, restricted root depth; *c*, clay in the upper part of the soil; *s*, sandy texture; *f*, high content of coarse fragments in the soil profile; and *r*, steep slopes. The letter *o* indicates insignificant limitations or restrictions. If a soil has more than one limitation, priority in placing the soil into a limitation class is in the following order: x, w, t, d, c, s, f, and r.

In table 8 the soils are also rated for a number of factors to be considered in management. *Slight, moderate,* and *severe* are used to indicate the degree of major soil limitations.

Ratings of the *erosion hazard* indicate the risk of loss of soil in well-managed woodland. The risk is *slight* if the expected soil loss is small, *moderate* if some measures are needed to control erosion during logging and road construction, and *severe* if intensive management or special equipment and methods are needed to prevent excessive loss of soil.

Ratings of *equipment limitation* reflect the characteristics and conditions of the soil that restrict use of the equipment generally needed in woodland management or harvesting. A rating of *slight* indicates that use of equipment is not limited to a particular kind of equipment or time of year; *moderate* indicates a short seasonal limitation or a need for some modification in management or equipment; *severe* indicates a seasonal limitation, a need for special equipment or management, or a hazard in the use of equipment.

Seedling mortality ratings indicate the degree that the soil affects expected mortality of planted tree seedlings when plant competition is not a limiting factor. Seedlings from good planting stock that are properly planted during a period of sufficient rainfall are rated. A rating of *slight* indicates that the expected mortality of the planted seedlings is less than 25 percent; *moderate*, 25 to 50 percent; and *severe*, more than 50 percent.

Ratings of *plant competition* indicate the degree to which undesirable plants are expected to invade or grow if openings are made in the tree canopy. The invading plants compete with native plants or planted seedlings by impeding or preventing their growth. A rating of *slight* indicates little or no competition from other plants; *moderate* indicates that plant competition is expected to hinder the development of a fully stocked stand of desirable trees; *severe* means that plant competition is expected to prevent the establishment of a desirable stand unless the site is intensively prepared, weeded, or otherwise managed for the control of undesirable plants.

The *potential productivity* of merchantable or *important trees* on a soil is expressed as a *site index*. This index is the average height, in feet, that dominant and codominant trees of a given species attain in a specified number of years. The site index applies to fully stocked, even-aged, unmanaged stands. Important trees are those that woodland managers generally favor in intermediate or improvement cuttings. They are selected on the basis of growth rate, quality, value, and marketability.

Trees to plant are those that are suitable for commercial wood or nut production and that are suited to the soils.

Woodland Understory Vegetation

Understory vegetation consists of grasses, forbs, shrubs, and other plants. Some types of forest, under proper management, can produce enough understory vegetation to support grazing of livestock or wildlife, or both.

The quantity and quality of understory vegetation vary with the kind of soil, the age and kind of trees, the density of the canopy, and the depth and condition of the forest litter. The density of the forest canopy affects the amount of light that understory plants receive during the growing season.

Table 9 shows, for each soil suitable for woodland, the potential for producing understory vegetation. The table also lists the common names of the characteristic vegetation that grows on a specified soil and the percentage composition, by air-dry weight, of each kind of plant. The kind and percentage of understory plants listed in the table are those to be expected where canopy density is most nearly typical of forests that yield the highest production of wood crops.

The total production of understory vegetation is expressed in pounds per acre of air-dry vegetation for favorable, normal, and unfavorable years. In a favorable year the soil moisture is above average during the optimum part of the growing season; in a normal year soil moisture is average; and in an unfavorable year it is below average.

Engineering

This section provides information about the use of soils for building sites, sanitary facilities, construction material, and water management. Among those who can benefit from this section are engineers, landowners, community planners, town and city managers, land developers, builders, contractors, and farmers and ranchers.

The ratings in the engineering tables are based on test data and estimated data in the "Soil Properties" section. The ratings were determined jointly by soil scientists and engineers of the Soil Conservation Service using known relationships between the soil properties and the behavior of soils in various engineering uses.

Among the soil properties and site conditions identified by a soil survey and used in determining the ratings in this section were grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock that is within 5 or 6 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure or aggregation, in-place soil density, and geologic origin of the soil material. Where pertinent, data about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kind of absorbed cations were also considered.

On the basis of information assembled about soil properties, ranges of values can be estimated for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, shear strength, compressibility, slope stability, and other factors of expected soil behavior in engineering uses. As appropriate, these values can be applied to each major horizon of each soil or to the entire profile.

These factors of soil behavior affect construction and maintenance of roads, airport runways, pipelines, foundations for small buildings, ponds and small dams, irrigation projects, drainage systems, sewage and refuse disposal systems, and other engineering works. The ranges of values can be used to: (1) select potential residential, commercial, industrial, and recreational uses; (2) make preliminary estimates pertinent to construction in a particular area; (3) evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; (4) evaluate alternative sites for location of sanitary landfills, onsite sewage disposal systems, and other waste disposal facilities; (5) plan detailed onsite investigations of soils and geology; (6) find sources of gravel, sand, clay, and topsoil; (7) plan farm drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; (8) relate performance of structures already built to the properties of the kinds of soil on which they are built so that performance of similar structures on the same or a similar soil in other locations can be predicted; and (9) predict the trafficability of soils for cross-country movement of vehicles and construction equipment.

Data presented in this section are useful for land-use planning and for choosing alternative practices or general designs that will overcome unfavorable soil properties and minimize soil-related failures. Limitations to the use of these data, however, should be well understood. First, the data are generally not presented for soil material below a depth of 5 or 6 feet. Also, because of the scale of the detailed map in this soil survey, small areas of soils that differ from the dominant soil may be included in mapping. Thus, these data do not eliminate the need for onsite investigations, testing, and analysis by personnel having expertise in the specific use contemplated.

The information is presented mainly in tables. Table 10 shows, for each kind of soil, the degree and kind of limitations for building site development; table 11, for sanitary facilities; and table 13, for water management. Table 12 shows the suitability of each kind of soil as a source of construction materials.

The information in the tables, along with the soil map, the soil descriptions, and other data provided in this survey can be used to make additional interpretations and to construct interpretive maps for specific uses of land.

Some of the terms used in this soil survey have a special meaning in soil science. Many of these terms are defined in the Glossary.

Building Site Development

The degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, and local roads and streets are indicated in table 10. A *slight* limitation indicates that soil properties are favorable for the specified use; any limitation is minor and easily overcome. A *moderate* limitation indicates that soil properties and site features are unfavorable for the specified use, but the limitations can be overcome or minimized by special planning and design. A *severe* limitation indicates one or more soil properties or site features are so unfavorable or difficult to overcome that a major increase in construction effort, special design, or intensive maintenance is required. For some soils rated severe, such costly measures may not be feasible.

Shallow excavations are used for pipelines, sewerlines, telephone and power transmission lines, basements, open ditches, and cemeteries. Such digging or trenching is influenced by the soil wetness of a high seasonal water table, the texture and consistence of soils; the tendency of soils to cave in or slough; and the presence of very firm, dense soil layers, bedrock, or large stones. In addition, excavations are affected by slope of the soil and the probability of flooding. Ratings do not apply to soil horizons below a depth of 6 feet unless otherwise noted.

In the soil series descriptions, the consistence of each soil horizon is defined, and the presence of very firm or extremely firm horizons, usually difficult to excavate, is indicated.

Dwellings and *small commercial buildings* referred to in table 10 are built on undisturbed soil and have foundation loads of a dwelling no more than three stories high. Separate ratings are made for small commercial buildings without basements and for dwellings with and without basements. For such structures, soils should be sufficiently stable that cracking or subsidence from settling or shear failure of the foundation does not occur. These ratings were determined from estimates of the shear strength, compressibility, and shrink-swell potential of the soil. Soil texture, plasticity and in-place density, potential frost action, soil wetness, and depth to a seasonal high water table were also considered. Soil wetness and depth to a seasonal high water table indicate potential difficulty in providing adequate drainage for basements, lawns, and gardens. Depth to bedrock, slope, and large stones in or on the soil are also important considerations in the choice of sites for these structures and were considered in determining the ratings (fig. 5). Susceptibility to flooding is a serious limitation.

Local roads and streets referred to in table 10 have an all-weather surface that can carry light to medium traffic all year. They consist of subgrade of the underlying soil material; a base of gravel, crushed rock fragments, or soil material stabilized with lime or cement; and a flexible or rigid surface, commonly asphalt or concrete. The roads are graded with soil material at hand, and most cuts and fills are less than 6 feet deep.

The load supporting capacity and the stability of the soil as well as the quantity and workability of fill material available are important in design and construction of roads and streets. The classifications of the soil and the soil texture, density, shrink-swell potential, and potential frost action are indicators of the traffic supporting capacity used in making the ratings. Soil wetness, flooding,

slope, depth to hard rock or very compact layers, and content of large stones affect stability and ease of excavation.

The best soils for *lawns and landscaping* are those that remain firm after rain and are not dusty when dry. They absorb water readily and hold sufficient moisture for plant growth. The surface layer should be free of stones, and if shaping is required, the soil should be sufficiently deep to bedrock or hardpan to allow for the necessary grading.

Sanitary Facilities

Favorable soil properties and site features are needed for proper functioning of septic tank absorption fields, sewage lagoons, and sanitary landfills. The nature of the soil is important in selecting sites for these facilities and in identifying limiting soil properties and site features to be considered in design and installation. Also, those soil properties that affect ease of excavation or installation of these facilities will be of interest to contractors and local officials. Table 11 shows the degree and kind of limitations of each soil for such uses and for use of the soil as daily cover for landfills. It is important to observe local ordinances and regulations.

If the degree of soil limitation is expressed as *slight*, soils are generally favorable for the specified use and limitations are minor and easily overcome; if *moderate*, soil properties or site features are unfavorable for the specified use, but limitations can be overcome by special planning and design; and if *severe*, soil properties or site features are so unfavorable or difficult to overcome that major soil reclamation, special designs, or intensive maintenance is required.

Septic tank absorption fields are subsurface systems of tile or perforated pipe that distribute effluent from a septic tank into the natural soil. Only the soil horizons between depths of 18 and 72 inches are evaluated for this use. The soil properties and site features considered are those that affect the absorption of the effluent and those that affect the construction of the system.

Properties and features that affect absorption of the effluent are permeability, depth to seasonal high water table, depth to bedrock, and susceptibility to flooding. Stones, boulders, and shallowness to bedrock interfere with installation. Excessive slope may cause lateral seepage and surfacing of the effluent. Also, soil erosion and soil slippage are hazards if absorption fields are installed on sloping soils.

In some soils, loose sand and gravel or fractured bedrock is less than 4 feet below the tile lines. In these soils the absorption field does not adequately filter the effluent, and ground water in the area may be contaminated.

On many of the soils that have moderate or severe limitations for use as septic tank absorption fields, a system to lower the seasonal water table could be installed or the size of the absorption field could be increased so that performance is satisfactory.

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons have a nearly level floor and cut slopes or embankments of compacted soil material. Aerobic lagoons generally are designed to hold 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. Soils that are very high in organic matter and those that have cobbles, stones, or boulders are not suitable. Unless the soil has very slow permeability, contamination of ground water is a hazard where the seasonal high water table is above the level of the lagoon floor. In soils where the water table is seasonally high, seepage of ground water into the lagoon can seriously reduce the lagoon's capacity for liquid waste. Slope, depth to bedrock, and susceptibility to flooding also affect the suitability of sites for sewage lagoons or the cost of construction. Shear strength and permeability of compacted soils affect the performance of embankments.

Sanitary landfill is a method of disposing of solid waste by placing refuse in successive layers either in excavated trenches or on the surface of the soil. The waste is spread, compacted, and covered daily with thin layers of soil. Landfill areas are subject to heavy vehicular traffic. Risk of polluting ground water and trafficability affect the suitability of a soil for this use. The best soils have a loamy or silty texture, have moderate to slow permeability, are deep to a seasonal water table, and are not subject to flooding. Clayey soils are likely to be sticky and difficult to spread. Sandy or gravelly soils generally have rapid permeability, which might allow noxious liquids to contaminate ground water. Soil wetness may be a limitation because operating heavy equipment on a wet soil is difficult. Seepage into the refuse increases the risk of pollution of ground water.

In the trench type of landfill, ease of excavation also affects the suitability of a soil for this purpose, so the soil must be deep to bedrock and free of large stones and boulders. Where the seasonal water table is high, water seeps into trenches and causes problems in filling.

Unless otherwise stated, the limitations in table 11 apply only to the soil material within a depth of about 6 feet. If the trench is deeper, a limitation of slight or moderate may not be valid. Site investigation is needed before a site is selected.

Daily cover for landfill should be soil that is easy to excavate and spread over the compacted fill in wet and dry weather. Soils that are loamy or silty and free of stones or boulders are better than other soils. Clayey soils may be sticky and difficult to spread; sandy soils may be subject to soil blowing.

The soils selected for final cover of landfills should be suitable for growing plants. Of all the horizons, the A horizon in most soils has the best workability, more organic matter, and the best potential for growing plants. Thus, for either the area- or trench-type landfill, stockpiling material from the A horizon for use as the surface layer of the final cover is desirable.

Where it is necessary to bring in soil material for daily or final cover, thickness of suitable soil material available and depth to a seasonal high water table in soils surrounding the sites should be evaluated. Other factors to be evaluated are those that affect reclamation of the borrow areas. These factors include slope, erodibility, and potential for plant growth.

Construction Materials

The suitability of each soil as a source of roadfill, sand, gravel, and topsoil is indicated in table 12 by ratings of good, fair, or poor. The texture, thickness, and organic-matter content of each soil horizon are important factors in rating soils for use as construction materials. Each soil is evaluated to the depth observed, generally about 6 feet.

Roadfill is soil material used in embankments for roads. Soils are evaluated as a source of roadfill for low embankments, which generally are less than 6 feet high and less exacting in design than high embankments. The ratings reflect the ease of excavating and working the material and the expected performance of the material where it has been compacted and adequately drained. The performance of soil after it is stabilized with lime or cement is not considered in the ratings, but information about some of the soil properties that influence such performance is given in the descriptions of the soil series.

The ratings apply to the soil material between the A horizon and a depth of 5 to 6 feet. It is assumed that soil horizons will be mixed during excavation and spreading. Many soils have horizons of contrasting suitability within their profile. The estimated engineering properties in table 17 provide specific information about the nature of each horizon. This information can help determine the suitability of each horizon for roadfill.

Soils rated *good* are coarse grained. They have low shrink-swell potential, low potential frost action, and few cobbles and stones. They are at least moderately well drained and have slopes of 15 percent or less. Soils rated *fair* have a plasticity index of less than 15 and have other limiting features, such as moderate shrink-swell potential, moderately steep slopes, wetness, or many stones. If the thickness of suitable material is less than 3 feet, the entire soil is rated *poor*.

Sand and *gravel* are used in great quantities in many kinds of construction. The ratings in table 12 provide guidance as to where to look for probable sources and are based on the probability that soils in a given area contain sizable quantities of sand or gravel. A soil rated *good* or *fair* has a layer of suitable material at least 3 feet thick, the top of which is within a depth of 6 feet. Coarse fragments of soft bedrock material, such as shale and siltstone, are not considered to be sand and gravel. Fine-grained soils are not suitable sources of sand and gravel.

The ratings do not take into account depth to the water table or other factors that affect excavation of the material. Descriptions of grain size, kinds of minerals, and stratification are given in the soil series descriptions and in table 17.

Topsoil is used in areas where vegetation is to be established and maintained. Suitability is affected mainly by the ease of working and spreading the soil material in preparing a seedbed and by the ability of the soil material to support plantlife. Also considered is the damage that can result at the area from which the topsoil is taken.

The ease of excavation is influenced by the thickness of suitable material, wetness, slopes, and amount of stones. The ability of the soil to support plantlife is determined by texture, structure, and the amount of soluble salts or toxic substances. Organic matter in the A1 or Ap horizon greatly increases the absorption and retention of moisture and nutrients. Therefore, the soil material from these horizons should be carefully preserved for later use.

Soils rated *good* have at least 16 inches of friable loamy material at their surface. They are free of stones and cobbles, are low in content of gravel, and have gentle slopes. They are low in soluble salts that can limit or prevent plant growth. They are naturally fertile or respond well to fertilizer. They are not so wet that excavation is difficult during most of the year.

Soils rated *fair* are loose sandy soils or firm loamy or clayey soils in which the suitable material is only 8 to 16 inches thick or soils that have appreciable amounts of gravel, stones, or soluble salt.

Soils rated *poor* are very sandy soils and very firm clayey soils; soils with suitable layers less than 8 inches thick; soils having large amounts of gravel, stones, or soluble salt; steep soils; and poorly drained soils.

Although a rating of *good* is not based entirely on high content of organic matter, a surface horizon is generally preferred for topsoil because of its organic-matter content. This horizon is designated as A1 or Ap in the soil series descriptions. The absorption and retention of moisture and nutrients for plant growth are greatly increased by organic matter.

Water Management

Many soil properties and site features that affect water management practices have been identified in this soil survey. In table 13 the degree of soil limitation and soil and site features that affect use are indicated for each kind of soil. This information is significant in planning, installing, and maintaining water control structures.

Soil and site limitations are expressed as slight, moderate, and severe. *Slight* means that the soil properties and site features are generally favorable for the specified use and that any limitation is minor and easily overcome. *Moderate* means that some soil properties or site features are unfavorable for the specified use but can be overcome or modified by special planning and design. *Severe* means that the soil properties and site features are so unfavorable and so difficult to correct or overcome that major soil reclamation, special design, or intensive maintenance is required.

Pond reservoir areas hold water behind a dam or embankment (fig. 6). Soils best suited to this use have a low

seepage potential, which is determined by permeability and the depth to fractured or permeable bedrock or other permeable material.

Embankments, dikes, and levees require soil material that is resistant to seepage, erosion, and piping and has favorable stability, shrink-swell potential, shear strength, and compaction characteristics (fig. 7). Large stones and organic matter in a soil downgrade the suitability of a soil for use in embankments, dikes, and levees.

Aquifer-fed excavated ponds are bodies of water made by excavating a pit or dugout into a ground-water aquifer. Excluded are ponds that are fed by surface runoff and embankment ponds that impound water 3 feet or more above the original surface. Ratings in table 13 are for ponds that are properly designed, located, and constructed. Soil properties and site features that affect aquifer-fed ponds are depth to a permanent water table, permeability of the aquifer, quality of the water, and ease of excavation.

Drainage of soil is affected by such soil properties as permeability, texture, depth to bedrock, hardpan, or other layers that affect the rate of water movement, depth to the water table, slope, stability of ditchbanks, susceptibility to flooding, salinity and alkalinity, and availability of outlets for drainage.

Terraces and diversions are embankments or a combination of channels and ridges constructed across a slope to intercept runoff. They allow water to soak into the soil or flow slowly to an outlet. Features that affect suitability of a soil for terraces are uniformity and steepness of slope; depth to bedrock, hardpan, or other unfavorable material; large stones; permeability; ease of establishing vegetation; and resistance to water erosion, soil blowing, soil slipping, and piping.

Grassed waterways are constructed to channel runoff to outlets at a nonerosive velocity (fig. 8). Features that affect the use of soils for waterways are slope, permeability, erodibility, wetness, and suitability for permanent vegetation.

Irrigation

Irrigation is expensive, but it can be profitable if an efficient system is installed to supplement local rainfall. The feasibility of irrigation is determined mainly by the nature of the soil and the quality and quantity of water available.

To be suitable for irrigation, a soil must be productive, capable of storing enough water to meet the needs of plants, not too sloping, permeable enough to prevent accumulation of salts, and deep enough to allow necessary leveling and to provide an adequate root zone. Soils in capability classes I and II are best suited to irrigation. Irrigation is more successful on nearly level or gently sloping soils than on more strongly sloping soils.

The main sources of water for irrigation are from reservoirs, underground water in alluvial material along major streams, and underground water in upland areas where the quantity is sufficient. The best source for water is in alluvial material.

Wells are needed to tap a source of underground water. The depth to the underground water level ranges from only a few feet near the streams to about 200 feet in upland areas. The quality of the underground water generally is good. The quantity that can be obtained from a single well ranges from 50 to 600 gallons per minute. Each well should be subjected to a 24- to 48-hour pumping test, which will determine the drawdown, the pumping life, and the capacity of the well. Information on drawdown, lift, and well capacity is essential for the selection of an efficient pumping plant and for the design of a suitable irrigation system.

Before investing in an irrigation system, a water right must be obtained before water can be drawn for irrigation. An application for a water right must be filed with the Oklahoma Water and Resource Board.

A surface system is best for some soils in the county, and a sprinkler system is best for others. The selection of a system depends on the lay of the land, the cost of leveling, the kinds of crops to be grown, and other factors. The main types of surface irrigation used in the county are border and furrow.

A border system is best suited to loamy soils that have slopes of less than 3 percent. For efficient use of water, a border system requires land leveling, a fairly large stream of water, corrugations on clayey soils, short runs on fine sandy loams, and close-growing crops on slopes of more than 1 percent.

A furrow system is suitable for all soils that have slopes of less than 5 percent. Small amounts of water can be distributed evenly by this system, and row crops can be irrigated easily. The limitations of a furrow system are the need for short runs on fine sandy loams, the complicated layouts on rolling land, the maintenance requirements, and the difficulty of harvesting crops.

A sprinkler system is best for nearly level to sloping, loamy soils. The advantages of such a system are that land leveling, ditches, or surface drainage systems are not required and that the equipment can be moved from field to field. The disadvantages are the high cost of installation and maintenance, the difficulty of moving a portable system in cultivated fields, the risk of increased fungus growth, and the failure of some crops to bear fruit if the blossoms are sprinkled. Sprinker irrigation is not suitable for clayey soils, which take in water slowly.

All crops commonly grown in the county can be grown under irrigation, but irrigated soils need intensive management for control of erosion and maintenance of productivity. If markets are available, irrigation of field crops, nurseries, orchards, truck crops, and grasses can be successful. The estimated yields for some of the main vegetable crops grown in the county are given in Table 14.

Recreation

The soils of the survey area are rated in table 15 according to limitations that affect their suitability for recreation uses. The ratings are based on such restrictive soil features as flooding, wetness, slope, and texture of the surface layer. Not considered in these ratings, but important in evaluating a site, are location and accessibility of the area, size and shape of the area and its scenic quality, the ability of the soil to support vegetation, access to water, potential water impoundment sites available, and either access to public sewerlines or capacity of the soil to absorb septic tank effluent. Soils subject to flooding are limited, in varying degree, for recreation use by the duration and intensity of flooding and the season when flooding occurs. Onsite assessment of height, duration, intensity, and frequency of flooding is essential in planning recreation facilities.

The degree of the limitation of the soils is expressed as slight, moderate, or severe. *Slight* means that the soil properties are generally favorable and that the limitations are minor and easily overcome. *Moderate* means that the 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 15 can be supplemented by information in other parts of this survey. Especially helpful are interpretations for septic tank absorption fields, given in table 11, and interpretations for dwellings without basements and for local roads and streets, given in table 10.

Camp areas require such site preparation as shaping and leveling for 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 for this use have mild slopes and are not wet or subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing camping sites.

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for use as picnic areas are firm when wet, are not dusty when dry, are not subject to flooding during the period of use, and do not have slopes or stones or boulders that will 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 or boulders, is firm after rains, and is not dusty when dry. If shaping is required to obtain a uniform grade, the depth of the soil over bedrock or hardpan should be enough to allow necessary grading.

Paths and trails for walking, horseback riding, bicycling, and other uses should require little or no cutting and filling. The best soils for this use are those that are not wet, are firm after rains, are not dusty when dry, and are not subject to flooding more than once during the annual period of use. They should have moderate slopes and have few or no stones or boulders on the surface.

Wildlife Habitat

JEROME F. SYKORA, biologist, SCS, helped prepare this section.

Soils directly affect the kind and amount of vegetation that is available to wildlife as food and cover, and they affect the construction of water impoundments. The kind and abundance of wildlife that populate an area depend largely on the amount and distribution of food, cover, and water. If any one of these elements is missing, inadequate, or inaccessible, wildlife either are scarce or do not inhabit the area.

If the soils have the potential, wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by helping the natural establishment of desirable plants.

In table 16, the soils in the survey area are rated according to their potential to support the main kinds of wildlife habitat in the area. This information can be used in planning for parks, wildlife refuges, nature study areas, and other developments for wildlife; selecting areas that are suitable for wildlife; selecting soils that are suitable for creating, improving, or maintaining specific elements of wildlife habitat; and 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* means that the element of wildlife habitat or the kind of habitat is easily created, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected if the soil is used for the designated purpose. A rating of *fair* means that the element of wildlife habitat or kind of habitat can be created, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of *poor* means that limitations are severe for the designated element or kind of wildlife habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and must be intensive. A rating of *very poor* means that restrictions for the element of wildlife habitat or kind of wildlife are very severe, and that unsatisfactory results can be expected. Wildlife habitat is impractical or even impossible to create, improve, or maintain on soils having such a rating.

The elements of wildlife habitat are briefly described in the following paragraphs.

Grain and seed crops are seed-producing annuals used by wildlife. Examples are corn, wheat, oats, and barley. The major soil properties 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.

Grasses and legumes are domestic perennial grasses and herbaceous legumes that are planted for wildlife food and cover. Examples are fescue, bluegrass, lovegrass, switchgrass, bromegrass, clover, alfalfa, serecia and crownvetch. Major soil properties 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.

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds, that provide food and cover for wildlife. Examples are bluestem, indiangrass, euphorbia, goldenrod, beggarweed, pokeweed, Maximilian sunflower, partridgepea, annual sunflowers and grama. Major soil properties 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.

Hardwood trees and the associated woody understory provide cover for wildlife and produce nuts or other fruit, buds, catkins, twigs, bark, or foliage that wildlife eat. Examples of native plants are oak, poplar, cherry, sweetgum, apple, hawthorn, dogwood, persimmon, sumac, hickory, black walnut, blackberry, grape, blackhaw, osageorange, and bur oak. Examples of fruit-producing shrubs that are commercially available and suitable for planting on soils rated good are Russian-olive, mulberry autumn-olive, and crabapple. Major soil properties that affect growth of hardwood trees and shrubs are depth of the root zone, available water capacity, and wetness.

Coniferous plants are cone-bearing trees, shrubs, or ground cover plants that furnish habitat or supply food in the form of browse, seeds, or fruitlike cones. Examples are pine, and eastern redcedar. Soil properties that have a major effect on the growth of coniferous plants are depth of the root zone, available water capacity, and wetness.

Shrubs are bushy woody plants that produce fruit, buds, twigs, bark, or foliage used by wildlife or that provide cover and shade for some species of wildlife. Examples are sumac, coralberry, skunkbrush, and green brier. Major soil properties that affect the growth of shrubs are depth of the root zone, available water capacity, salinity, and moisture.

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites, exclusive of submerged or floating aquatics. They produce food or cover for wildlife that use wetland as habitat. Examples of wetland plants are smartweed, wild millet, rushes, sedges, reeds, saltgrass, and cattail. Major soil properties affecting wetland plants are texture of the surface layer, wetness, reaction, slope, and surface stoniness.

Shallow water areas are bodies of water that have an average depth of less than 5 feet and that are useful to wildlife. They can be naturally wet areas, or they can be created by dams or levees or by water-control devices in marshes or streams. Examples are waterfowl feeding areas, wildlife watering developments, and other wildlife ponds. Major soil properties affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability. The availability of a dependable water supply is important if water areas are to be developed.

The potential for wildlife habitat is briefly described in the following paragraphs.

Openland wildlife consists of cropland, pasture, meadows, and areas that are a combination of grasses, herbs, shrubs, and vines. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. The kinds of wildlife attracted to these areas include bobwhite quail, pheasant, meadowlark, field sparrow, killdeer, cottontail rabbit, red fox, and woodchuck.

Woodland wildlife consists of areas of hardwoods or conifers, or a mixture of both, and associated grasses, legumes, and wild herbaceous plants. Wildlife attracted to these areas include wild turkey, woodcock, thrushes, vireos, woodpeckers, tree squirrels, grey fox, raccoon, deer, elk, and black bear.

Wetland wildlife consists of open, marshy or swampy, shallow-water areas where water-tolerant plants grow. Some of the wildlife attracted to such areas are ducks, geese, herons, shore birds, rails, kingfishers, muskrat, mink, and beaver.

Rangeland wildlife consists of areas of wild herbaceous plants and shrubs. Wildlife attracted to rangeland include white-tailed deer, quail, meadowlark, and lark bunting.

Soil Properties

Extensive data about soil properties are summarized on the following pages. The two main sources of these data are the many thousands of soil borings made during the course of the survey and the laboratory analyses of selected soil samples from typical profiles.

In making soil borings during field mapping, soil scientists can identify several important soil properties. They note the seasonal soil moisture condition or the presence of free water and its depth. For each horizon in the profile, they note the thickness and color of the soil material; the texture, or amount of clay, silt, sand, and gravel or other coarse fragments; the structure, or the natural pattern of cracks and pores in the undisturbed soil; and the consistence of the soil material in place under the existing soil moisture conditions. They record the depth of plant roots, determine the pH or reaction of the soil, and identify any free carbonates.

Samples of soil material are analyzed in the laboratory to verify the field estimates of soil properties and to determine all major properties of key soils, especially properties that cannot be estimated accurately by field ob-

servation. Laboratory analyses are not conducted for all soil series in the survey area, but laboratory data for many soil series not tested are available from nearby survey areas.

The available field and laboratory data are summarized in tables. The tables give the estimated range of engineering properties, the engineering classification, and the physical and chemical properties of each major horizon of each soil in the survey area. They also present pertinent soil and water features and data obtained from physical and chemical laboratory analyses of soils.

Engineering Properties and Classification

Table 17 gives estimates of engineering properties and classifications for the major horizons of each soil in the survey area.

Most soils have, within the upper 5 or 6 feet, horizons of contrasting properties. Table 17 gives information for each of these contrasting horizons in a typical profile. *Depth* to the upper and lower boundaries of each horizon is indicated. More information about the range in depth and about other properties in each horizon is given for each soil series in the section "Soil Series and Morphology."

Texture is described in table 17 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 soil material that is less than 2 millimeters in diameter. "Loam," for example, is soil material that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If a soil contains gravel or other particles coarser than sand, an appropriate modifier is added, for example, "gravelly loam." Other texture terms are defined in the Glossary.

The two systems commonly used in classifying soils for engineering use are the Unified Soil Classification System (Unified) (*2*) and the system adopted by the American Association of State Highway and Transportation Officials (AASHTO) (*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, plasticity index, liquid limit, and organic-matter content. Soils are grouped into 15 classes—eight classes of coarse-grained soils, identified as GW, GP, GM, GC, SW, SP, SM, and SC; six classes of fine-grained soils, identified as ML, CL, OL, MH, CH, and OH; and one class of highly organic soils, identified as Pt. Soils on the borderline between two classes have a dual classification symbol, for example, CL-ML.

The *AASHTO* system classifies soils according to those properties that affect their use in highway construction and maintenance. In this system a mineral soil is classified in one of seven basic groups ranging 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. At the other extreme, in group A-7, are fine-grained soils. Highly organic soils are classified in group A-8 on the basis of visual inspection.

When laboratory data are available, the A-1, A-2, and A-7 groups are further classified as follows: A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, and A-7-6. As an additional refinement, the desirability of soils as subgrade material can be indicated by a group index number. These numbers range from 0 for the best subgrade material to 20 or higher for the poorest. The estimated classification, without group index numbers, is given in table 17. Also in table 17 the percentage, by weight, of rock fragments more than 3 inches in diameter is estimated for each major horizon. These estimates are determined mainly by observing volume percentage in the field and then converting that, by formula, to weight percentage.

Percentage of the soil material less than 3 inches in diameter that passes each of four sieves (U.S. standard) is estimated for each major horizon. The estimates are based on tests of soils that were sampled in the survey area and in nearby areas and on field estimates from many borings made during the survey.

Liquid limit and *plasticity index* indicate the effect of water on the strength and consistence of soil. These indexes are used in both the Unified and AASHTO soil classification systems. They are also used as indicators in making general predictions of soil behavior. Range in liquid limit and plasticity index are estimated on the basis of test data from the survey area or from nearby areas and on observations of the many soil borings made during the survey.

In some surveys, the estimates are rounded to the nearest 5 percent. Thus, if the ranges of gradation and Atterburg limits extend a marginal amount across classification boundaries (1 or 2 percent), the classification in the marginal zone is omitted in table 17.

Physical and Chemical Properties

Table 18 shows estimated values for several soil characteristics and features that affect behavior of soils in engineering uses. These estimates are given for each major horizon, at the depths indicated, in the typical pedon of each soil. The estimates are based on field observations and on test data for these and similar soils.

Permeability is estimated on the basis of known relationships among the soil characteristics observed in the field—particularly soil structure, porosity, and gradation or texture—that influence the downward movement of water in the soil. The estimates are for vertical water movement when the soil is saturated. Not considered in the estimates is lateral seepage or such transient soil features as plowpans and surface crusts. Permeability of the soil is an important factor to be considered in planning and designing drainage systems, in evaluating the potential of soils for septic tank systems and other waste disposal systems, and in many other aspects of land use and management.

Available water capacity is rated on the basis of soil characteristics that influence the ability of the soil to hold water and make it available to plants. Important characteristics are content of organic matter, soil texture, and soil structure. Shallow-rooted plants are not likely to use the available water from the deeper soil horizons. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design of irrigation systems.

Soil reaction is expressed as range in pH values. The range in pH of each major horizon is based on many field checks. For many soils, the values have been verified by laboratory analyses. Soil reaction is important in selecting the crops, ornamental plants, or other plants to be grown; in evaluating soil amendments for fertility and stabilization; and in evaluating the corrosivity of soils.

Shrink-swell potential depends mainly on the amount and kind of clay in the soil. Laboratory measurements of the swelling of undisturbed clods were made for many soils. For others the swelling was estimated on the basis of the kind and amount of clay in the soil and on measurements of similar soils. The size of the load and the magnitude of the change in soil moisture content also influence the swelling of soils. Shrinking and swelling of some soils can cause damage to building foundations, basement walls, roads, and other structures unless special designs are used (fig. 9). A high shrink-swell potential indicates that special design and added expense may be required if the planned use of the soil will not tolerate large volume changes.

Risk of corrosion pertains to potential soil-induced chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to soil moisture, particle-size distribution, total acidity, and electrical conductivity of the soil material. The rate of corrosion of concrete is based mainly on the sulfate content, texture, and acidity of the soil. Protective measures for steel or more resistant concrete help to avoid or minimize damage resulting from the corrosion. Uncoated steel intersecting soil boundaries or soil horizons is more susceptible to corrosion than an installation that is entirely within one kind of soil or within one soil horizon.

Erosion factors are used to predict the erodibility of a soil and its tolerance to erosion in relation to specific kinds of land use and treatment. The soil erodibility factor (K) is a measure of the susceptibility of the soil to erosion by water (fig. 10). Soils having the highest K values are the most erodible. K values range from 0.10 to 0.64. To estimate annual soil loss per acre, the K value of a soil is modified by factors representing plant cover, grade and length of slope, management practices, and climate. The soil-loss tolerance factor (T) is the maximum rate of soil erosion, whether from rainfall or soil blowing, that can occur without reducing crop production or environmental quality. The rate is expressed in tons of soil loss per acre per year.

Soil and Water Features

Table 19 contains information helpful in planning land uses and engineering projects that are likely to be affected by soil and water features.

Hydrologic soil groups are used to estimate runoff from precipitation. Soils not protected by vegetation are placed in one of four groups on the basis of the intake of water after the soils have been wetted and have received 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 chiefly of deep, well drained to excessively drained sands or gravels. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep to deep, moderately well drained to 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 that have a layer that impedes the downward movement of water or soils that have 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 clay soils that have a high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Flooding is the temporary covering of soil with water from overflowing streams, with runoff from adjacent slopes, and by tides. Water standing for short periods after rainfall or snowmelt and water in swamps and marshes is not considered flooding. Flooding is rated in general terms that describe the frequency and duration of flooding and the time of year when flooding is most likely. The ratings are based on evidence in the soil profile of the effects of flooding, namely thin strata of gravel, sand, silt, or, in places, clay deposited by floodwater; irregular decrease in organic-matter content with increasing depth; and absence of distinctive soil horizons that form in soils of the area that are not subject to flooding. The ratings are also based on local information about floodwater levels in the area and the extent of flooding; and information that relates the position of each soil on the landscape to historic floods.

The generalized description of flood hazards is of value in land-use planning and provides a valid basis for land-use restrictions. The soil data are less specific, however, than those provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

High water table is the highest level of a saturated zone more than 6 inches thick for a continuous period of more than 2 weeks during most years. The depth to a seasonal high water table applies to undrained soils. Estimates are based mainly on the relationship between grayish colors or mottles in the soil and the depth to free water observed in many borings made during the course of the soil survey. Indicated 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. Only saturated zones above a depth of 5 or 6 feet are indicated.

Information about the seasonal high water table helps in assessing the need for specially designed foundations, the need for specific kinds of drainage systems, and the need for footing drains to insure dry basements. Such information is also needed to decide whether or not construction of basements is feasible and to determine how septic tank absorption fields and other underground installations will function. Also, a seasonal high water table affects ease of excavation.

Bedrock is shown for all soils that are underlain by bedrock at a depth of 5 to 6 feet or less. For many soils, the limited depth to bedrock is a part of the definition of the soil series. The depths shown are based on measurements made in many soil borings and on other observations during the soil mapping. The kind of bedrock and its hardness as related to ease of excavation is also shown. Rippable bedrock can be excavated with a single-tooth ripping attachment on a 200-horsepower tractor, but hard bedrock generally requires blasting.

Classification of the Soils

In this section, the soil series recognized in the survey area are described, the current system of classifying soils is defined, and the soils in the area are classified according to the current system.

Soil Series and Morphology

In this section, each soil series recognized in the survey area is described in detail. The descriptions are arranged in alphabetic order by series name.

Characteristics of the soil and the material in which it formed are discussed for each series. Then a representative profile which is a vertical section of a small three-dimensional area of soil typical of the soil series in the survey area, is described. The detailed descriptions of each soil horizon follow standards in the Soil Survey Manual (*3*). Unless otherwise noted, colors described are for moist soil.

Following the representative profile description is the range of important characteristics of the soil series in this survey area. Phases, or mapping units, of each soil series are described in the section "Soil Maps for Detailed Planning."

Apperson Series

The Apperson series consists of deep, slowly permeable, very gently sloping and gently sloping soils on uplands. These soils formed in loamy and clayey material weathered from limestone under a cover of native grasses. The water table is at a depth of 1.5 to 2 feet for brief periods during December through April.

Representative profile of Apperson silty clay loam, 1 to 3 percent slopes, 2,500 feet north and 60 feet east of the southwest corner sec. 3, T. 19 N., R. 14 E.:

A1—0 to 8 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; moderate fine and medium granular structure; hard, firm; many fine and coarse roots; common worm casts; slightly acid; diffuse smooth boundary.

B1—8 to 16 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; moderate medium subangular blocky structure; very hard, firm; common fine and coarse roots; common worm casts; slightly acid; diffuse smooth boundary.

B21t—16 to 28 inches; very dark gray (10YR 3/1) silty clay; common fine faint mottles of dark grayish brown (10YR 4/2), dark gray (10YR 4/1) dry; moderate medium blocky structure; very hard, very firm; clay films on faces of peds; few iron and manganese concretions; common fine roots; neutral; gradual smooth boundary.

B22t—28 to 42 inches; very dark grayish brown (2.5Y 3/2) silty clay; many fine distinct mottles of yellowish brown (10YR 5/6), dark grayish brown (2.5Y 4/2) dry; moderate medium blocky structure; extremely hard, very firm; clay films on faces of peds; very fine iron and manganese concretions; few fine roots; mildly alkaline; gradual smooth boundary.

B23t—42 to 52 inches; dark grayish brown (2.5Y 4/2) silty clay; many medium and fine distinct yellowish brown (10YR 5/6) mottles; grayish brown (2.5Y 5/2) dry; moderate medium blocky structure; very hard, firm; clay films on faces of peds; many fine iron and manganese concretions; pockets of darker soil from horizons above; moderately alkaline; abrupt wavy boundary.

R—52 to 60 inches; grayish hard limestone bedrock.

Thickness of solum and depth to bedrock is 40 to 60 inches. Wide cracks are common during dry periods.

The A horizon is black (10YR 2/1) or very dark gray (10YR 3/1). It is slightly acid or medium acid.

The B1 horizon is black (10YR 2/1), very dark grayish brown (10YR 3/2), or very dark gray (10YR 3/1). It is silty clay loam or silty clay and medium acid through mildly alkaline.

The B21t horizon is black (10YR 2/1), very dark brown (10YR 2/2), very dark gray (10YR 3/1), very dark grayish brown (10YR 3/2), or dark gray (10YR 4/1). It has reddish or brownish mottles. The B21t horizon is slightly acid through mildly alkaline.

The B22t and B23t horizons are very dark grayish brown (10YR 3/2; 2.5Y 3/2), dark grayish brown (10YR 4/2; 2.5Y 4/2), dark brown (10YR 3/3, 4/3), very dark gray (10YR 3/1), or dark gray (10YR 4/1). They have grayish, brownish, yellowish, or reddish mottles. Limestone fragments range from 0 to 10 percent in the B2t horizon. They are slightly acid through mildly alkaline.

The B3 horizon is dark grayish brown (10YR 4/2; 2.5Y 4/2), grayish brown (10YR 5/2; 2.5Y 5/2), dark brown or brown (10YR 3/3, 4/3, 5/3), dark yellowish brown (10YR 4/4), yellowish brown (10YR 5/4), olive brown (2.5Y 4/4), or light olive brown (2.5Y 5/4). It has reddish, yellowish, brownish, or grayish mottles in most pedons. It is slightly acid through moderately alkaline.

Apperson soils are on smooth ridges and side slopes of uplands. They are associated with Carytown, Dennis, Kanima, Lula, Okemah, and Shidler soils.

Bates Series

The Bates series consists of moderately deep, moderately permeable, very gently sloping through sloping soils on uplands. These soils formed in loamy material weathered from sandstone under a cover of prairie grasses. The water table is at a depth of more than 6 feet.

Representative profile of Bates loam, 1 to 3 percent slopes, 1,600 feet north and 100 feet east of the southwest corner of sec. 30, T. 22 N., R. 14 E.:

Ap—0 to 10 inches; very dark grayish brown (10YR 3/2) loam, grayish brown (10YR 5/2) dry; moderate fine granular structure; slightly hard, friable; few worm casts; neutral; gradual smooth boundary.

B1—10 to 14 inches; dark brown (10YR 3/3) clay loam, brown (10YR 5/3) dry; moderate fine and medium subangular blocky structure; hard, firm; few very fine reddish brown soft sandstone fragments less than 3 inches in size; organic staining in a few root channels; slightly acid; gradual smooth boundary.

B2t—14 to 24 inches; dark brown (7.5YR 4/4) clay loam, brown (7.5YR 5/4) dry; few fine prominent yellowish red mottles; moderate fine and medium subangular blocky structure; hard, firm; clay films on faces of peds; few fine sandstone fragments less than 3 inches in diameter; slightly acid; gradual smooth boundary.

B3—24 to 34 inches; dark brown (10YR 4/3) and yellowish brown (10YR 5/4) clay loam; few fine prominent yellowish red mottles; weak medium subangular blocky structure; hard, firm; patchy clay films on faces of peds; common fine and medium iron-manganese concretions; 10 percent fragments of sandstone less than 3 inches in diameter; slightly acid; clear smooth boundary.

Cr—34 to 40 inches; yellowish, soft, acid sandstone with thin interbedding of silty shale.

Thickness of the soil ranges from 20 to 40 inches and corresponds with the depth to sandstone bedrock.

The A horizon is very dark grayish brown (10YR 3/2) and dark brown (10YR 3/3; 7.5YR 3/2). It is less than 15 percent fragments of sandstone. The A horizon is medium acid or strongly acid except in limed areas.

The B horizon is dark brown (10YR 3/3, 4/3; 7.5YR 4/4), brown (10YR 5/3; 7.5YR 5/4), dark yellowish brown (10YR 4/4), yellowish brown (10YR 5/4, 5/6), or strong brown (7.5YR 5/6). In some pedons, it has dark grayish brown, dark gray, gray, or grayish brown mottles in the lower part. The B horizon is loam, sandy clay loam, or clay loam, and it is less than 20 percent fragments of sandstone. It is slightly acid through strongly acid.

Bates soils are on broad, smooth ridge crests and side slopes on uplands. They are associated with Coweta, Dennis, and Eram soils.

Carytown Series

The Carytown series consists of deep, very slowly permeable, nearly level through very gently sloping soils on uplands. These soils formed in loamy and clayey material under a cover of prairie grasses. The water table is at a depth of less than 1 1/2 feet for brief to long periods during December through April.

Representative profile of Carytown silt loam, in an area of Okemah-Parsons-Carytown complex, 0 to 1 pecent slopes, 1,350 feet north and 60 feet west of the southeast corner of sec. 3, T. 19 N., R. 14 E.:

Ap—0 to 7 inches; dark grayish brown (10YR 4/2) silt loam, grayish brown (10YR 5/2) dry; weak fine granular structure; hard, friable; lower 2 inches is grayish brown; medium acid; abrupt wavy boundary.

B21t—7 to 14 inches; very dark grayish brown (2.5Y 3/2) silty clay; few fine distinct yellowish brown mottles; dark grayish brown (2.5Y 4/2) dry; moderate coarse columnar and moderate medium subangular blocky structure; very hard, very firm; few pressure faces; neutral; gradual smooth boundary.

B22t—14 to 23 inches; dark yellowish brown (10YR 4/4) silty clay; few fine distinct yellowish brown mottles; yellowish brown (10YR 5/4) dry; moderate medium subangular blocky structure; very hard, very firm; dark grayish brown (10YR 4/2) coating on faces of peds; few fine iron-manganese concretions; slightly acid; gradual smooth boundary.

B23t—23 to 41 inches; olive brown (2.5Y 4/4) silty clay with few fine distinct yellowish brown mottles; light olive brown (2.5Y 5/4) dry; moderate medium subangular blocky structure; very hard, very firm; few iron-manganese concretions; dark grayish brown (10YR 4/2) coatings on faces of peds; common fine crystals of gypsum; slightly acid; gradual wavy boundary.

B3—41 to 64 inches; mottled yellowish brown (10YR 5/6), dark grayish brown (10YR 4/2), and olive brown (2.5Y 4/4) silty clay; weak coarse subangular blocky structure; very firm; common fine iron-manganese concretions; common fine to large calcium carbonate concretions; moderately alkaline.

Thickness of solum is more than 50 inches, and depth to bedrock is more than 60 inches.

The A horizon is very dark grayish brown (10YR 3/2; 2.5Y 3/2) or dark grayish brown (10YR 4/2; 2.5Y 4/2). It is neutral to medium acid. In most pedons, the A2 horizon is grayish brown (10YR 4/2), light brownish gray (10YR 6/2), brown (10YR 4/3, 5/3), or pale brown (10YR 6/3). It is neutral to strongly acid. Thickness of the A horizon is 7 to 18 inches.

The B horizon is very dark gray (10YR 3/1; N 3/0), dark gray (10YR 4/1; N 4/0), very dark grayish brown (10YR 3/2; 2.5Y 3/2), dark grayish brown (10YR 4/2; 2.5Y 4/2), dark brown (10YR 3/3, 4/3), dark yellowish brown (10YR 3/4, 4/4), or olive brown (2.5Y 4/4). It is medium acid to moderately alkaline in the upper part and neutral to moderately alkaline in the lower part.

Carytown soils are on broad, smooth side slopes and flat areas. They are associated with Dennis, Okemah, Parsons, and Apperson soils.

Catoosa Series

The Catoosa series consists of moderately deep, moderately permeable, very gently sloping through sloping soils on uplands. These soils formed in loamy material weathered from limestone under a cover of prairie grasses. The water table is at a depth of more than 6 feet.

Representative profile of Catoosa silt loam, 1 to 3 percent slopes, 2,200 feet south and 1,750 feet west of the northeast corner of sec. 15, T. 19 N., R 14 E.:

A1—0 to 10 inches; dark brown (7.5YR 3/2) silt loam, brown (7.5YR 5/2) dry; moderate fine granular structure; slightly hard, friable; slightly acid; gradual smooth boundary.

B1—10 to 15 inches; dark reddish brown (5YR 3/3) silty clay loam, reddish brown (5YR 4/3) dry; moderate medium granular structure; hard, friable; medium acid; gradual smooth boundary.

B2t—15 to 28 inches, dark reddish brown (5YR 3/4) silty clay loam, reddish brown (5YR 4/4) dry; few fine distinct dark red mottles; moderate medium subangular blocky structure; hard, firm; clay films on surfaces of peds; few fine black concretions; slightly acid; abrupt wavy boundary.

R—28 to 40 inches, hard limestone bedrock.

The thickness of the solum and depth to bedrock ranges from 20 to 40 inches.

The A horizon is very dark grayish brown (10YR 3/2), dark brown (10YR 3/3; 7.5YR 3/2), and dark reddish brown (5YR 3/2, 3/3). Reaction is slightly acid or medium acid.

The B1 horizon is dark brown (7.5YR 3/2, 4/2, 4/4), dark reddish brown (5YR 3/3, 3/4), or reddish brown (5YR 4/3, 4/4). It is silt loam, clay loam, or silty clay loam. Reaction is slightly acid or medium acid.

The B2t horizon is dark brown (7.5YR 4/4), dark reddish brown (5YR 3/3, 3/4; 2.5YR 3/4), reddish brown (5YR 4/3, 4/4; 2.5YR 4/4), yellowish red (5YR 4/6), dark red (2.5YR 3/6), or red (2.5YR 4/6). It is clay loam or silty clay loam (27 to 35 percent clay). Some pedons are heavy clay loam or silty clay loam in the lower part. Reaction of the B2t horizon ranges from medium acid through neutral.

The R horizon is hard limestone.

Catoosa soils are on broad, smooth ridge crests and side slopes. They are associated with Lula, Newtonia, and Shidler soils.

Choska Series

The Choska series consists of deep, moderately permeable, nearly level soils on flood plains. These soils formed in sandy and loamy alluvium under a cover of trees with an understory of native grasses. The water table is at a depth of more than 6 feet.

Representative profile of Choska very fine sandy loam, 750 feet south and 100 feet west of the northeast corner of sec. 17, T. 17 N., R. 14 E.:

A1—O to 14 inches; dark reddish brown (5YR 3/3) very fine sandy loam, reddish brown (5YR 5/3) dry; moderate very fine and fine granular structure; slightly hard, very friable; slightly acid; clear smooth boundary.

C1—14 to 25 inches; yellowish red (5YR 4/6) very fine sandy loam, reddish yellow (5YR 6/6) dry; massive; slightly hard, very friable; organic stains in a few root channels; neutral; clear smooth boundary.

IIC2—25 to 35 inches; dark reddish brown (5YR 3/3) silt loam, reddish brown (5YR 5/3) dry; weak fine granular structure; slightly hard, very friable; calcareous, moderately alkaline; clear smooth boundary.

IIIC3—35 to 62 inches; yellowish red (5YR 4/6) very fine sandy loam, yellowish red (5YR 5/6) dry; massive; soft, very friable; few thin strata of loamy fine sand, loam, and silt loam; calcareous, moderately alkaline.

Depth to bedrock is more than 60 inches.

The A horizon is dark brown (7.5YR 3/2) or dark reddish brown (5YR 3/2, 3/3). It is slightly acid through mildly alkaline.

The C horizon is brown (7.5YR 4/4, 5/4), strong brown (7.5YR 5/6), reddish brown (5YR 4/4, 5/4; 2.5YR 4/4, 5/4), yellowish red (5YR 4/6, 5/6), or red (2.5YR 4/6, 5/6). It is very fine sandy loam or silt loam with thin strata of loamy fine sand to silty clay loam. The C horizon is neutral through moderately alkaline, and in most pedons it is calcareous in the lower part.

Choska soils are on smooth, nearly level flood plains. They are associated with Kiomatia, Latanier, and Severn soils.

Cleora Series

The Cleora series consists of deep, moderately rapidly permeable, nearly level soils on flood plains. These soils formed in loamy and sandy alluvium under a cover of trees with an understory of native grasses. The water table is at a depth of more than 6 feet.

Representative profile of Cleora fine sandy loam, 750 feet west and 690 feet north of the southeast corner of sec. 4, T. 19 N., R. 10 E.:

A1—O to 11 inches; dark brown (10YR 3/3) fine sandy loam, brown (10YR 5/3) dry; weak fine granular structure; soft, very friable; few worm casts; slightly acid; clear smooth boundary.

AC—11 to 31 inches; brown (10YR 4/3) fine sandy loam, pale brown (10YR 6/3) dry; weak fine granular structure; soft, very friable; few thin strata of dark brown fine sandy loam; slightly acid; clear smooth boundary.

C—31 to 62 inches; dark brown (7.5YR 4/4) fine sandy loam, light brown (7.5YR 6/4) dry; massive; soft, very friable; thin strata of dark brown loam and fine sandy loam; slightly acid.

The depth to bedrock is more than 60 inches.

The A horizon is very dark grayish brown (10YR 3/2) or dark brown (10YR 3/3; 7.5YR 3/2). It is slightly acid or medium acid except in limed areas.

The AC horizon is brown (10YR 4/3, 5/3; 7.5YR 4/4, 5/4), dark yellowish brown (10YR 4/4), or yellowish brown (10YR 5/4). In most pedons, it has thin, slightly darker strata of loamy fine sand through loam. It is medium acid through neutral.

The C horizon is similar in color, texture, and reaction to the AC horizon.

Cleora soils are on smooth flood plains. They are associated with Kamie, Radley, Severn, and Wynona soils.

Coweta Series

The Coweta series consists of shallow, moderately permeable, very gently sloping through moderately steep soils on uplands (fig. 11). These soils formed in loamy material weathered from sandstone. The water table is at a depth of more than 6 feet.

Representative profile of Coweta loam, in an area of Coweta-Bates complex, 2 to 6 percent slopes, 1,350 feet south and 1,500 feet east of the northwest corner of sec. 8, T. 22 N., R. 13 E.:

A1—O to 6 inches; very dark grayish brown (10YR 3/2) loam, grayish brown (10YR 5/2) dry; moderate fine granular structure; slightly hard, friable; few fine sandstone fragments; slightly acid; gradual wavy boundary.

B2—6 to 17 inches; brown (10YR 4/3) clay loam, brown (10YR 5/3) dry; weak fine granular structure; slightly hard, friable; 10 percent fragments less than 3 inches in diameter and 5 percent fragments 3 to 10 inches in diameter; medium acid; abrupt wavy boundary.

Cr—17 to 32 inches; pale brown (10YR 6/3) and brownish yellow (10YR 6/6) soft sandstone interbedded with thin layers of shale; slightly acid.

The solum is 10 to 20 inches in thickness, and it is slightly acid through strongly acid throughout.

The A horizon is very dark grayish brown (10YR 3/2) and dark brown (7.5YR 3/2; 10YR 3/3). It is loam or fine sandy loam and is 2 to 20 percent fragments of rock.

The B2 horizon is brown (10YR 4/3, 5/3; 7.5YR 4/2, 4/4, 5/4), dark grayish brown (10YR 4/2), dark yellowish brown (10YR 3/4, 4/4), yellowish brown (10YR 5/4, 5/6), and strong brown (7.5YR 5/6). It is fine sandy loam, loam or clay loam and is O to 15 percent fragments of rocks.

The Cr horizon is soft sandstone interbedded with shale. Some pedons have hard sandstone below a depth of 24 inches.

Coweta soils are on smooth ridge crests of uplands. They are associated with Bates, Dennis, Eram, and Okemah soils.

Darnell Series

The Darnell series consists of shallow, moderately rapidly permeable, gently sloping to steep soils on

uplands. These soils formed in loamy sediments weathered from sandstone under a cover of trees with an understory of grasses. The depth to the water table is more than 6 feet.

Representative profile of Darnell fine sandy loam, in an area of Niotaze-Darnell complex, 15 to 25 percent slopes, 2,520 feet west and 750 feet south of the northeast corner sec. 30, T. 19 N., R. 11 E.:

A1—O to 4 inches; dark brown (7.5YR 3/2) fine sandy loam, brown (7.5YR 5/2) dry; weak fine granular structure; slightly hard, very friable; 10 percent fragments of gravelly and cobbly sandstone; few stones; medium acid; gradual smooth boundary.

B2—4 to 15 inches; brown (7.5YR 4/4) fine sandy loam, light brown (7.5YR 6/4) dry; weak fine granular structure; slightly hard, very friable; 10 percent fragments of gravelly and cobbly sandstone; few stones; strongly acid; gradual wavy boundary.

Cr—15 to 26 inches, red (2.5YR 4/6) sandstone that is difficult to auger; strongly acid.

Solum thickness and depth to sandstone ranges from 10 to 20 inches.

The A horizon is very dark grayish brown (10YR 3/2), dark grayish brown (10YR 4/2), or dark brown (10YR 3/3, 4/3; 7.5YR 3/2, 4/2, 4/4). It is fine sandy loam or gravelly and cobbly fine sandy loam. Fragments of sandstone make up O to 20 percent of the A horizon. Most pedons have a few stones. The A horizon is neutral through strongly acid.

The B horizon is brown (10YR 4/3, 5/3; 7.5YR 4/2, 4/4, 5/4), yellowish brown (10YR 5/4, 5/6), light yellowish brown (10YR 6/4), strong brown (7.5YR 5/6), dark reddish brown (5YR 3/4; 2.5YR 3/4), reddish brown (5YR 4/4; 2.5YR 4/4), or yellowish red (5YR 4/6, 5/6). It is fine sandy loam or loam with O to 20 percent gravel-sized fragments of sandstone. The B horizon is neutral through strongly acid.

The Cr horizon is sandstone that is similar in color and reaction to the B horizon.

Darnell soils are on smooth ridge crests. They are associated with Niotaze soils.

Dennis Series

The Dennis series consists of deep, slowly permeable, very gently sloping through sloping soils on uplands. These soils formed in loamy and clayey sediments under native grasses. The water table is at a depth of 2 to 3 feet for brief periods during December through April.

Representative profile of Dennis silt loam, 1 to 3 percent slopes, 600 feet east and 2,520 feet south of the northwest corner of 21, T. 19 N., R. 14 E.:

A1—O to 8 inches; very dark grayish brown (10YR 3/2) silt loam, dark grayish brown (10YR 4/2) dry; weak fine granular structure; hard, friable; slightly acid; gradual smooth boundary.

A12—8 to 15 inches; very dark grayish brown (10YR 3/2) silt loam, dark brown (10YR 4/3) dry; moderate fine granular structure; hard, friable; few worm casts; coatings on peds of slightly lighter color than above horizon in lower 2 inches; medium acid; gradual smooth boundary.

B1—15 to 25 inches; dark yellowish brown (10YR 4/4) silty clay loam, yellowish brown (10YR 5/4) dry; moderate fine subangular blocky structure; hard, firm; patchy clay films on faces of some peds; medium acid; gradual smooth boundary.

B21t—25 to 35 inches; dark brown (7.5YR 4/4) silty clay, brown (7.5YR 5/4) with few fine faint gray and few fine prominent yellowish red mottles dry; moderate fine and medium subangular blocky structure; very hard, very firm; clay films on faces of peds; few fine iron-manganese concretions; organic staining in root channels; medium acid; gradual smooth boundary.

B22t—35 to 47 inches; mottled brown (7.5YR 5/4), brownish yellow (10YR 6/6), and light brownish gray (2.5Y 6/2) silty clay; moderate fine and medium subangular blocky structure; very hard, very firm; thin clay films on faces of peds, few fine black iron-manganese concretions and soft reddish bodies; organic stains in root channels; medium acid; gradual smooth boundary.

B3—47 to 65 inches; coarsely mottled light brownish gray (10YR 6/2), red (2.5YR 5/6), and gray (10YR 5/1) silty clay; weak medium and coarse blocky structure; very hard, very firm; patchy clay films on faces of peds; few fine black iron-manganese concretions; medium acid.

Thickness of the solum and depth to bedrock is greater than 60 inches.

The A horizon is very dark grayish brown (10YR 3/2) or dark brown (10YR 3/3). Some profiles have a slightly lighter colored A2 horizon. Reaction is medium acid or strongly acid, but some areas are more alkaline because they have been limed. Thickness of the A horizon is less than 16 inches.

The B1 horizon is dark yellowish brown (10YR 3/4, 4/4) and brown or dark brown (10YR 3/3, 4/3; 7.5YR 4/4). It is silty clay loam or clay loam and medium acid through very strongly acid.

The B2t horizon is strong brown (7.5YR 5/6), yellowish brown (10YR 5/4, 5/6), dark yellowish brown (10YR 4/4), brown or dark brown (10YR 4/3, 5/3; 7.5YR 4/4, 5/4), olive brown (2.5Y 4/4), and light olive brown (2.5Y 5/4, 5/6). It contains grayish, reddish, and yellowish mottles. The texture of the B2t horizon is clay, silty clay, clay loam, or silty clay loam (more than 35 percent clay). Reaction is slightly acid through strongly acid.

The B3 horizon has coarse mottles in shades of red, yellow, brown, or gray. Reaction is medium acid through mildly alkaline.

Dennis soils are on smooth ridge crests and side slopes on uplands. They are usually associated with Apperson, Bates, Carytown, Coweta, Eram, Kanima, Newtonia, Okemah, and Parsons soils.

Enders Series

The Enders series consists of deep, very slowly permeable, sloping to steep soils on uplands. These soils formed in material weathered from shale under a cover of trees with an understory of grasses. Depth to the water table is more than 6 feet.

Representative profile of Enders loam, in an area of Enders-Hector complex, 5 to 30 percent slopes, 430 feet west and 30 feet north of the southeast corner of sec. 16, T. 16 N., R. 14 E.:

A11—O to 2 inches; very dark grayish brown (10YR 3/2) loam, grayish brown (10YR 5/2) dry; weak medium granular structure; slightly hard, firm; 10 percent gravel fragments, 5 percent cobbles and stones; very friable, soft; strongly acid; clear smooth boundary.

A12—2 to 8 inches, brown (10Y 5/3) loam, very pale brown (10YR 7/3) dry; weak medium granular structure; slightly hard, friable; 10 percent rock fragments, 1/2 inch to 2 inches in size; strongly acid; clear smooth boundary.

B1—8 to 10 inches; yellowish red (5YR 4/6) clay loam, yellowish red (5YR 5/6) dry; moderate fine subangular blocky structure; hard, firm; very strongly acid; gradual smooth boundary.

B2t—10 to 38 inches; yellowish red (5YR 4/6) clay, yellowish red (5YR 5/6) dry; strong fine subangular blocky structure; very hard, very firm; few pressure faces on peds; very strongly acid; gradual smooth boundary.

B3—38 to 44 inches; mottled yellowish brown (10YR 5/6), very pale brown (10YR 7/3), and yellowish red (5YR 5/6) clay; moderate medium subangular blocky structure; very hard, firm; very strongly acid; gradual smooth boundary.

Cr—44 to 47 inches; mottled yellowish brown (10YR 5/6), very pale brown (10YR 7/3), and yellowish red (5YR 5/6) weathered shale; platy structure; very hard, very firm; very strongly acid; grades into shale.

Solum thickness and depth to bedrock ranges from 40 to 60 inches. Reaction in all horizons is strongly acid or very strongly acid.

The A1 horizon is very dark grayish brown (10YR 3/2), dark grayish brown (10YR 4/2), or dark brown (10YR 3/3, 4/3). Shale and sandstone fragments of gravel, cobble, and stone size make up 5 to 15 percent of the A1 horizon.

The A12 horizon is dark brown (10YR 4/3, 7.5YR 4/4), brown (10YR 5/3, 7.5YR 5/4), yellowish brown (10YR 5/4, 5/6), or strong brown (7.5YR 5/6). Shale and sandstone fragments of gravel, cobble, and stone size make up 5 to 15 percent of the A12 horizon.

The B1 horizon is brown (7.5YR 4/4, 5/4), strong brown (7.5YR 5/6), reddish brown (5YR 4/4, 5/4), or yellowish red (5YR 4/6, 4/8, 5/6) clay loam, silty clay loam, loam, and silt loam. Shale fragments make up 2 to 15 percent of the B1 horizon.

The B2t horizon is yellowish red (5YR 4/6, 5/6) or red (2.5YR 4/6, 5/6), and it is mottled with brown or gray in the lower part of some pedons. It is silty clay or clay and is 2 to 15 percent fragments of shale.

The B3 horizon is mottled red and brown with gray mottles in some pedons. It is silty clay or clay and is 15 to 30 percent shale fragments.

Enders soils are on broad, smooth uplands. They are associated with Hector and Linker soils.

Eram Series

The Eram series consists of deep, slowly permeable, gently sloping to moderately steep soils on uplands. These soils formed in loamy and clayey sediments that weathered from shale under native grasses. The water table is at a depth of 2 or 3 feet during December through April.

Representative profile of Eram silty clay loam, 3 to 5 percent slopes, 2,390 feet west and 40 feet north of the southeast corner of sec. 27, T. 19 N., R. 14 E.:

A1—O to 14 inches; very dark brown (10YR 2/2) silty clay loam, very dark grayish brown (10YR 3/2) dry; moderate fine granular structure; hard, friable; slightly acid; gradual smooth boundary.

B2t—14 to 23 inches; very dark grayish brown (10YR 3/2) silty clay loam, dark grayish brown (10YR 4/2) dry; moderate fine subangular blocky structure; hard, firm, few reddish iron stains; thin patchy clay films; medium acid; gradual smooth boundary.

B3—23 to 34 inches; dark grayish brown (2.5Y 4/2) silty clay loam, grayish brown (2.5Y 5/2) with common medium red (2.5YR 4/6) mottles dry; weak medium subangular blocky structure; very hard, firm; few fine iron concretions; thin continuous clay films on faces of peds; medium acid; gradual smooth boundary.

Cr—34 to 40 inches, gray and olive shale with a few thin layers of sandstone.

Thickness of the solum and depth to shale is 20 to 40 inches.

The A horizon is very dark brown (10YR 2/2), very dark grayish brown (10YR 3/2), and dark brown (10YR 3/3; 7.5YR 3/2). It is slightly acid or medium acid.

The B2t horizon is very dark grayish brown (10YR 3/2; 2.5Y 3/2), dark grayish brown (10YR 4/2; 2.5Y 4/2), dark brown (10YR 3/3), brown (10YR 5/3), yellowish brown (10YR 5/4), olive brown (2.5Y 4/4), light olive brown (5Y 5/4), and olive (5Y 4/3, 4/4, 5/3, 5/4). Most pedons have gray or brown mottles. The B2t horizon is silty clay loam, silty clay, or clay and is strongly acid through neutral.

Where present, a B3 horizon has similar color, texture, and reaction to the B2t horizon.

The Cr horizon is shale that is noncalcareous in most places.

Eram soils are on broad, smooth ridge crests and side slopes. They are associated with Bates, Coweta, and Dennis soils.

Glenpool Series

The Glenpool series consists of deep, rapidly permeable, very gently sloping to moderately steep soils on uplands. These soils formed in sandy sediments under a cover of trees with an understory of grasses. Depth to the water table is more than 5 feet.

Representative profile of Glenpool loamy fine sand, 3 to 15 percent slopes, 2,400 feet south and 150 feet west of the northeast corner of sec. 33, T. 18 N., R. 13 E.:

A1—O to 4 inches; very dark grayish brown (10YR 3/2) loamy fine sand, grayish brown (10YR 5/2) dry; weak fine granular structure; soft, very friable; medium acid; gradual smooth boundary.

A2—4 to 41 inches; brown (7.5YR 5/4) fine sand, pink (5YR 7/4) dry; loose dry or moist; medium acid; gradual smooth boundary.

B2t—41 to 48 inches; strong brown (7.5YR 5/6) loamy fine sand, granular structure; soft, very friable; clay films bridging sand grains; medium acid; clear wavy boundary.

A&B1—48 to 55 inches; red (2.5YR 5/6) loamy fine sand (A22); single grained; loose; with alternating lamellae of red (2.5YR 4/6) fine sandy loam (B22t); the lamellae are very fine and fine subangular blocky structure; soft, very friable; wavy and discontinuous 1/4 inch to 3/4 inch thick and 4 to 10 inches apart; the lamellae have clay bridges between the sand grains; strongly acid; gradual smooth boundary.

A&B2—55 to 80 inches; reddish yellow (5YR 6/6) loamy fine sand (A23); single grained; loose; with lamellae of yellowish red (5YR 4/6) fine sandy loam (B23t); the lamellae are weak fine subangular blocky structure; soft, very friable; wavy and discontinuous 1/4 inch to 3/4 inch thick and 6 to 15 inches apart; the lamellae have clay bridges between the sand grains; strongly acid.

Solum thickness and depth to bedrock is more than 60 inches. Combined thickness of the A1 and A21 horizons ranges from 20 to 60 inches.

The A1 horizon is very dark grayish brown (10YR 3/2), dark grayish brown (10YR 4/2), pale brown (10YR 6/3), pinkish gray (7.5YR 6/2), and dark brown (10YR 3/3, 4/3; 7.5YR 3/2. 4/2, 4/4). Reaction is slightly acid or medium acid, and texture is loamy fine sand or fine sand.

The A2 horizon is grayish brown (10YR 5/2), brown (7.5YR 5/2, 5/4), yellowish brown (10YR 5/4), light brownish gray (10YR 6/2), pale brown (10YR 6/3), light yellowish brown (10YR 6/4), pinkish gray (7.5YR 6/2), and light brown (7.5YR 6/4). Reaction is slightly acid or medium acid, and texture is loamy fine sand or fine sand.

The B2t horizon is brown (7.5YR 4/4), light brown (7.5YR 6/4), strong brown (7.5YR 5/6), reddish yellow (7.5YR 6/6), and yellowish red (5YR 5/6). Reaction is medium acid or strongly acid, and texture is loamy fine sand.

The A part of the A&B horizon is red (2.5YR 4/6, 5/6), yellowish red (5YR 5/6), reddish brown (5YR 4/4), and reddish yellow (5YR 6/6). Reaction is strongly acid or very strongly acid, and texture is loamy fine sand.

The B part of the A&B horizon is red (2.5YR 4/6, 5/6), yellowish red (5YR 4/6, 5/6) or reddish brown (5YR 4/4, 5/4; 2.5YR 4/4, 5/5). It is fine sandy loam or loamy fine sand, and reaction is strongly acid or very strongly acid. Some pedons have skeletons in the A&B2 horizon. These skeletons make up less than 5 percent, by volume, of this horizon.

Glenpool soils are on broad side slopes. They are associated with Kamie, Larton, and Tullahasee soils.

Hector Series

The Hector series consists of shallow, moderately rapidly permeable, very gently sloping to steep soils on

uplands. These soils formed in loamy material weathered from sandstone under a cover of trees with an understory of grasses. The depth to the water table is greater than 6 feet.

Representative profile of Hector loam, in an area of Hector-Linker complex, 1 to 5 percent slopes, 1,020 feet east and 60 feet south of the northwest corner of sec. 16, T. 16 N., R. 14 E.:

A1—0 to 2 inches; very dark grayish brown (10YR 3/2) loam, grayish brown (10YR 5/2) dry; weak fine granular structure; soft, very friable; few fine pebbles, 5 percent cobbles and stones; slightly acid; clear smooth boundary.

A2—2 to 9 inches; grayish brown (10YR 5/2) gravelly loam, light brownish gray (10YR 6/2) dry; weak fine granular structure; slightly hard, very friable; 20 percent gravel, 5 percent cobbles and stones; medium acid; clear smooth boundary.

B2—9 to 15 inches; yellowish brown (10YR 5/6) gravelly loam, brownish yellow (10YR 6/6) dry; weak fine subangular blocky structure; slightly hard, very friable; 25 percent gravel, 5 percent cobbles and stones; strongly acid; abrupt wavy boundary.

R—15 to 20 inches; hard sandstone.

Thickness of the soil and depth to sandstone is 10 to 20 inches. The soil is 0 to 30 percent sandstone fragments of gravel, cobble, and stone size.

The A1 horizon is very dark grayish brown (10YR 3/2), brown (10YR 4/3; 7.5YR 4/2), or dark grayish brown (10YR 4/2).

The A2 horizon is grayish brown (10YR 5/2), dark yellowish brown (10YR 4/4), or brown (10YR 4/3, 5/3). The A horizon is slightly acid through strongly acid.

The B2 horizon is yellowish brown (10YR 5/4, 5/6), strong brown (7.5YR 5/6), brown (10YR 5/3; 7.5YR 5/4), reddish brown (5YR 4/4), or yellowish red (5YR 4/6). It is loam or fine sandy loam and strongly acid or very strongly acid.

These soils have a slightly darker A1 horizon than is typical for the Hector series. Use, behavior, and management are similar to those of the Hector series.

Hector soils are on broad ridge crests and side slopes of uplands. They are associated with Enders and Linker soils.

Kamie Series

The Kamie series consists of deep, moderately permeable, very gently sloping through sloping soils on uplands. These soils formed in sandy and loamy material under a cover of trees with an understory of native grasses. Depth to the water table is more than 6 feet.

Representative profile of Kamie loamy fine sand, 3 to 8 percent slopes, 2,450 feet south and 130 feet west of the northeast corner of sec. 20, T. 18 N., R. 13 E.:

A1—0 to 6 inches; dark brown (10YR 4/3) loamy fine sand, pale brown (10YR 6/3) dry; weak fine granular structure; soft, very friable; neutral; clear smooth boundary.

A2—6 to 18 inches; brown (7.5YR 5/4) loamy fine sand, pink (7.5YR 7/4) dry; weak fine granular structure; slightly hard, very friable; slightly acid; clear smooth boundary.

B21t—18 to 45 inches; yellowish red (5YR 4/6) sandy clay loam, yellowish red (5YR 5/6) dry; weak fine and medium subangular blocky structure; very hard, friable; thin patchy clay films on faces of peds; medium acid; gradual smooth boundary.

B22t—45 to 54 inches; yellowish red (5YR 5/6) sandy clay loam, reddish yellow (5YR 6/6) dry; weak medium subangular blocky structure; very hard, friable; thin patchy clay films on faces of peds; few clean sand grains in lower part; medium acid; gradual smooth boundary.

B3—54 to 64 inches; yellowish red (5YR 4/6) sandy clay loam, yellowish red (5YR 5/6) dry; weak medium subangular blocky structure; hard, friable; thin patchy clay films bridging sand grains; clean sand grains make up 4 percent of volume; medium acid.

Thickness of the solum and depth to bedrock is more than 60 inches. Thickness of the A horizon is 8 to 20 inches.

The A1 horizon is dark grayish brown (10YR 4/2) or brown (10YR 4/3, 5/3; 7.5YR 4/2). It is fine sandy loam or loamy fine sand and is neutral through medium acid.

The A2 horizon is brown (10YR 4/3, 5/3; 7.5YR 4/4, 5/4), dark yellowish brown (10YR 4/4), yellowish brown (10YR 5/4), or strong brown (7.5YR 5/6). The texture and reaction are the same as the A1 horizon.

The B21t horizon is yellowish red (5YR 4/6, 5/6), dark red (2.5YR 3/6), or red (2.5YR 4/6, 5/6). It is sandy clay loam or clay loam, and it is medium acid or strongly acid.

The B22t horizon is reddish brown (5YR 4/4, 5/4; 2.5YR 5/4), yellowish red (5YR 4/6, 5/6), or red (2.5YR 4/6, 5/6). It is sandy clay loam or clay loam and is medium acid through very strongly acid.

The B3 horizon is yellowish red (5YR 4/6, 5/6), reddish yellow (5YR 6/6), red (2.5YR 4/6, 5/6), or light red (2.5YR 6/6). Its texture and reaction are the same as the B22t horizon.

Kamie soils are on broad ridge crests and side slopes above drainageways. They are usually associated with Cleora, Larton, Okay, Glenpool, and Tullahassee soils.

Kanima Series

The Kanima series consists of deep, moderately permeable, gently sloping to very steep soils on uplands. These soils formed in loamy and shaly materials under a cover of grasses, shrubs, and trees. The water table is at a depth of more than 6 feet.

Representative profile of Kanima shaly silty clay loam, in an area of Kanima soils, 1 to 50 percent slopes, 1,450 feet west and 60 feet south of the northeast corner of sec. 36, T. 18 N., R. 14 E.:

A—0 to 3 inches; dark brown (10YR 4/3) shaly silty clay loam, brown (10YR 5/3) dry; moderate fine granular structure; hard, firm; 15 percent fragments of shale; moderately alkaline; clear wavy boundary.

C—3 to 72 inches; olive gray (5Y 4/2) very shaly silty clay loam, olive gray (5Y 5/2) dry; massive; very hard, very firm; few fragments of silty clay loam with patchy clay films on faces of peds; 60 percent fragments of shale; few medium fragments of shale and coal; extremely acid coatings of iron oxides on faces of some peds; neutral.

Depth to bedrock is more than 6 feet.

The A horizon is dark brown (10YR 4/2; 2.5Y 4/2), very dark grayish brown (10YR 3/2; 2.5Y 3/2), or dark brown (10YR 3/3, 4/3). It is silty clay loam or clay loam or their shaly counterparts. The A horizon is medium acid through moderately alkaline.

The C horizon is very dark grayish brown (10YR 3/2; 2.5Y 3/2), dark grayish brown (10YR 4/2; 2.5Y 4/2), brown (10YR 4/3, 5/3), or olive gray (5Y 4/2, 5/2). It is shaly silty clay loam or shaly clay loam or their very shaly counterparts. The C horizon is medium acid through moderately alkaline.

Kanima soils are in upland strip-mined areas. They are associated with Apperson, Dennis, Lula, and Newtonia soils.

Kiomatia Series

The Kiomatia series consists of deep, rapidly permeable, nearly level soils on flood plains. These soils formed in sandy and loamy alluvium under a cover of trees with

an understory of native grasses. The depth to the water table is 3 to 5 feet during December through June.

Representative profile of Kiomatia loamy fine sand, in an area of Kiomatia soils, 2,250 feet north and 1,500 feet east of the southwest corner of sec. 20, T. 17 N., R. 14 E.:

A1—0 to 10 inches; dark brown (7.5YR 4/4) loamy fine sand, light brown (7.5YR 6/4) dry; single grained; soft, very friable; few thin strata of brown loam and very fine sandy loam; calcareous, moderately alkaline; clear smooth boundary.

C1—10 to 16 inches; reddish brown (5YR 5/4) very fine sandy loam, light reddish brown (5YR 6/4) dry; massive; slightly hard, very friable; calcareous, moderately alkaline; clear smooth boundary.

C2—16 to 61 inches; light brown (7.5YR 6/4) fine sand, pink (7.5YR 8/4) dry; single grained; soft, loose; common fine strata of reddish brown fine sandy loam, very fine sandy loam, and loam; calcareous, moderately alkaline.

The depth to bedrock is more than 60 inches.

The A horizon is brown (7.5YR 4/4, 5/4), strong brown (7.5YR 5/6), light brown (7.5YR 6/4), reddish brown (5YR 4/3, 4/4, 5/3, 5/4), or light reddish brown (5YR 6/4). The texture varies from loamy fine sand or fine sandy loam.

The C horizon is brown (7.5YR 4/4, 5/4), strong brown (7.5YR 5/6), light brown (7.5YR 6/4), reddish brown (5YR 5/4), light reddish brown (5YR 6/4), and pink (7.5YR 7/4; 5YR 7/3). It is fine sand or loamy fine sand with strata of loamy very fine sand through loam.

Kiomatia soils are on nearly level flood plains. They are usually associated with Choska and Severn soils.

Larton Series

The Larton series consists of deep, moderately permeable, nearly level to very gently sloping soils on uplands. These soils formed in sandy and loamy material under a cover of trees with an understory of grasses. The water table is at a depth of more than 6 feet.

Representative profile of Larton loamy fine sand, in an area of Larton-Glenpool complex, 0 to 3 percent slopes, 1,600 feet south and 1,300 feet west of the northeast corner of sec. 28, T. 18 N., R. 13 E.:

A1—0 to 11 inches; dark brown (7.5YR 4/4) loamy fine sand, light brown (7.5YR 6/4) dry; weak fine granular structure; soft, very friable; upper 5 inches is overburden material; slightly acid; gradual smooth boundary.

A2—11 to 30 inches; brown (7.5YR 5/4) loamy fine sand, pink (7.5YR 7/4) dry; weak fine granular structure; slightly hard, friable; medium acid; gradual smooth boundary.

B21t—30 to 36 inches; yellowish red (5YR 4/6) sandy clay loam, yellowish red (5YR 5/6) dry; weak fine subangular blocky structure; hard, firm; thin patchy clay films on faces of peds; medium acid; gradual smooth boundary.

B22t—36 to 54 inches; yellowish red (5YR 4/8) sandy clay loam, yellowish red (5YR 5/8) dry; weak fine and medium subangular blocky structure; hard, firm; thin patchy clay films on faces of peds; medium acid; gradual smooth boundary.

B23t—54 to 66 inches; yellowish red (5YR 4/6) sandy clay loam, yellowish red (5YR 5/6) dry; weak medium subangular blocky structure; hard, friable; thin patchy clay films on faces of peds; few clean sand grains; medium acid.

The solum thickness and depth to sandstone is more than 60 inches. The solum is slightly acid or medium acid.

The A1 or Ap horizon is dark brown (7.5YR 4/4; 10YR 4/3) or pale brown (10YR 6/3). The A2 horizon is brown (7.5YR 4/4, 5/4), strong brown (7.5YR 5/6), or light yellowish brown (10YR 6/4). Thickness of the A horizon is 20 to 40 inches.

The upper part of the B2t horizon is red (2.5YR 4/6, 5/6), yellowish red (5YR 4/6, 4/8, 5/6), or strong brown (7.5YR 5/6). It is sandy clay loam (20 to 30 percent clay). The lower part of the B2t horizon is strong brown (7.5YR 5/6), reddish yellow (5YR 6/6), yellowish red (5YR 4/6, 4/8, 5/6, 5/8), or red (2.5YR 5/6).

Larton soils are on broad, smooth ridge crests and side slopes. They are associated with Kamie and Glenpool soils.

Latanier Series

The Latanier series consists of deep, very slowly permeable, nearly level soils on flood plains. These soils formed in loamy and clayey alluvium under a cover of trees with an understory of native grasses. The depth to the water table is 2.5 to 5 feet for short periods during November through April.

Representative profile of Latanier clay, 1,760 feet west and 320 feet north of the southeast corner of sec. 25, T. 17 N., R. 13 S.:

Ap—0 to 11 inches; dark reddish brown (5YR 3/2) clay, dark reddish gray (5YR 4/2) dry; moderate fine subangular blocky structure; very hard, very firm; moderately alkaline; clear smooth boundary.

B21—11 to 21 inches; dark reddish brown (2.5YR 3/4) clay, reddish brown (2.5YR 4/4) dry; moderate fine and medium blocky structure; very hard, very firm; shiny surfaces on faces of peds; dark material from above horizon; few fine carbonate concretions; calcareous, moderately alkaline; gradual smooth boundary.

B22—21 to 32 inches; dark reddish brown (5YR 3/3) clay, reddish brown (5YR 4/3) dry; moderate fine blocky structure; very hard, very firm; shiny surfaces on faces of peds; few fine particles of organic matter; few fine carbonate concretions; calcareous, moderately alkaline; abrupt wavy boundary.

IIC1—32 to 42 inches; dark reddish brown (5YR 3/3) silty clay loam, reddish brown (5YR 5/3) dry; weak fine subangular blocky structure; hard, friable; thin strata of fine sandy loam and silty clay loam; organic stains on a few peds; few fine carbonate concretions; calcareous, moderately alkaline; clear smooth boundary.

IIIC2—42 to 66 inches; reddish brown (5YR 5/4) fine sandy loam, light reddish brown (5YR 6/4) dry; massive; soft, very friable; thin strata of very fine sandy loam, loam, and clay loam; calcareous, moderately alkaline.

The solum thickness is 24 to 36 inches, and the depth to bedrock is more than 60 inches. The soil is calcareous at a depth of 10 to 36 inches. In some profiles a buried A horizon is within a depth of 40 inches. The clay or silty clay is 24 to 36 inches thick.

The A horizon is dark brown (7.5YR 3/2) or dark reddish brown (5YR 3/2, 3/3). The A horizon is neutral through mildly alkaline and noncalcareous.

The B horizon is dark reddish brown (5YR 3/3, 3/4; 2.5YR 3/4) in the upper part, and it grades to dark red (2.5YR 3/6) in the lower part in some pedons. The B horizon is clay or silty clay, and it is calcareous or noncalcareous and neutral through moderately alkaline.

The C horizon is dark reddish brown (5YR 3/3, 3/4; 2.5YR 3/4), reddish brown (5YR 4/4, 5/4; 2.5YR 4/4, 5/4), yellowish red (5YR 4/6, 5/6), dark red (2.5YR 3/6), and red (2.5YR 4/6, 5/6). The C horizon has strata of very fine sandy loam, loam, and silty clay loam (15 to 30 percent clay). It is mildly or moderately alkaline.

These soils are mostly fine sandy loams in the lower part of this profile; this is outside the range allowed for the Latanier series. Use, behavior, and management are similar to those of the Latanier series.

Latanier soils are on nearly level flood plains. They are associated with Choska and Severn soils.

Linker Series

The Linker series consists of moderately deep, moderately permeable, very gently sloping through gently sloping soils on uplands. These soils formed in loamy material weathered from sandstone under a cover of trees with an understory of grasses. The depth to the water table is greater than 6 feet.

Representative profile of Linker loam, in an area of Hector-Linker complex, 1 to 5 percent slopes, 420 feet east and 30 feet north of the southwest corner of sec. 9, T. 16 N., R. 14 E.:

A1—0 to 2 inches; very dark grayish brown (10YR 3/2) loam, grayish brown (10YR 5/2) dry; weak fine granular structure; slightly hard, very friable; slightly acid; clear smooth boundary.

A2—2 to 5 inches; grayish brown (10YR 5/2) loam, light brownish gray (10YR 6/2) dry; weak fine granular structure; slightly hard, very friable; strongly acid; clear smooth boundary.

B1—5 to 12 inches; reddish brown (5YR 4/4) loam, light reddish brown (5YR 6/4) dry; weak medium subangular blocky structure; hard, friable; patchy clay films on faces of peds; few fine pebbles; strongly acid; clear smooth boundary.

B2t—12 to 26 inches; yellowish red (5YR 4/6) sandy clay loam, reddish yellow (5YR 6/6) dry; moderate medium subangular blocky structure; hard, firm; clay films on faces of peds, 5 percent fine gravel; strongly acid; gradual wavy boundary.

B3—26 to 31 inches; yellowish red (5YR 5/6) gravelly sandy clay loam, reddish yellow (5YR 6/6) dry; common fine brown mottles; weak fine subangular blocky structure; few patchy clay films on faces of peds, 15 percent fine gravel; strongly acid; abrupt wavy boundary.

R—31 to 35 inches; hard, massive sandstone.

Thickness of the soil and depth to sandstone is 20 to 40 inches. The soil is strongly acid or very strongly acid, but it ranges to neutral in limed areas.

The A1 horizon is very dark grayish brown (10YR 3/2), dark grayish brown (10YR 4/2), or brown (7.5YR 4/2). The A2 horizon is grayish brown (10YR 5/2), brown (10YR 5/3; 7.5YR 5/2, 5/4), or yellowish brown (10YR 5/4). The A1 and A2 horizons are 0 to 5 percent gravel.

The B1 horizon is strong brown (7.5YR 5/6) or yellowish red (5YR 4/6, 4/8, 5/6, 5/8). It is loam or sandy clay loam and is 0 to 5 percent gravel.

The B2t horizon is red (2.5YR 4/6, 4/8, 5/6, 5/8) or yellowish red (5YR 4/6, 4/8, 5/6, 5/8). It is loam, clay loam, or sandy clay loam (18 to 28 percent clay and 0 to 5 percent gravel).

The B3 horizon is similar in color to the B2t horizon but contains brownish mottles. It is also similar in texture but is 0 to 15 percent gravel.

These soils have a slightly less acid A1 horizon than is typical for the Linker series. Use, behavior, and management are similar to those of the Linker series.

Linker soils are on broad, very gently sloping through gently sloping uplands. They are associated with Enders and Hector soils.

Lula Series

The Lula series consists of deep, moderately permeable, very gently sloping soils on uplands. These soils formed in loamy material weathered from limestone under a cover of grasses. The depth to the water table is more than 6 feet.

Representative profile of Lula silt loam, 1 to 3 percent slopes, 1,500 feet north and 1,050 feet west of the southeast corner of sec. 21, T. 19 N., R. 14 E.:

A1—0 to 14 inches; dark reddish brown (5YR 3/2) silt loam, reddish gray (5YR 5/2) dry; moderate fine granular structure; slightly hard, firm; few worm casts; medium acid; gradual smooth boundary.

B1—14 to 19 inches; dark reddish brown (5YR 3/4) silty clay loam, reddish brown (5YR 4/4) dry; moderate fine and medium granular structure; hard, friable; thin patchy clay films on faces of peds; few worm casts; medium acid, gradual smooth boundary.

B21t—19 to 37 inches; dark red (2.5YR 3/6) silty clay loam, red (2.5YR 4/6) dry; moderate fine and medium blocky structure; hard, firm; continuous clay films on faces of peds; few worm casts in upper part; organic staining in root channels; few fine iron-manganese concretions; medium acid; gradual smooth boundary.

B22t—37 to 54 inches; dark red (2.5YR 3/6) silty clay loam, red (2.5YR 4/6) dry; moderate fine and medium blocky structure; hard, firm; continuous clay films on faces of peds; few fine and medium iron-manganese concretions; organic staining in few root channels; few fine pebbles and weathered fragments; medium acid; abrupt wavy boundary.

R—54 to 60 inches; hard limestone bedrock.

Thickness of the solum and depth to bedrock is 40 to 60 inches.

The A horizon is dark reddish brown (5YR 3/2, 3/3), dark brown (7.5YR 3/2; 10YR 3/3), or very dark grayish brown (10YR 3/2). It is slightly acid or medium acid.

The B1 horizon is dark reddish brown (5YR 3/3, 3/4), reddish brown (5YR 4/3, 4/4), dark brown (7.5YR 4/4), or dark yellowish brown (10YR 3/4, 4/4). It is silt loam or silty clay loam and is slightly acid or medium acid.

The B2t horizon is dark brown (7.5YR 4/4), dark reddish brown (5YR 3/4; 2.5YR 3/4), reddish brown (5YR 4/4; 2.5YR 4/4), yellowish red (5YR 4/6), dark red (2.5YR 3/6), or red (2.5YR 4/6). The B2t horizon is slightly acid through strongly acid.

Lula soils are on broad, smooth ridge crests and side slopes. They are associated with Apperson, Catoosa, Kanima, and Newtonia soils.

Mason Series

The Mason series consists of deep, moderately slowly permeable, nearly level soils on flood plains. These soils formed in loamy alluvium under a cover of grasses and scattered trees. The depth to the water table is more than 6 feet.

Representative profile of Mason silt loam, 1,200 feet north and 60 feet west of the southeast corner of sec. 7, T. 17 N., R. 14 E.:

A1—0 to 13 inches; very dark grayish brown (10YR 3/2) silt loam, dark grayish brown (10YR 4/2) dry; moderate fine granular structure; slightly hard, friable; few worm casts in lower part; neutral; gradual smooth boundary.

B21t—13 to 21 inches; very dark grayish brown (10YR 3/2) silty clay loam, dark grayish brown (10YR 4/2) dry; moderate fine subangular blocky structure; hard, friable; patchy clay films on faces of peds; few worm casts; slightly acid; gradual smooth boundary.

B22t—21 to 37 inches; very dark grayish brown (10YR 3/2) silty clay loam, grayish brown (10YR 5/2) dry; moderate medium subangular blocky structure; hard, firm; patchy clay films on faces of peds; slightly acid; gradual smooth boundary.

B3—37 to 56 inches; dark brown (10YR 3/3) silty clay loam, brown (10YR 5/3) dry; moderate medium subangular blocky structure; hard, firm; patchy clay films; slightly acid; gradual smooth boundary.

C—56 to 64 inches; dark brown (7.5YR 4/4) silty clay loam, brown (7.5YR 5/4) dry; massive; hard, firm; few fine iron-manganese concretions; few small pockets of silt loam; neutral.

Thickness of the solum is 40 to more than 60 inches, and the depth to bedrock is more than 60 inches. The mollic epipedon is more than 20 inches thick.

The A horizon is very dark grayish brown (10YR 3/2) or very dark brown (10YR 2/2). It is neutral through medium acid.

The B2t horizon is very dark grayish brown (10YR 3/2), dark brown (7.5YR 3/2, 4/2, 4/4; 10YR 3/3, 4/3), dark grayish brown (10YR 4/2), and dark yellowish brown (10YR 3/4, 4/4). It is silt loam or silty clay loam and is slightly acid or medium acid.

The B3 horizon is similar in color, texture, and reaction to the B2t horizon. In a few pedons, it has gray, brown, and red mottles.

The C horizon is similar in color and texture to the B3 horizon. It is weakly stratified in a few pedons. The C horizon is slightly acid through mildly alkaline.

Mason soils are on flood plains. They are associated with Osage, Radley, and Wynona soils.

Newtonia Series

The Newtonia series consists of deep, moderately permeable, very gently sloping to gently sloping soils on uplands. These soils formed in loamy and clayey sediments under a cover of grasses. The water table is at a depth of more than 6 feet.

Representative profile of Newtonia silt loam, 1 to 3 percent slopes, 2,080 feet east and 200 feet south of the northwest corner of sec. 19, T. 20 N., R. 14 E.:

A1—O to 11 inches; dark brown (7.5YR 3/2) silt loam, brown (7.5YR 5/2) dry; moderate fine granular structure; slightly hard, friable; slightly acid; gradual smooth boundary.

B1—11 to 18 inches, dark reddish brown (5YR 3/3) silt loam, reddish brown (5YR 5/3) dry; moderate fine and medium subangular blocky structure; hard, friable; few worm casts; medium acid; gradual smooth boundary.

B21t—18 to 26 inches; dark reddish brown (2.5YR 3/4) silty clay loam, reddish brown (2.5YR 4/4) dry; moderate fine and medium subangular blocky structure; hard, friable; few worm casts, nearly continuous clay films on faces of peds; strongly acid; gradual smooth boundary.

B22t—26 to 46 inches; dark red (2.5YR 3/6) silty clay loam, red (2.5YR 4/6) dry; moderate fine and medium subangular blocky structure; hard, friable; nearly continuous clay films on faces of peds; medium acid; gradual smooth boundary.

B3—46 to 62 inches; red (2.5YR 4/6) silty clay loam, red (2.5YR 5/6) dry; moderate fine subangular blocky structure; hard, friable; nearly continuous clay films on faces of peds; slightly acid.

Soils thickness and depth to bedrock is more than 60 inches.

The A horizon is very dark grayish brown (10YR 3/2), dark brown (10YR 3/3; 7.5YR 3/2), or dark reddish brown (5YR 3/2, 3/3). It is slightly acid or medium acid.

The B1 horizon is dark brown (7.5YR 3/2, 4/2, 4/4), dark reddish brown (5YR 3/2, 3/3, 3/4), or reddish brown (5YR 4/3, 4/4). It is silt loam or silty clay loam and is slightly acid through strongly acid.

The B2t horizon is dark reddish brown (5YR 3/3, 3/4; 2.5YR 3/4), reddish brown (5YR 4/3, 4/4; 2.5YR 4/4), yellowish red (5YR 4/6), dark red (2.5YR 3/6), and red (2.5YR 4/6). It is silty clay loam, silty clay, or clay, and the upper 20 inches of the argillic horizon averages from 30 to 35 percent clay. The B2t horizon is medium acid or strongly acid.

The B3 horizon is dark red (2.5YR 3/6), red (2.5YR 4/6), and yellowish red (5YR 4/6). It is similar in texture to the B2t horizon.

Newtonia soils are on ridge crests and side slopes of uplands. They are associated with Catoosa, Dennis, Kanima, Lula, and Okay soils.

Niotaze Series

The Niotaze series consists of moderately deep, slowly permeable, gently sloping through steep soils on uplands. These soils formed in loamy and clayey sediments weathered from shale under a cover of trees with an understory of native grasses. The water table is at a depth of 1 to 3 feet for brief periods during November through April.

Representative profile of Niotaze gravelly and cobbly fine sandy loam, in an area of Niotaze-Darnell complex, 15 to 25 percent slopes, 1,570 feet north and 250 feet east of the southwest corner of sec. 3, T. 18 N., R. 13 E.:

A1—O to 5 inches; very dark grayish brown (10YR 3/2) gravelly and cobbly fine sandy loam; weak very fine granular structure; soft, very friable; 15 percent gravel and cobbles, 15 percent stones; medium acid; clear smooth boundary.

A2—5 to 12 inches; brown (10YR 5/3) gravelly and cobbly fine sandy loam; weak very fine granular structure; soft, very friable; 15 percent gravel and cobbles, 15 percent stones; strongly acid; abrupt smooth boundary.

IIB2t—12 to 28 inches; coarsely mottled reddish brown (5YR 4/4) and brown (7.5YR 5/4) clay; weak medium subangular blocky structure; very hard, very firm; clay films on faces of peds, few fragments of sandstone; very strongly acid; gradual smooth boundary.

IIB3—28 to 35 inches; coarsely mottled yellowish red (5YR 4/6) light olive brown (2.5Y 5/4) and gray (10YR 5/1) clay; weak coarse subangular blocky structure; very hard, very firm; thin patchy clay films on faces of peds; few fine fragments of sandstone; very strongly acid; clear wavy boundary.

IICr—35 to 60 inches; soft stratified grayish shale.

Thickness of the solum and depth to shale is 20 to 40 inches.

The A1 horizon is very dark grayish brown (10YR 3/2), dark grayish brown (10YR 4/2), or dark brown (10YR 3/3, 4/3). It is fine sandy loam and gravelly, cobbly, or stony fine sandy loam. The A1 horizon is slightly acid or medium acid.

The A2 horizon is grayish brown (10YR 5/2), brown (10YR 5/3; 7.5YR 5/2), light brownish gray (10YR 6/2), pinkish gray (7.5YR 6/2), or pale brown (10YR 6/3). It is similar in texture to the A1 horizon, and it is medium acid or strongly acid.

The IIB2t horizon is olive brown (2.5Y 4/4), light olive brown (2.5Y 5/4, 6/6), yellowish brown (10YR 5/4, 5/6), dark yellowish brown (10YR 4/4), brown (10YR 4/3, 5/3; 7.5YR 4/4, 5/4), strong brown (7.5YR 5/6), reddish brown (5YR 4/3, 4/4, 5/3, 5/4; 2.5YR 4/4, 5/4), yellowish red (5YR 4/6, 5/6), or red (2.5YR 4/6, 5/6). In most pedons it has reddish, brownish, or yellowish mottles. The IIB2t horizon is silty clay loam, silty clay, or clay, and some pedons have a few fragments of sandstone. It is slightly acid to very strongly acid.

The IIB3 horizon is similar in color and texture to the IIB2t horizon. It is neutral to strongly acid.

Niotaze soils are on smooth side slopes of uplands. They are associated with Darnell soils.

Okay Series

The Okay series consists of deep, moderately permeable, nearly level to gently sloping soils on uplands. These soils formed in loamy material under native grass and scattered trees. The water table is at a depth of more than 6 feet.

Representative profile of Okay loam, 1 to 3 percent slopes, 2,600 feet south and 100 feet west of the northeast corner of sec. 12, T. 17 N., R 14 E.:

A1—O to 12 inches; dark brown (10YR 3/3) loam, brown (10YR 5/3) dry; moderate fine granular structure; slightly hard, friable; many fine roots; slightly acid; gradual smooth boundary.

B1—12 to 18 inches; dark brown (7.5YR 3/2) loam, dark brown (7.5YR 4/2) dry; moderate fine subangular blocky structure: hard, friable;

few fine roots; thin patchy clay films on faces of peds; slightly acid; gradual smooth boundary.

B21t—18 to 38 inches, reddish brown (5YR 4/4) clay loam, reddish brown (5YR 5/4) dry; moderate medium subangular blocky structure; very hard, firm; few fine roots; nearly continuous clay films on faces of peds; slightly acid; gradual smooth boundary.

B22t—38 to 46 inches; reddish brown (5YR 5/4) clay loam, light reddish brown (5YR 6/4) dry; moderate medium subangular blocky structure; very hard, firm; nearly continuous clay films on faces of peds; slightly acid; gradual smooth boundary.

B3—46 to 70 inches; reddish brown (5YR 5/4) loam, light reddish brown (5YR 6/4) dry; weak medium subangular blocky structure; hard, friable; few pockets of clean sand grains in lower part; slightly acid.

The solum is 40 to more than 60 inches thick, and the depth to bedrock is more than 60 inches.

The A horizon is dark brown (10YR 3/3; 7.5YR 3/2), very dark grayish brown (10YR 3/2), or dark reddish brown (5YR 3/2, 3/3). It is slightly acid or medium acid.

The B1 horizon is dark brown or brown (7.5YR 3/2, 4/2, 4/4), dark reddish brown (5YR 3/2, 3/3, 3/4), dark reddish gray (5YR 4/2), or reddish brown (5YR 4/3, 4/4). It is loam, clay loam, or sandy clay loam and is slightly acid or medium acid.

The B2t horizon is dark brown (7.5YR 4/4, 5/4), strong brown (7.5YR 5/6, 5/8), yellowish red (5YR 4/6, 4/8, 5/6, 5/8), dark reddish brown (2.5YR 3/4; 5YR 3/4), dark red (2.5YR 3/6), reddish brown (2.5YR 4/4, 5/4; 5YR 4/4, 5/4), or red (2.5YR 4/6, 4/8, 5/6, 5/8). It is loam, clay loam, or sandy clay loam (18 to 30 percent clay). The reaction of the B2t horizon is slightly acid through strongly acid.

The B3 horizon has similar colors to the B2t horizon. It is fine sandy loam, loam, or sandy clay loam that has appreciably less clay than the B2t horizon. The B3 horizon is neutral through strongly acid.

The C horizon has loamy sediments similar in color and reaction to the B3 horizon.

Okay series are on broad areas of uplands. They are associated with Kamie and Newtonia soils.

Okemah Series

The Okemah series consists of deep, slowly permeable, nearly level soils on uplands. These soils formed in loamy and clayey sediments weathered from shales under a cover of native grasses. The water table is at a depth of 2 to 3 feet feet during December through April.

Representative profile of Okemah silt loam, O to 1 percent slopes, 800 feet west and 150 feet south of the northeast corner of sec. 12, T. 22 N., R. 13 E.:

Ap—O to 9 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; moderate fine granular structure; hard, friable; medium acid; clear smooth boundary.

A1—9 to 14 inches; very dark brown (10YR 2/2) silt loam, dark grayish brown (10YR 4/2) dry; moderate fine granular structure; hard, friable; slightly acid; clear smooth boundary.

A3—14 to 20 inches; very dark brown (10YR 2/2) silt loam, dark grayish brown (10YR 4/2) dry; moderate fine subangular blocky structure; hard, firm; neutral; gradual smooth boundary.

B21t—20 to 28 inches; very dark grayish brown (2.5Y 3/2) silty clay, grayish brown (2.5Y 5/2) dry; with few fine prominent yellowish red mottles; moderate fine subangular blocky structure; very hard, very firm; clay films on faces of peds; few fine iron- manganese concretions; mildly alkaline; gradual smooth boundary.

B22t—28 to 48 inches; coarsely mottled dark yellowish brown (10YR 4/4), light olive brown (2.5Y 5/6), and grayish brown (10YR 5/2) silty clay; weak medium subangular blocky structure; very hard, very firm; clay films on faces of peds; common fine iron-manganese concretions; mildly alkaline; gradual smooth boundary.

B3—48 to 68 inches; coarsely mottled dark grayish brown (2.5Y 4/2), grayish brown (2.5Y 5/2), and strong brown (7.5YR 5/6) silty clay; weak coarse subangular blocky structure; very hard, very firm; few fine iron-manganese concretions; moderately alkaline.

Thickness of the solum and depth to bedrock is more than 60 inches. Thickness of the A horizon is 15 to 26 inches.

The A horizon is very dark grayish brown (10YR 3/2), very dark brown (10YR 2/2), very dark gray (10YR 3/1), or black (10YR 2/1). It is medium acid through neutral.

The B2t horizon is mainly very dark grayish brown (10YR 3/2; 2.5Y 3/2), dark grayish brown (10YR 4/2; 2.5Y 4/2), dark gray (10YR 4/1), or very dark gray (10YR 3/1). In the lower part in most pedons, the B2t horizon is mottled in grayish, brownish, and reddish shades. It is silty clay loam, silty clay, or clay, and it is medium acid through mildly alkaline.

The B3 horizon has colors similar to those of the B2t horizon and has many coarse mottles in the lower part. It is neutral through moderately alkaline.

Okemah soils are on broad, smooth, nearly level uplands. They are associated with Apperson, Carytown, Coweta, Dennis, and Parsons soils.

Osage Series

The Osage series consists of deep, very slowly permeable, nearly level soils on flood plains. These soils formed in loamy and clayey alluvium under a cover of trees with an understory of native grasses. The water table is near the surface for brief to long periods during November through May.

Representative profile of Osage silty clay, 1,000 feet west and 750 feet south of the northeast corner of sec. 14, T. 20 N., R. 13 E.:

A11—O to 8 inches; black (10YR 2/1) silty clay, very dark gray (10YR 3/1) dry; strong fine granular structure; very hard, very firm; few very fine white specks; medium acid; gradual smooth boundary.

A12—8 to 18 inches; black (10YR 2/1) silty clay, very dark gray (10YR 3/1) dry; few fine distinct strong brown mottles; moderate fine and medium subangular blocky structure; very hard, very firm; common very fine white specks; medium acid; gradual smooth boundary.

B2g—18 to 38 inches; very dark gray (N 3/0) silty clay, dark gray (N 4/0) dry; few fine distinct strong brown mottles; moderate fine and medium subangular blocky structure; very hard, very firm; few slickensides; common very fine white specks; medium acid; gradual smooth boundary.

B3g—38 to 62 inches; very dark gray (N 3/0) silty clay, dark gray (N 4/0) dry; common fine strong brown mottles; weak moderate subangular blocky structure; very hard, very firm; few very fine white specks; few fine iron-manganese concretions; few slickensides; slightly acid.

Thickness of the solum is more than 40 inches, and depth to bedrock is more than 60 inches.

The A horizon is black (10YR 2/1), very dark gray (10YR 3/1), very dark brown (10YR 2/2), and very dark grayish brown (10YR 3/2). It is strongly acid to neutral.

The B horizon is black (N 2/0; 5Y 2/1), or very dark gray (N 3/0; 5Y 3/1). It is silty clay loam, silty clay, or clay (35 to 60 percent clay). The B horizon is medium acid to neutral in the upper part and slightly acid to mildly alkaline in the lower part. It is calcareous below a depth of 36 inches in some pedons.

Osage soils are on broad, nearly level flood plains. They are associated with Mason, Radley, and Wynona soils.

Parsons Series

The Parsons series consists of deep, very slowly permeable, nearly level soils on uplands. These soils formed in loamy and clayey material under a cover of grasses. The water table is at a depth of 0.5 to 1.5 feet during December through April.

Representative profile of Parsons silt loam, in an area of Okemah-Parsons-Carytown complex, 0 to 1 percent slopes, 120 feet south and 150 feet west of the northeast corner of sec. 23, T. 18 N., R. 13 E.:

A1—0 to 8 inches; very dark grayish brown (10YR 3/2) silt loam, dark grayish brown (10YR 4/2) dry; weak fine granular structure; slightly hard, friable; slightly acid; gradual smooth boundary.

A2—8 to 14 inches; dark grayish brown (10YR 4/2) silt loam, grayish brown (10YR 5/2) dry; weak fine granular structure; slightly hard, friable; slightly acid; abrupt wavy boundary.

B21tg—14 to 23 inches; very dark gray (10YR 3/1) clay, dark gray (10YR 4/1) dry; few fine reddish brown and yellowish red mottles; moderate medium blocky structure; extremely hard, very firm; pressure faces on peds; thin light gray coatings on faces of some peds; slightly acid; gradual smooth boundary.

B22tg—23 to 37 inches; dark gray (10YR 4/1) clay, gray (10YR 5/1) dry; few fine reddish brown mottles; moderate medium blocky structure; extremely hard, very firm; pressure faces on some peds; slightly acid; gradual smooth boundary.

B23t—37 to 52 inches; gray (10YR 5/1) clay, gray (10YR 6/1) dry; common fine strong brown mottles; coarse blocky structure; very hard, very firm; pressure faces on some peds, few fine organic stains; slightly acid; gradual smooth boundary.

B3—52 to 74 inches; gray (10YR 5/1) clay, gray (10YR 6/1) dry with common coarse strong brown (7.5YR 5/6) mottles; weak coarse blocky structure; very hard, very firm; pressure faces on some peds; mildly alkaline.

Thickness of the solum and depth to bedrock is more than 60 inches.

The A1 horizon is very dark grayish brown (10YR 3/2) or dark grayish brown (10YR 4/2).

The A2 horizon is grayish brown (10YR 5/2), dark grayish brown (10YR 4/2), or gray (10YR 5/1). Thickness of the A1 and A2 horizons is less than 16 inches.

The B2t horizon is very dark gray (10YR 3/1), dark gray (10YR 4/1), gray (10YR 5/1), very dark grayish brown (10YR 3/2; 2.5Y 3/2), dark grayish brown (10YR 4/2; 2.5Y 4/2), or grayish brown (10YR 5/2; 2.5Y 5/2). It has reddish, grayish, or brownish mottles, and it is slightly acid or medium acid.

The B3 horizon is similar to the B2t horizon in color and texture. It is slightly acid through mildly alkaline.

Parsons soils are on smooth uplands. They are associated with Carytown, Dennis, and Okemah soils.

Radley Series

The Radley series consists of deep, moderately permeable, nearly level soils on flood plains. These soils formed in loamy alluvium under a cover of mostly oak trees with an understory of native grasses. Depth to the water table is more than 6 feet.

Representative profile of Radley silt loam, 1,500 feet north and 400 feet east of the southwest corner of sec. 1, T. 20 N., R. 13 E.:

A1—0 to 10 inches; dark brown (10YR 3/3) silt loam, brown (10YR 5/3) dry; moderate fine granular structure; slightly hard, friable; organic stains in a few root channels; neutral; gradual smooth boundary.

B2—10 to 18 inches; brown (10YR 4/3) silt loam, pale brown (10YR 6/3) dry; weak fine granular structure; hard, friable; organic stains in a few root channels; neutral; clear smooth boundary.

C1—18 to 36 inches; brown (10YR 4/3) silt loam, pale brown (10YR 6/3) dry; with few fine faint yellowish brown mottles; massive; hard, friable; organic stains in few root channels; neutral; clear smooth boundary.

C2—36 to 62 inches; brown (10YR 5/3) silt loam, pale brown (10YR 6/3) dry; with common medium faint yellowish brown (10YR 5/6) and few common faint gray (10YR 5/1) mottles; massive; hard, friable; few thin strata of very fine sandy loam to silt loam; neutral.

Thickness of solum ranges from 10 to 30 inches, and depth to bedrock is more than 60 inches. All horizons are medium acid through neutral.

The A horizon is very dark grayish brown (10YR 3/2), dark brown (10YR 3/3), or very dark brown (10YR 2/2). In some pedons brownish, reddish, or yellowish mottles are below a depth of 20 inches.

The B2 horizon is dark grayish brown (10YR 4/2), grayish brown (10YR 5/2), or brown (10YR 4/3, 5/3; 7.5YR 4/2, 5/2). In some pedons, it has brownish, yellowish, and reddish mottles. The B2 horizon is silt loam or silty clay loam (18 to 35 percent clay).

The C horizon is similar to the B2 horizon in color and texture. Thin strata of finer and coarser textured material is below a depth of 40 inches.

Radley soils are on flood plains. They are associated with Cleora, Mason, Osage, and Wynona soils.

Severn Series

The Severn series consists of deep, moderately rapidly permeable, nearly level soils on flood plains. These soils formed in loamy and sandy alluvium under a cover of trees with an understory of native grasses. The water table is at a depth of more than 6 feet.

Representative profile of Severn very fine sandy loam, 300 feet north and 150 feet west of the southeast corner of sec. 18, T. 17 N., R. 14 E.:

Ap—0 to 8 inches; reddish brown (5YR 4/3) very fine sandy loam, reddish brown (5YR 5/3) dry; weak fine granular structure; soft, very friable; mildly alkaline; gradual smooth boundary.

C1—8 to 28 inches; reddish brown (5YR 4/4) very fine sandy loam, light reddish brown (5YR 6/4) dry; weak fine granular structure; soft, very friable; few thin strata of very fine sand, fine sandy loam, and loam; calcareous, moderately alkaline; clear smooth boundary.

C2—28 to 48 inches; yellowish red (5YR 4/6) very fine sandy loam, reddish yellow (5YR 6/6) dry; weak granular structure; soft, very friable; calcareous, moderately alkaline; clear smooth boundary.

C3—48 to 60 inches; reddish brown (5YR 4/4) very fine sandy loam, reddish brown (5YR 5/4) dry; massive; slightly hard, friable; few thin strata of fine sandy loam and very fine sand; calcareous, moderately alkaline.

The depth to bedrock is more than 60 inches. These soils are calcareous in all horizons below a depth of 10 inches. Some profiles are calcareous to the surface.

The A horizon is dark brown (7.5YR 3/2, 4/4), dark reddish brown (5YR 3/4), or reddish brown (5YR 4/3, 4/4, 5/4).

The C horizon is strong brown (7.5YR 5/6), reddish brown (5YR 4/4, 5/4; 2.5YR 4/4, 5/4), yellowish red (5YR 4/6, 5/6), or reddish yellow (5YR 6/6; 7.5YR 6/6) loamy very fine sand and very fine sandy loam with thin strata of fine sandy loam, loam, and silt loam.

Severn soils are on flood plains. They are associated with Choska, Cleora, Kiomatia, and Latanier soils.

Shidler Series

The Shidler series consists of shallow, moderately permeable, very gently sloping to strongly sloping soils on uplands. These soils formed in loamy material over limestone under a cover of native grasses. The water table is at a depth of more than 6 feet.

Representative profile of Shidler silty clay loam, in an area of Shidler-Rock outcrop complex, 1 to 12 percent slopes, 1,600 feet south and 1,260 feet west of the northeast corner of sec. 15, T. 19 N., R. 14 E.:

A11—0 to 4 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; moderate fine granular structure; hard, firm; few worm casts; few fragments of limestone less than 3 inches in diameter; mildly alkaline; gradual smooth boundary.

A12—4 to 9 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; moderate fine and medium subangular blocky structure; hard, firm; few worm casts; few small pressure faces on peds; 5 percent by volume limestone fragments less than 3 inches in diameter; mildly alkaline; gradual smooth boundary.

A13—9 to 16 inches; very dark brown (10YR 2/2) silty clay loam, very dark grayish brown (10YR 3/2) dry; moderate fine and medium subangular blocky structure; hard, firm; few pressure faces on peds; about 10 percent by volume limestone fragments less than 3 inches in diameter; calcareous, moderately alkaline; abrupt wavy boundary.

R—16 to 20 inches; hard gray limestone bedrock.

The thickness of the solum and depth to hard limestone ranges from 4 to 20 inches.

The A horizon is black (10YR 2/1), very dark gray (10YR 3/1), very dark brown (10YR 2/2), very dark grayish brown (10YR 3/2), and dark brown (10YR 3/3; 7.5YR 3/2). It is silt loam or silty clay loam, and rock fragments make up less than 35 percent of the horizon. Rock fragments ranging from 10 to 36 inches in diameter make up 0 to 15 percent of the horizon, and fragments ranging from 3 to 10 inches in diameter make up 0 to 20 percent. The A horizon is neutral through mildly alkaline. It is calcareous in the lower part in most pedons.

The R layer is grayish limestone.

Shidler soils are on broad, smooth ridge crests. They are associated with Apperson and Catoosa soils.

Tullahassee Series

The Tullahassee series consists of deep, moderately rapidly permeable, nearly level soils on flood plains. These soils formed in sandy and loamy alluvium under a cover of trees with an understory of native grasses. The water table is at a depth of 2 to 3 feet during November through May.

Representative profile of Tullahassee fine sandy loam, 150 feet east and 150 feet south of the northwest corner of sec. 28, T. 18 N., R. 13 E.:

A1—0 to 8 inches; dark brown (10YR 4/3) fine sandy loam, pale brown (10YR 6/3) dry; weak fine granular structure; soft, friable; slightly acid; gradual smooth boundary.

C1—8 to 21 inches; dark grayish brown (10YR 4/2) fine sandy loam, light brownish gray (10YR 6/2) dry; few medium distinct reddish yellow (7.5YR 7/6) and brownish yellow (10YR 6/8) mottles; soft, friable; thin strata of loamy fine sand, loam, or silt loam; slightly acid; gradual smooth boundary.

C2—21 to 45 inches; brown (10YR 5/3) fine sandy loam, pale brown (10YR 6/3) dry; few medium distinct strong brown (7.5YR 5/8) and few coarse distinct dark gray (10YR 4/1) mottles; soft, friable; thin strata of sand, loamy fine sand, loam, or silt loam; slightly acid; gradual smooth boundary.

C3—45 to 64 inches; dark grayish brown (10YR 4/2) fine sandy loam, grayish brown (10YR 5/2) dry; few medium distinct strong brown (7.5YR 5/8) and few coarse distinct dark gray (10YR 4/1) mottles; soft, friable; thin strata of fine sandy loam, loam or silt loam; slightly acid.

The depth to bedrock is more than 60 inches. Reaction in all horizons is slightly acid or medium acid.

The A horizon is dark grayish brown (10YR 4/2), brown (10YR 4/3, 5/3; 7.5YR 4/2, 4/4, 5/2, 5/4), dark yellowish brown (10YR 4/4), grayish brown (10YR 5/2), or yellowish brown (10YR 5/4). It is mottled with brown or gray in some pedons.

The C1 horizon is similar in color to the A horizon. It is mottled in gray, brown, red, or yellow. It is fine sandy loam or loam and has thin strata of loamy fine sand or silt loam.

The C2 and C3 horizons are very dark grayish brown (10YR 3/2), brown (10YR 3/3, 4/3, 5/3; 7.5YR 3/2, 4/2, 5/2), dark grayish brown (10YR 4/2), grayish brown (10YR 5/2), light brownish gray (10YR 6/2), pale brown (10YR 6/3), or pinkish gray (7.5YR 6/2). They are mottled in brown, gray, yellow, or red. The C2 and C3 horizons are fine sandy loam or loam and have thin strata of sand, loamy fine sand, or silt loam.

Tullahassee soils are on smooth, nearly level flood plains. They are associated with Cleora, Glenpool, and Kamie soils.

Wynona Series

The Wynona series consists of deep, slowly permeable, nearly level soils on flood plains. These soils formed in loamy and clayey alluvium under a cover of trees with an understory of native grasses. The water table is at the surface to a depth of 2 feet for short periods during November through April.

Representative profile of Wynona silty clay loam, 1,450 feet east and 60 feet south of the northeast corner of sec. 1, T. 22 N., R. 12 E.:

Ap—0 to 10 inches; very dark brown (10YR 2/2) silty clay loam, dark grayish brown (10YR 4/2) dry; moderate fine granular structure; hard, firm; mildly alkaline; clear smooth boundary.

A1—10 to 23 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; few fine distinct brown mottles in lower part; moderate fine granular structure; hard, firm; few worm casts; slightly acid; gradual smooth boundary.

B2g—23 to 42 inches; very dark gray (10YR 3/1) silty clay loam, dark gray (10YR 4/1) dry; common fine distinct brown mottles; moderate fine subangular blocky structure; hard, firm; slightly acid; gradual smooth boundary.

B3g—42 to 64 inches; very dark gray (10YR 3/1) silty clay loam, dark gray (10YR 4/1) dry; many medium distinct brown (7.5YR 4/4) mottles; weak fine subangular blocky structure; neutral.

Solum thickness ranges from 40 to more than 60 inches, and the depth to bedrock is more than 60 inches. The A horizon is black (10YR 2/1), very dark brown (10YR 2/2), very dark gray (10YR 3/1), or very dark grayish brown (10YR 3/2) and is mottled in shades of brown or red. It is slightly acid or medium acid except in limed areas, where it ranges to mildly alkaline.

The A1 horizon is very dark gray (10YR 3/1), very dark grayish brown (10YR 3/2), or dark grayish brown (10YR 4/2) with brownish, grayish, or reddish mottles. It is slightly acid through medium acid.

The B2g horizon is very dark gray (10YR 3/1), dark gray (10YR 4/1), very dark grayish brown (10YR 3/2), or dark brown (10YR 3/3, 4/3). Some pedons are mottled in shades of red, brown, or gray. The B3g horizon is silty clay loam or silty clay, and it is slightly acid through strongly acid.

Wynona soils are on broad flood plains. They are associated with Cleora, Mason, Osage, and Radley soils.

Classification

The system of soil classification currently used was adopted by the National Cooperative Soil Survey in 1965. Readers interested in further details about the system should refer to the latest literature available (*4*).

The system of classification has six categories. Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. In this system the classification is based on the different soil properties that can be observed in the field or those that can be inferred either from other properties that are observable in the field or from the combined data of soil science and other disciplines. The properties selected for the higher categories are the result of soil genesis or of factors that affect soil genesis. In table 20, the soils of the survey area are classified according to the system. Categories of the system are discussed in the following paragraphs.

ORDER. Ten soil orders are recognized as classes in the system. The properties used to differentiate among orders are those that reflect the kind and degree of dominant soil-forming processes that have taken place. Each order is identified by a word ending in *sol*. An example is Entisol.

SUBORDER. Each order is divided into suborders based primarily on properties that influence soil genesis and are important to plant growth or that are selected to reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Aquent (*Aqu*, meaning water, plus *ent*, from Entisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of expression of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and a prefix that suggests something about the properties of the soil. An example is Haplaquents (*Hapl*, meaning simple horizons, plus *aquent*, the suborder of Entisols that have an aquic moisture regime).

SUBGROUP. Each great group may be divided into three subgroups: the central (typic) concept of the great groups, which is not necessarily the most extensive subgroup; the intergrades, or transitional forms to other orders, suborders, or great groups; and the extragrades, which have some properties that are representative of the great groups 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 for the subgroup that is thought to typify the great group. An example is Typic Haplaquents.

FAMILY. Families are established within a subgroup on the basis of similar physical and chemical properties that affect management. Among the properties considered in horizons of major biological activity below plow depth are particle-size distribution, mineral content, temperature regime, thickness of the soil penetrable by roots, consistence, moisture equivalent, soil slope, and permanent cracks. A family name consists of the name of a subgroup and a series of adjectives. The adjectives are the class names for the soil properties used as family differentiae. An example is fine-loamy, mixed, nonacid, mesic, Typic Haplaquents.

SERIES. The series consists of soils that formed in a particular kind of material and have horizons that, except for texture of the surface soil or of the underlying substratum, are similar in differentiating characteristics and in arrangement in the soil profile. Among these characteristics are color, texture, structure, reaction, consistence, and mineral and chemical composition.

Formation of the Soils

In this section the five major factors that affect the formation of soils are described. Soil is produced by the action of soil-forming processes on materials desposited or accumulated by geologic agencies. The characteristics of the soil at any given point are determined by the physical and mineral composition of the parent material; the climate under which the soil material has accumulated and has existed since accumulation; the plant and animal life on and in the soil; the relief, or lay of the land; and the length of time the forces of soil formation have acted on the parent material.

Climate and vegetation are the active factors in soil formation. They act on the parent material accumulated through the weathering of rocks and slowly change it into a natural body that has genetically related horizons. The effects of climate and vegetation are conditioned by relief. The parent material also affects the nature of the profile and, in extreme instances, determines most of its characteristics. Finally, time is needed to change the parent material into a soil profile. It may be much or little, but generally much time is required to develop a profile that has distinct horizons.

The five factors of soil formation are so closely interrelated in their effects on the soil that few generalizations can be made about the effect of any one unless conditions are specified for the other four. Many of the processes of soil development are unknown.

Climate.—The climate of the survey area is temperate and humid. Winds are southerly. Rainfall is generally well distributed throughout the year, but dry periods of 2 to 6 weeks occur during summer. The average annual rainfall is about 36 inches and is enough to support trees, which contributed to soil development in about 37 percent of the area. Intensive rains, which commonly occur during spring, erode most slopes. Erosion has occurred on most cultivated soils.

The average annual temperature is about 60 degrees F, but extremes range from higher than 90 degrees to less than 0 degrees. The frost-free season is about 215 days. Freezing and thawing have especially altered the rock

structure in the upper 2 feet of soil, which developed in sandstone material.

The climate is fairly uniform throughout the survey area and is partly responsible for the dominance of prairie grasses or trees. The influence of climate in weathering soil material and in developing horizons is greatly altered by the effects on soil of parent material, vegetation and animals, relief, time, and man.

Parent material.—Parent material is weathered, unconsolidated rock or mineral material from which the soil forms. In the formation of soils, parent material affects color, texture, structure, natural fertility, and other soil characteristics.

Residuum and alluvium are two general kinds of parent material in the survey area. On the prairie, soils that formed in residuum were derived from shales, sandstone, and limestone of the Pennsylvanian Age. Dennis, Eram, and Okemah soils formed mostly in shales and sandstone material. Bates and Coweta soils formed over sandstone. Bates soils have loamy, clay-enriched horizons, and Coweta soils have a loamy horizon shallow over sandstone.

Apperson, Catoosa, Lula, Newtonia, and Shidler soils formed in loamy and clayey material over limestone. Parsons and Carytown soils formed in clayey valley fill, which is alluvium. These soils have a clay-enriched horizon that is similar to the parent material but that has been strongly weathered. Also on the prairie are the Okay soils, which formed in loamy material on the uplands that parallel some of the large streams in the county.

In wooded areas on uplands, the soils formed in shale and sandstone. Darnell, Hector, and Linker soils were derived from the sandstone which is on most ridges. Enders and Niotaze soils formed in clayey parent material; they have a clayey subsoil, which corresponds to the parent material.

In wooded areas on flood plains, the soils formed in sandy, loamy, or clayey sediments. Kiomatia soils formed mostly in sandy sediments, and Choska, Cleora, Mason, Radley, Severn, Tullahassee,and Wynona soils formed mostly in loamy alluvial sediments. Latanier and Osage soils formed mostly in clayey alluvium.

Plant and animal life.—Plants and animals are active in soil formation. Plants and micro-organisms grow in the weathered parent material and help break down rock structure. They also produce organic residue. As this residue is produced, an organic layer (A1 horizon) is formed and gradually thickens.

The organic layer is the most fertile part of the soil. In this layer bacteria, fungi, and other micro-organisms decompose organic matter, convert humus to simpler forms, liberate plant nutrients, and fix nitrogen. Larger organisms, such as the earthworms that are plentiful in the soils, contribute to the translocation of plant residue, to soil aeration, and to the development of soil structure.

The kind and amount of vegetation regulate the thickness of the A1 horizon. The kind of vegetation depends largely on the moisture supply and on the texture and acidity of the surface layer.

In wooded areas on uplands, the soils have a thin A1 horizon, usually an A2 horizon, and they have a low or medium base saturation. Darnell, Hector, Enders, Glenpool, Kamie, Larton, Linker, and Niotaze soils are examples.

In wooded areas on flood plains, the soils usually have a thick, dark-colored A horizon because they receive extra water for more plant growth. Timber on the Kiomatia and Severn soils has added only a small amount of organic matter because these soils are very young and have a thin A horizon. Soils that are on flood plains and that have a thick A horizon are Choska, Cleora, Latanier, Osage, Radley, Tullahassee, and Wynona soils.

The other soils in the county formed under native grass and have a thick, dark A1 horizon. Large amounts of plant residue and basic elements are returned to the surface layer, since about one-third of the grass roots die and are regrown each year. Soils on the prairie are normally less acid than soils that formed under trees in upland areas.

Relief.—Relief alters the effect of climate on soil development and horizon formation. If the slope is steep, runoff removes soil material almost as fast as it forms, but if slope is gentle or nearly level, soil material accumulates. For example, Parsons soils, which are nearly level, are more developed than Dennis or Bates soils, which are gently sloping on uplands. Parsons soils receive additional water and have more water percolating through the profile to influence loss, gain, and transfer of soil constituents. They have lost clay, iron, alluminum, and base elements from a bleached eluvial (A2) horizon. The eluvial horizon and the upper clay-enriched (B2t) horizon are usually more acid and have lower base saturation than horizons in most of the other soils on the prairie. The accumulation of clay in the clay-enriched horizon has become sufficient to restrict internal drainage in Parsons soils and cause a reversal in the leaching of basic elements. One of the most easily leached elements, sodium, has begun to accumulate; with time, Parsons soils may develop a sodium enriched B2t horizon similar to the one in Carytown soils.

The gently sloping Dennis soils, on uplands, have a thicker and more clayey, clay-enriched (B2t) horizon than the moderately deep Bates soils on similar slopes primarily because their parent material is more weatherable. Although Bates soils are less mature than Dennis soils, they are more deeply developed and have clay-enriched horizons, which the shallow Coweta soils lack. Coweta soils, which are shallow over sandstone, have more runoff and less accumultion of soil material than Bates soils. Other soils on the uplands formed in a manner similar to Parsons, Dennis, Bates, and Coweta soils.

Relief also alters the effect of climate on soil development and horizon formation in soils on flood plains, which receive floodwater that contributes to the thicking of the A horizon and to the high base saturation. These soils

have not had sufficient time to develop a clay-enriched B2t horizon.

Time.—The length of time required for a soil to form depends on the combined effects of other soil-forming factors. The soils in the survey area range from immature to old. The age of the soils is indicated by the degree of horizon development. If the soil-forming factors have not been active long enough for genetically related horizons to form, the soils are considered young or immature. Mature soils have genetically related horizons, and old soils show advanced horizon development or degradation of some horizon within the pedon. Severn, Choska, and Coweta soils are immature soils in Tulsa county; Dennis, Enders, and Newtonia soils are considered mature soils, since they have a B2t horizon. The old soils in the county, such as Parsons and Carytown soils, have developed an A2 horizon.

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(3) 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]

(4) United States Department of Agriculture. 1975. Soil taxonomy. U.S. Dep. Agric. Handb. 436, 754 pp., illus.

Glossary

AC soil. A soil having only an A and a C horizon. Commonly such soil formed in recent alluvium or on steep rocky slopes.

Aeration, soil. The exchange of air in soil with air from the atmosphere. The air in a well aerated soil is similar to that in the atmosphere; the air in a poorly aerated soil is considerably higher in carbon dioxide and lower in oxygen.

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alkali (sodic) soil. A soil having so high a degree of alkalinity (pH 8.5 or higher), or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases), or both, that plant growth is restricted.

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Area reclaim. 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 mapping unit.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as—

	Inches
Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	More than 9

Base saturation. The degree to which material having base exchange properties is saturated with exchangeable bases (sum of Ca, Mg, Na, K), expressed as a percentage of the 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.

Bench terrace. A raised, level or nearly level strip of earth constructed on or nearly on a contour, supported by a barrier of rocks or similar material, and designed to make the soil suitable for tillage and to prevent accelerated erosion.

Bisequum. Two sequences of soil horizons, each of which consists of an illuvial horizon and the overlying eluvial horizons.

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 frequent 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 with magnesium carbonate) to effervesce (fizz) visibly when treated with cold, dilute hydrochloric acid. A soil having measurable amounts of calcium carbonate or magnesium carbonate.

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.

Catena. A sequence, or "chain," of soils on a landscape that formed in similar kinds of parent material but have different characteristics as a result of differences in relief and drainage.

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.

Cement rock. (Local) Shaly limestone used in the manufacture of cement.

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 loosen the subsoil and bring clods to the surface. A form of emergency tillage to control soil blowing.

Clay. As a soil separate, the mineral soil particles less than 0.002 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 coat, 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. Mineral or rock particles up to 3 inches (2 millimeters to 7.5 centimeters) in diameter.

Coarse textured (light 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 bases of steep slopes.

Complex slope. Irregular or variable slope. Planning or constructing terraces, diversions, and other water-control measures is difficult.

Complex, soil. A mapping unit of two or more kinds of soil occurring in such an intricate pattern that they cannot be shown separately on a soil map at the selected scale of mapping and publication.

Compressible. Excessive decrease in volume of soft soil under load.

Congeliturbate. Soil material disturbed by frost action.

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 (or contour farming). Growing crops in strips that follow the contour. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

Control section. The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is 40 or 80 inches (1 or 2 meters).

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. Unstable walls of cuts made by earthmoving equipment. The soil sloughs easily.

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. A delay in grazing until range plants have reached a specified stage of growth. Grazing is deferred in order to increase the vigor of forage and to allow desirable plants to produce seed. Contrasts with continuous grazing and rotation grazing.

Delta. An alluvial deposit, commonly triangular in shape, formed largely beneath water and deposited at the mouth of a river or stream.

Depth to rock. Bedrock at a depth that adversely affects 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 for 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, as for example in "hillpeats" and "climatic moors."

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 running water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of the activities of man or other animals or of a catastrophe in nature, for example, fire, that exposes a bare surface.

Erosion pavement. A layer of gravel or stones that remains on the ground surface after fine particles are removed by wind or water. Desert pavements result from wind erosion in arid areas.

Excess alkali. Excess exchangeable sodium. The resulting poor physical properties restrict the growth of plants.

Excess fines. Excess silt and clay. The soil does not provide a source of gravel or sand for construction purposes.

Excess lime. Excess carbonates. Excessive carbonates, or lime, restrict the growth of some plants.

Excess salts. Excess water soluble salts. Excessive salts 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. The rapid movement of water into the soil.

Favorable. Favorable soil features for the specified use.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Field moisture capacity. The moisture content of a soil, expressed as a percentage of the ovendry weight, after the gravitational, or free, water has drained away; the field moisture content 2 or 3 days after a soaking rain; also called *normal field capacity, normal moisture capacity,* or *capillary capacity.*

Fibric soil material (peat). The least decomposed of all organic soil material. Peat contains a large amount of well preserved fiber that is readily identifiable according to botanical origin. Peat has the lowest bulk density and the highest water content at saturation of all organic soil material.

Fine textured (heavy 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.

Flooding. The temporary covering of soil with water from overflowing streams, runoff from adjacent slopes, and tides. Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions; *occasional* that it occurs on an average of once or less in 2 years; and *frequent* that it occurs on an average of more than once in 2 years. Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, and *long* if more than 7 days. Probable dates are expressed in months; *November-May,* for example, means that flooding can occur during the period November through May. Water standing for short periods after rainfall or commonly covering swamps and marshes is not considered flooding.

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.

Forage. Plant material used as feed by domestic animals. Forage can be grazed or cut for hay.

Forb. Any herbaceous plant not a grass or a sedge.

Frost action. Freezing and thawing of soil moisture. Frost action can damage structures and plant roots.

Genesis, soil. The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.

Gilgai. Typically, the microrelief of Vertisols—clayey soils having a high coefficient of expansion and contraction with changes in moisture content. Commonly a succession of microbasins and microknolls in nearly level areas or of microvalleys and microridges parallel with the slope.

Gleyed soil. A soil having one or more neutral gray horizons as a result of waterlogging and lack of oxygen. The term "gleyed" also designates gray horizons and horizons having yellow and gray mottles as a result of intermittent waterlogging.

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 from 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 (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, which is the upper limit of saturation.

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.

Gypsum. Hydrous calcium sulphate.

Habitat. The natural abode of a plant or animal; refers to the kind of environment in which a plant or animal normally lives, as opposed to the range or geographical distribution.

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. The major horizons of mineral soil are as follows:

O horizon.—An organic layer, fresh and decaying plant residue, at the surface of a mineral soil.

A horizon.—The mineral horizon, formed or forming 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.—A mineral horizon, mainly a residual concentration of sand and silt high in content of resistant minerals as a result of the loss of silicate clay, iron, aluminum, or a combination of these.

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of change from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics caused (1) by accumulation of clay, sesquioxides, humus, or a combination of these; (2) by prismatic or blocky structure; (3) by redder or browner colors than those in the A horizon; or (4) by a combination of these. The combined A and B horizons are generally called the solum, or true soil. If a soil lacks 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 from which the solum is presumed to have formed. If the material is known to differ from that in the solum the Roman numeral II precedes the letter C.

R layer.—Consolidated rock beneath the soil. The rock commonly underlies a C horizon, but can be directly below an A or a B horizon.

Hummocky. Refers to a landscape of hillocks, separated by low sags, having sharply rounded tops and steep sides. Hummocky relief resembles rolling or undulating relief, but the tops of ridges are narrower and the sides are shorter and less even.

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.

Impervious soil. A soil through which water, air, or roots penetrate slowly or not at all. No soil is absolutely impervious to air and water all the time.

Increasers. Species in the climax vegetation that increase in amount as the more desirable plants are reduced by close grazing. Increasers commonly are the shorter plants and the less palatable to livestock.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Infiltration capacity. The maximum rate at which water can infiltrate into a soil under a given set of conditions.

Infiltration rate. The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

Invaders. On range, plants that encroach into an area and grow after the climax vegetation has been reduced by grazing. Generally, invader plants are those that follow disturbance of the surface.

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are—

Border.—Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.

Basin.—Water is applied rapidly to nearly level plains surrounded by levees or dikes.

Controlled flooding.—Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.

Corrugation.—Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops or in orchards so that it flows in only one direction.

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.

Lacustrine deposit (geology). Material deposited in lake water and exposed when the water level is lowered or the elevation of the land is raised.

Landslide. The rapid downhill movement of a mass of soil and loose rock generally when wet or saturated. The speed and distance of movement, as well as the amount of soil and rock material, vary greatly.

Large stones. Rock fragments 10 inches (25 centimeters) or more across. Large stones adversely affect the specified use.

Leaching. The removal of soluble material from soil or other material by percolating water.

Light textured soil. Sand and loamy sand.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Loess. Fine grained material, dominantly of silt-sized particles, deposited by wind.

Low strength. Inadequate strength for supporting loads.

Medium textured soil. Very fine sandy loam, loam, silt loam, or silt.

Metamorphic rock. Rock of any origin altered in mineralogical composition, chemical composition, or structure by heat, pressure, and movement. Nearly all such rocks are crystalline.

Mineral soil. Soil that is mainly mineral material and low in organic material. Its bulk density is greater than that of organic soil.

Minimum tillage. Only the tillage essential to crop production and prevention of soil damage.

Miscellaneous areas. Areas that have little or no natural soil, are too nearly inaccessible for orderly examination, or cannot otherwise be feasibly classified.

Moderately coarse textured (moderately light textured) soil. Sandy loam and fine sandy loam.

Moderately fine textured (moderately heavy textured) soil. Clay loam, sandy clay loam, and silty clay loam.

Moraine (geology). An accumulation of earth, stones, and other debris deposited by a glacier. Types are terminal, lateral, medial, and ground.

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 single 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.

Nutrient, plant. Any element taken in by a plant, essential to its growth, and used by it in the production of food and tissue. Plant nutrients are nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, zinc, and perhaps other elements obtained from the soil; and carbon, hydrogen, and oxygen obtained largely from the air and water.

Pan. A compact, dense layer in a soil. A pan impedes the movement of water and the growth of roots. The word "pan" is commonly combined with other words that more explicitly indicate the nature of the layer; for example, *hardpan, fragipan, claypan, plowpan,* and *traffic pan.*

Parent material. The great variety of unconsolidated organic and mineral material in which soil forms. Consolidated bedrock is not yet parent material by this concept.

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. The slow movement of water through the soil adversely affecting the specified use.

Permafrost. Layers of soil, or even bedrock, occurring in arctic or subarctic regions, in which a temperature below freezing has existed continuously for a long time.

Permeability. The quality that enables the soil to transmit water or air, measured as the number of inches per hour that water moves through the soil. Terms describing permeability are *very slow* (less than 0.06 inch), *slow* (0.06 to 0.20 inch), *moderately slow* (0.2 to 0.6 inch), *moderate* (0.6 to 2.0 inches), *moderately rapid* (2.0 to 6.0 inches), *rapid* (6.0 to 20 inches), and *very rapid* (more than 20 inches).

Phase, soil. A subdivision of a soil series or other unit in the soil classification system based on differences in the soil that affect its management. A soil series, for example, may be divided into phases on the bases of differences in slope, stoniness, thickness, or some other characteristic that affects management. These differences are too small to justify separate series.

pH value. (See Reaction, soil). A numerical designation of acidity and alkalinity in soil.

Piping. Moving water of subsurface tunnels or pipelike cavities in the soil.

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 a semisolid to a plastic state.

Plinthite. The sesquioxide-rich, humus-poor, highly weathered mixture of clay with quartz and other diluents that commonly appears as red mottles, usually in platy, polygonal, or reticulate patterns. Plinthite changes irreversibly to an ironstone hardpan or to irregular aggregates on exposure to repeated wetting and drying, especially if it is exposed also to heat from the sun. In a moist soil, plinthite can be cut with a spade, whereas ironstone cannot be cut but can be broken or shattered with a spade. Plinthite is one form of the material that has been called laterite.

Plowpan. A compacted layer formed in the soil directly below the plowed layer.

Polypedon. A volume of soil having properties within the limits of a soil series, the lowest and most homogeneous category of soil taxonomy. A "soil individual."

Poorly graded. Refers to 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 outlets. Surface or subsurface drainage outlets difficult or expensive to install.

Productivity (soil). The capability of a soil for producing a specified plant or sequence of plants under a specified system of management. Productivity is measured in terms of output, or harvest, in relation to input.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Range (or rangeland). Land that, for the most part, produces native plants suitable for grazing by livestock; includes land supporting some forest trees.

Range condition. The health or productivity of forage plants on a given range, in terms of the potential productivity under normal climate and the best practical management. Condition classes generally recognized are—*excellent, good, fair,* and *poor.* The classification is based on the percentage of original, or assumed climax vegetation on a site, as compared to what has been observed to grow on it when well managed.

Range site. An area of range where climate, soil, and relief are sufficiently uniform to produce a distinct kind and amount of native vegetation.

Reaction, soil. The degree of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degree of acidity or alkalinity is expressed as—

	pH
Extremely acid	Below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Regolith. The unconsolidated mantle of weathered rock and soil material on the earth's surface; the loose earth material above the solid rock. Soil scientists regard as soil only the part of the regolith that is modified by organisms and other soil-building forces. Most engineers describe the whole regolith, even to a great depth, as "soil."

Relief. The elevations or inequalities of a land surface, considered collectively.

Residuum (residual soil material). Unconsolidated, weathered, or partly weathered mineral material that accumulates over disintegrating rock.

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.

Rock fragments. Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

Rooting depth. Shallow root zone. The soil is shallow over a layer that greatly restricts roots. See Root zone.

Root zone. The part of the soil that can be penetrated by plant roots.

Runoff. The precipitation discharged in stream channels from a drainage area. The water that flows off the land surface without sinking in is called surface runoff; that which enters the ground before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Saline-alkali soil. A soil that contains a harmful concentration of salts and exchangeable sodium; contains harmful salts and is strongly alkaline; or contains harmful salts and exchangeable sodium and is very strongly alkaline. The salts, exchangeable sodium, and alkaline reaction are in the soil in such location that growth of most crop plants is less than normal.

Saline soil. A soil containing soluble salts in an amount that impairs growth of plants. A saline soil does not contain excess exchangeable sodium.

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.

Saprolite (geology). Soft, earthy, clay-rich, thoroughly decomposed rock formed in place by chemical weathering of igneous and metamorphic rock. In soil survey, the term saprolite is applied to any unconsolidated residual material underlying the soil and grading to hard bedrock below.

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. The rapid movement of water through the soil. Seepage adversely affects the specified use.

Sequum. A sequence consisting of an illuvial horizon and the overlying eluvial horizon.

Series, soil. A group of soils, formed from a particular type of parent material, having horizons that, except for the texture of the A or surface horizon, are similar in all profile characteristics and in arrangement in the soil profile. Among these characteristics are color, texture, structure, reaction, consistence, and mineralogical and chemical composition.

Shale. Sedimentary rock formed by the hardening of a clay deposit.

Sheet erosion. The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and runoff water.

Shrink-swell. 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-alumina ratio. The molecular ratio of silica to alumina in soil, clay, or any alumino-silicate mineral.

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.

Sinkhole. A depression in a landscape where limestone has been locally dissolved.

Site index. A designation of the quality of a forest site based on the height of the dominant stand at an arbitrarily chosen age. For example, if the average height attained by dominant and codominant trees in a fully stocked stand at the age of 50 years is 75 feet, the site index is 75 feet.

Slickensides. Polished and grooved surfaces produced by one mass sliding past another. In soils, slickensides may occur at the bases of slip surfaces on the steeper slopes; on faces of blocks, prisms, and

columns; and in swelling clayey soils, where there is marked change in moisture content.

Slick spot. Locally, 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.

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.

Slow intake. The slow movement of water into the soil.

Slow refill. The slow filling of ponds, resulting from restricted permeability in the soil.

Small stones. Rock fragments 3 to 10 inches (7.5 to 25 centimeters) in diameter. Small stones adversely affect the specified use.

Sodicity. The degree to which a soil is affected by exchangeable sodium. Sodicity is expressed as a sodium adsorption ratio (SAR) of a saturation extract, or the ratio of $Na^{+}Ca^{+} + Mg^{++}$. 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 that 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: *very coarse sand* (2.0 millimeters to 1.0 millimeter); *coarse sand* (1.0 to 0.5 millimeter); *medium sand* (0.5 to 0.25 millimeter); *fine sand* (0.25 to 0.10 millimeter); *very fine sand* (0.10 to 0.05 millimeter); *silt* (0.005 to 0.002 millimeter); and *clay* (less than 0.002 millimeter).

Solodized soil. A formerly alkali (sodic) soil that has been leached so that it has become acid and has a thick, gray upper layer over an acid, blocky B horizon. The resulting soil may be termed a Soloth.

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in mature 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 other plant and animal life characteristics of the soil are largely confined to the solum.

Stone line. A concentration of coarse fragments in soils that generally marks an old weathering surface. In a cross section, the line may be one fragment or more thick. The line generally overlies material that weathered in place and marks the top of a paleosol. It is ordinarily 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.

Stratified. Arranged in strata, or layers. The term refers to geologic material. Layers in soils that result from the processes of soil formation are called horizons; those inherited from the parent material are called strata.

Stripcropping. Growing crops in a systematic arrangement of strips or bands which provide vegetative barriers to wind and water erosion.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates that are separated from adjoining 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, to provide protection from soil blowing and water erosion after harvest, during preparation of a seedbed for the next crop, and during the early growing period of the new crop.

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Subsoiling. Tilling a soil below normal plow depth, ordinarily to shatter a hardpan or claypan.

Substratum. The part of the soil below the solum.

Subsurface layer. Technically, the A2 horizon. Generally refers to a leached horizon lighter in color and lower in content of organic matter than the overlying surface layer.

Summer fallow. The tillage of uncropped land during the summer to control weeds and allow storage of moisture in the soil for the growth of a later crop. A practice common in semiarid regions, where annual precipitaion is not enough to produce a crop every year. Summer fallow is frequently practiced before planting winter grain.

Surface soil. 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 or management.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that it can soak into the soil or flow slowly to a prepared outlet without harm. A terrace in a field is generally built so that the field can be farmed. A terrace intended mainly for drainage has a deep channel that is maintained in permanent sod.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea. A stream terrace is frequently called a second bottom, in contrast with a flood plain, and is seldom subject to overflow. A marine terrace, generally wide, was deposited by 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, silt loam, 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. Otherwise suitable soil material too thin for the specified use.

Tilth, soil. The condition of the soil, especially the soil structure, as related to the growth of plants. Good tilth refers to the friable state and is associated with high noncapillary porosity and stable structure. A soil in poor tilth is nonfriable, hard, nonaggregated, and difficult to till.

Toe slope. The outermost inclined surface at the base of a hill; part of a foot slope.

Topsoil (engineering). Presumably a fertile soil or soil material, or one that responds to fertilization, ordinarily rich in organic matter, used to topdress roadbanks, lawns, and gardens.

Trace elements. The chemical elements in soils, in only extremely small amounts, essential to plant growth. Examples are zinc, cobalt, manganese, copper, and iron.

Tuff. A compacted deposit 50 percent or more volcanic ash and dust.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Unstable fill. Risk of caving or sloughing in banks of fill material.

Valley fill. In glaciated regions, material deposited in stream valleys by glacial melt water. In nonglaciated regions, alluvium deposited by heavily loaded streams emerging from hills or mountains and spreading sediments onto the lowland as a series of adjacent alluvial fans.

Variant, soil. A soil having properties sufficiently different from those of other known soils to justify a new series name, but the limited geographic soil area does not justify creation of a new series.

Variegation. Refers to patterns of contrasting colors assumed to be inherited from the parent material rather than to be the result of poor drainage.

Water table. The upper limit of the soil or underlying rock material that is wholly saturated with water.

Water table, apparent. A thick zone of free water in the soil. An apparent water table is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil.

Water table, artesian. A water table under hydrostatic head, generally beneath an impermeable layer. When this layer is penetrated, the water level rises in an uncased borehole.

Water table, perched. A water table standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

Weathering. All physical and chemical changes produced in rocks or other deposits at or near the earth's surface by atmospheric agents. These changes result in disintegration and decomposition of the material.

Well graded. Refers to a soil or soil material consisting of particles well distributed over a wide range in size or diameter. Such a soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.

Wilting point (or permenanent wilting point). The moisture content of soil, on an ovendry basis, at which a plant (specifically sunflower) wilts so much that it does not revive when placed in a humid, dark chamber.

Illustrations

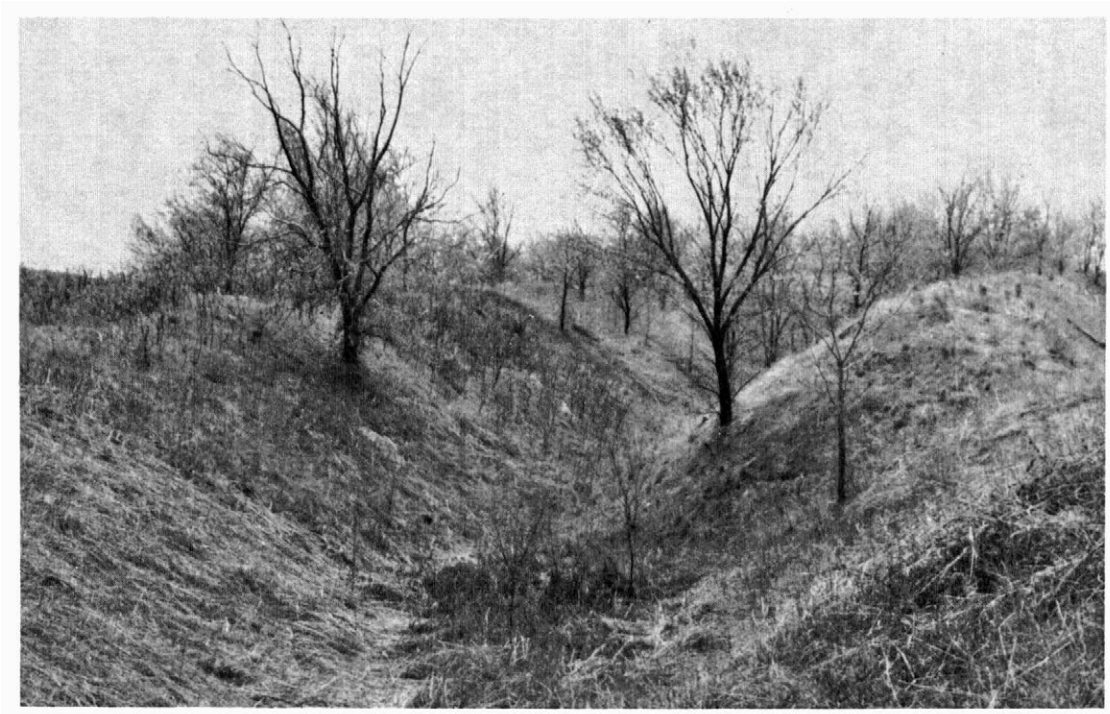

Figure 1.—Mine dump on Kanima soils, 3 to 50 percent slopes.

Figure 2.—Flooding is a major concern on Wynona silty clay loam.

FORAGE CALENDAR
(percentage of use)

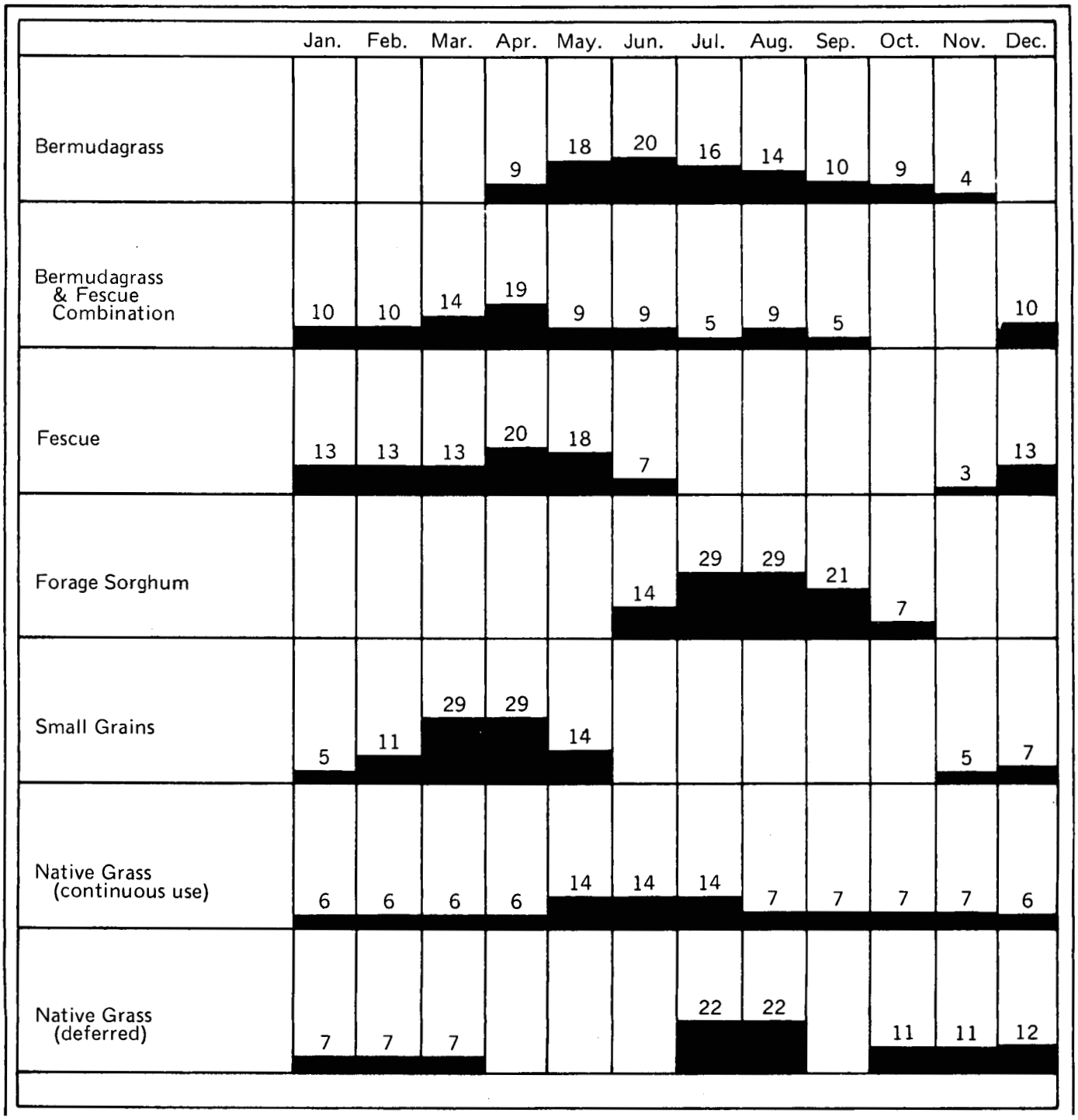

Figure 3.—Forage calendar.

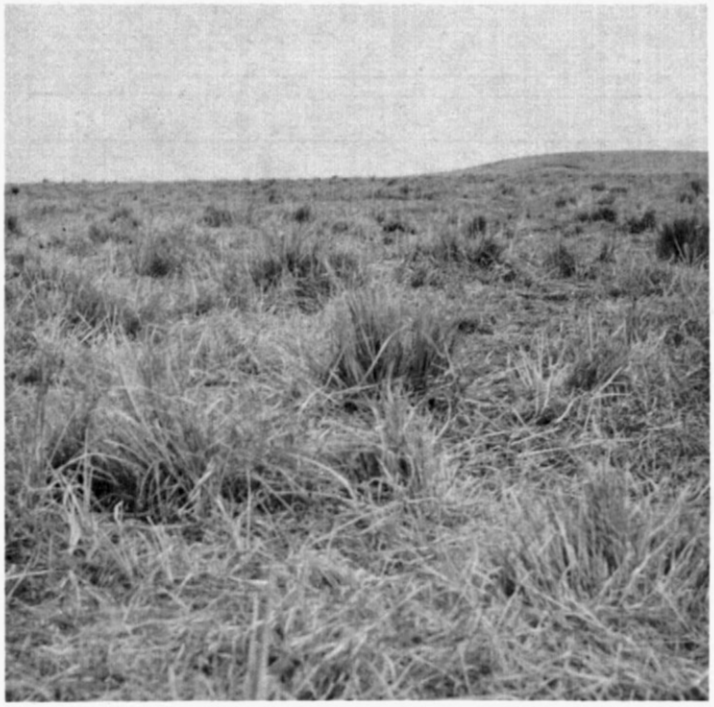

Figure 4.—Loamy Prairie range site in excellent condition in an area of Dennis silt loam, 3 to 5 percent slopes.

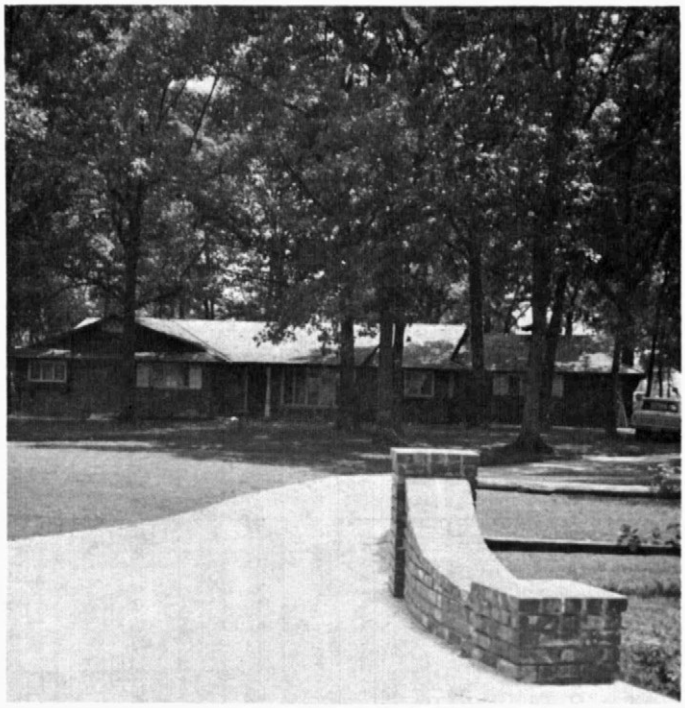

Figure 5.—Urban development on Larton-Glenpool complex, 0 to 3 percent slopes. This soil is not subject to excessive erosion.

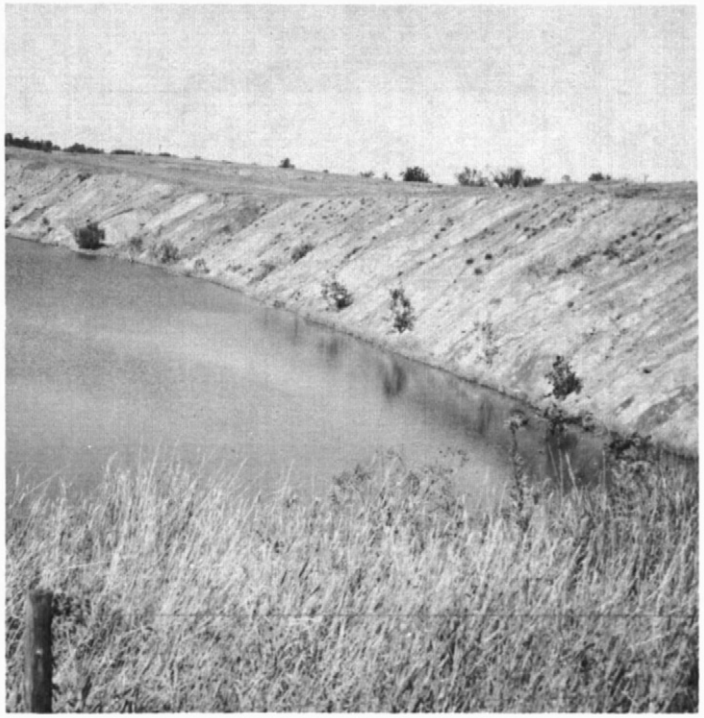

Figure 6.—This strip mine in an area of Kanima soils, 3 to 50 percent slopes, is used as a pond reservoir.

Figure 7.—Soil slippage on a road embankment, Eram-Coweta complex, 5 to 15 percent slopes, was at the contact point of soil and the underlying shale.

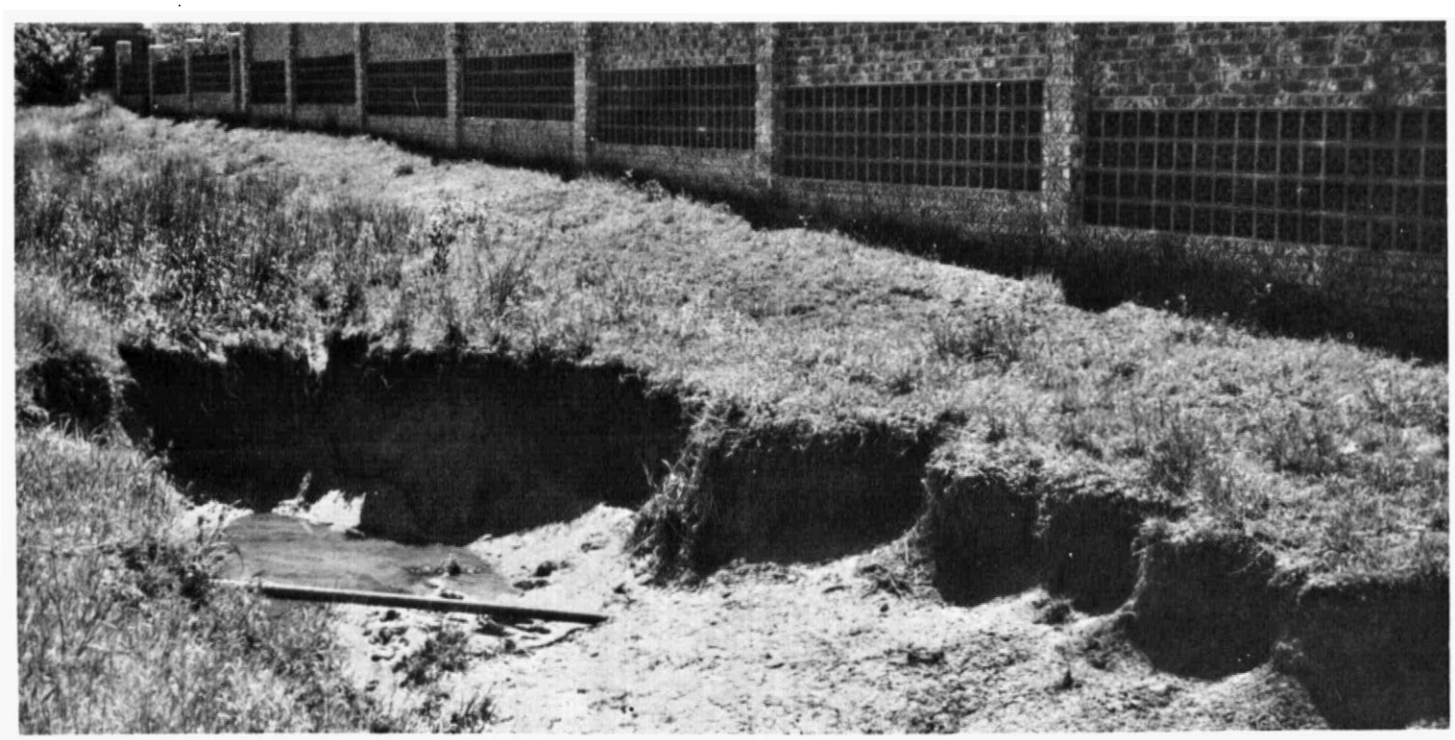

Figure 8.—Sedimentation is the result of this improperly designed waterway on Bates loam, 1 to 3 percent slopes.

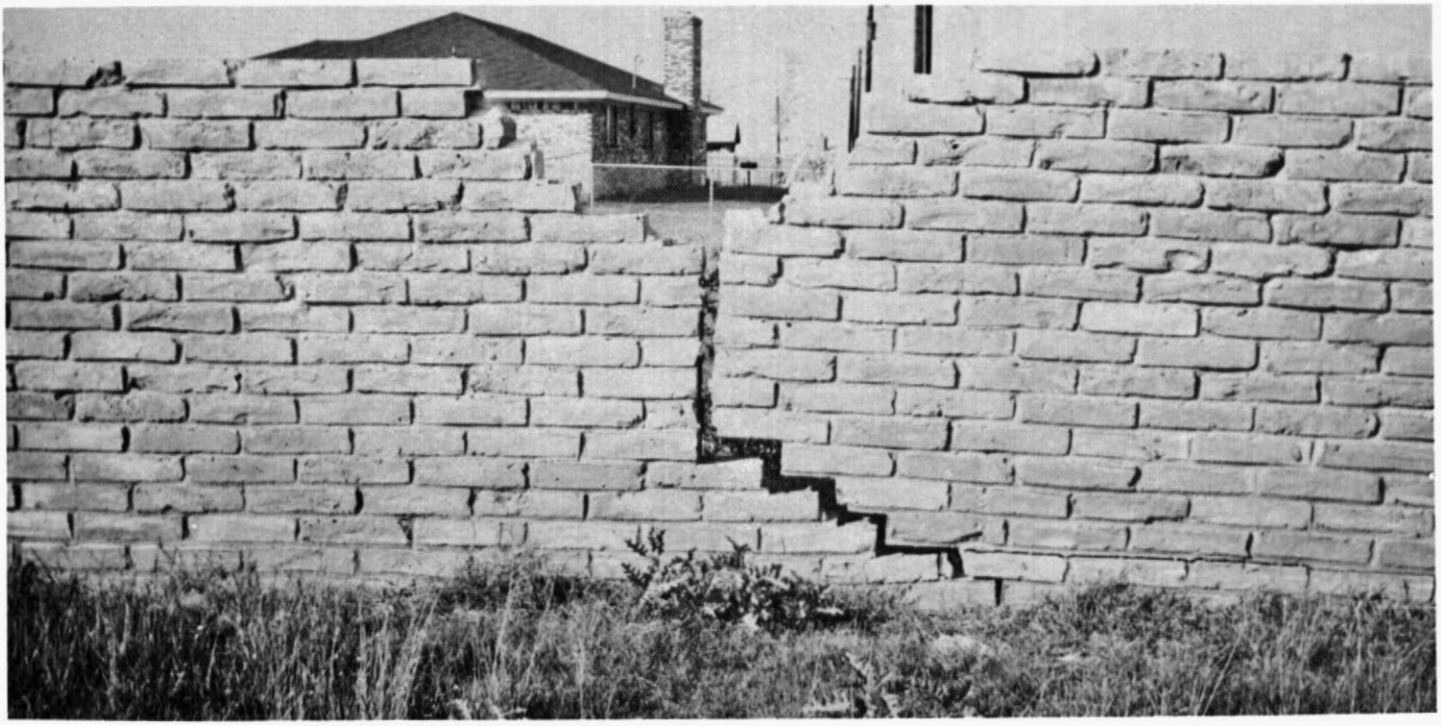

Figure 9.—Proper structural design is needed to compensate for high shrink-swell potential and low strength of these soils. Okemah-Parsons-Carytown complex, 0 to 1 percent slopes.

Figure 10.—This Niotaze soil is very erodible where vegetation has been removed.

Figure 11.—Profile of Coweta loam, in an area of Coweta-Bates complex, 2 to 6 percent slopes.

Tables

TABLE 1.--TEMPERATURE AND PRECIPITATION DATA

[Recorded in the period 1951-74 at Tulsa, Oklahoma]

Month	Temperature						Precipitation				
	Average daily maximum	Average daily minimum	Average	2 years in 10 will have-- Maximum temperature higher than--	2 years in 10 will have-- Minimum temperature lower than--	Average number of growing degree days[1]	Average	2 years in 10 will have-- Less than--	2 years in 10 will have-- More than--	Average number of days with 0.10 inch or more	Average snowfall
	F	F	F	F	F	Units	In	In	In		In
January----	46.6	25.5	36.1	74	1	9	1.31	.65	1.84	3	2.4
February---	52.5	30.0	41.3	79	7	19	1.72	.84	2.44	4	2.5
March------	60.6	37.5	49.1	89	13	146	2.86	1.03	4.32	5	2.2
April------	72.1	49.3	60.7	92	28	333	4.04	2.25	5.49	6	.1
May--------	79.9	58.5	69.2	93	39	595	4.66	2.67	6.27	7	0
June-------	87.8	67.3	77.6	99	51	828	4.22	2.13	5.93	6	0
July-------	93.4	72.0	82.7	105	56	1,014	3.90	.88	6.27	5	0
August-----	92.7	69.9	81.3	106	56	970	3.01	1.39	4.32	4	0
September--	84.6	62.2	73.4	100	44	702	4.82	1.60	7.37	5	0
October----	74.7	50.7	62.7	93	32	400	3.76	.97	6.00	4	0
November---	60.3	38.0	49.2	82	17	96	2.44	.54	3.92	4	.8
December---	50.0	29.4	39.7	74	3	19	1.98	.82	2.90	4	1.9
Year-----	71.3	49.2	60.3	107	0	5,131	38.72	29.10	47.70	57	9.9

[1]A growing degree day is a unit of heat available for plant growth. It can be calculated by adding the maximum and minimum daily temperatures, dividing the sum by 2, and subtracting the temperature below which growth is minimal for the principal crops in the area (50 F).

TABLE 2.--FREEZE DATES IN SPRING AND FALL

[Recorded in the period 1951-74 at Tulsa, Oklahoma]

Probability	Temperature		
	24 F or lower	28 F or lower	32 F or lower
Last freezing temperature in spring:			
1 year in 10 later than--	March 30	April 4	April 14
2 years in 10 later than--	March 24	March 30	April 10
5 years in 10 later than--	March 12	March 20	April 1
First freezing temperature in fall:			
1 year in 10 earlier than--	November 7	October 28	October 21
2 years in 10 earlier than--	November 13	November 3	October 26
5 years in 10 earlier than--	November 26	November 14	November 4

TABLE 3.--GROWING SEASON LENGTH

[Recorded in the period 1951-74 at Tulsa, Oklahoma]

Probability	Daily minimum temperature during growing season		
	Higher than 24 F	Higher than 28 F	Higher than 32 F
	Days	Days	Days
9 years in 10	227	212	195
8 years in 10	237	221	203
5 years in 10	258	238	217
2 years in 10	279	255	230
1 year in 10	289	264	238

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Acres	Percent
1	Apperson silty clay loam, 1 to 3 percent slopes	4,935	1.3
2	Apperson silty clay loam, 3 to 5 percent slopes	1,665	0.4
3	Bates loam, 1 to 3 percent slopes	1,725	0.5
4	Bates-Coweta complex, 3 to 5 percent slopes	3,395	0.9
5	Catoosa silt loam, 1 to 3 percent slopes	1,705	0.5
6	Catoosa-Rock outcrop complex, 1 to 8 percent slopes	5,990	1.6
7	Choska very fine sandy loam	11,025	2.9
8	Choska-Severn-Urban land complex	6,555	1.7
9	Cleora fine sandy loam	415	0.1
10	Coweta-Bates complex, 2 to 6 percent slopes	9,930	2.6
11	Coweta-Eram-Urban land complex, 3 to 12 percent slopes	10,430	2.8
12	Dennis silt loam, 1 to 3 percent slopes	28,915	7.8
13	Dennis silt loam, 3 to 5 percent slopes	7,470	2.0
14	Dennis silt loam, 2 to 5 percent slopes, eroded	12,680	3.4
15	Dennis-Carytown complex, 1 to 3 percent slopes	20,485	5.4
16	Dennis-Radley complex, 0 to 12 percent slopes	25,275	6.8
17	Dennis-Urban land complex, 0 to 5 percent slopes	15,930	4.2
18	Enders-Hector complex, 5 to 30 percent slopes	3,790	1.0
19	Eram silty clay loam, 3 to 5 percent slopes	1,460	0.4
20	Eram-Coweta complex, 5 to 15 percent slopes	19,700	5.2
21	Glenpool loamy fine sand, 3 to 15 percent slopes	3,175	0.8
22	Hector-Linker complex, 1 to 5 percent slopes	2,290	0.6
23	Kamie loamy fine sand, 3 to 8 percent slopes	4,525	1.2
24	Kamie fine sandy loam, 1 to 3 percent slopes	2,020	0.5
25	Kamie-Urban land complex, 1 to 8 percent slopes	4,720	1.3
26	Kanima soils, 3 to 50 percent slopes	1,525	0.4
27	Kiomatia soils	1,585	0.4
28	Larton-Glenpool complex, 0 to 3 percent slopes	1,680	0.4
29	Latanier clay	3,335	0.9
30	Lula silt loam, 1 to 3 percent slopes	735	0.2
31	Mason silt loam	995	0.3
32	Newtonia silt loam, 1 to 3 percent slopes	3,825	1.0
33	Newtonia silt loam, 3 to 5 percent slopes	1,735	0.5
34	Niotaze-Darnell complex, 3 to 15 percent slopes	8,865	2.4
35	Niotaze-Darnell complex, 15 to 25 percent slopes	18,835	5.0
36	Niotaze-Darnell complex, 25 to 45 percent slopes	4,385	1.2
37	Niotaze-Darnell-Urban land complex, 3 to 25 percent slopes	580	0.2
38	Oil-waste land	395	0.1
39	Okay loam, 0 to 1 percent slopes	1,295	0.3
40	Okay loam, 1 to 3 percent slopes	4,360	1.2
41	Okay loam, 3 to 5 percent slopes	4,295	1.1
42	Okay loam, 2 to 5 percent slopes, eroded	2,560	0.7
43	Okemah silt loam, 0 to 1 percent slopes	7,310	1.9
44	Okemah-Parsons-Carytown complex, 0 to 1 percent slopes	28,310	7.5
45	Osage silty clay	14,740	3.9
46	Pits	1,335	0.4
47	Radley silt loam	5,660	1.5
48	Radley soils	10,890	2.9
49	Severn very fine sandy loam	7,940	2.1
50	Shidler-Rock outcrop complex, 1 to 12 percent slopes	2,810	0.7
51	Tullahassee fine sandy loam	1,295	0.3
52	Urban land	1,210	0.3
53	Wynona silty clay loam	12,740	3.4
54	Wynona-Urban land complex	1,290	0.3
	Water	9,600	2.6
	Total	376,320	100.0

TABLE 5.--GRAZING YIELDS PER ACRE

[All yields were estimated for a high level of management in 1974. Absence of a yield figure indicates the crop or pasture grass is seldom grown or is not suited. All yields are given in animal-unit-months[1]]

Soil name and map symbol	Improved bermudagrass	Fescue-bermuda combination	Fescue	Small grains	Forage sorghum
Apperson:					
1	6.0	6.0	6.0	4.3	4.5
2	5.5	5.5	5.5	4.0	4.2
Bates:					
3	6.0	6.0	5.0	4.3	4.5
4[2]	5.0	---	---	4.0	3.7
Catoosa:					
5	6.0	6.0	5.0	4.3	4.5
6[2]	---	---	---	---	---
Choska:					
7	8.5	8.5	6.5	4.7	6.0
8[2]	---	---	---	---	---
Cleora:					
9	8.0	8.0	6.0	4.3	6.0
Coweta:					
10[2]	4.5	---	---	---	3.4
11[2]	---	---	---	---	---
Dennis:					
12	7.0	7.0	6.0	4.5	5.1
13	6.5	6.5	5.5	4.3	4.8
14	6.0	6.0	5.0	4.0	4.5
15[2]	5.5	5.5	5.0	4.0	4.2
16[2]	7.0	7.0	6.0	---	---
17[2]	---	---	---	---	---
Enders:					
18[2]	---	---	---	---	---
Eram:					
19	6.0	6.0	4.5	3.7	4.5
20[2]	4.5	---	---	---	3.4

See footnotes at end of table.

TABLE 5.--GRAZING YIELDS PER ACRE--Continued

Soil name and map symbol	Improved bermudagrass	Fescue-bermuda combination	Fescue	Small grains	Forage sorghum
Glenpool:					
21	6.0	---	---	---	4.5
Hector:					
22[2]	5.0	---	---	---	3.7
Kamie:					
23	6.0	---	---	3.7	4.5
24	6.5	6.0	5.0	4.0	4.8
25[2]	---	---	---	---	---
Kanima:					
26[2]	---	---	---	---	---
Kiomatia:					
27[2]	5.5	---	---	---	---
Larton:					
28[2]	6.0	---	---	3.7	4.5
Latanier:					
29	6.5	7.5	7.0	7.5	---
Lula:					
30	6.5	6.5	5.5	4.5	4.8
Mason:					
31	8.5	8.5	7.5	4.7	6.0
Newtonia:					
32	7.0	7.0	6.0	4.5	5.1
33	6.5	6.5	5.5	4.0	4.8
Niotaze:					
34[2]	4.5	---	---	---	3.4
35[2]	---	---	---	---	---
36[2]	---	---	---	---	---
37[2]	---	---	---	---	---
Oil-waste land:					
38	---	---	---	---	---

See footnotes at end of table.

TABLE 5.--GRAZING YIELDS PER ACRE--Continued

Soil name and map symbol	Improved bermudagrass	Fescue-bermuda combination	Fescue	Small grains	Forage sorghum
Okay:					
39	8.0	8.0	7.0	4.7	6.0
40	7.0	7.0	6.5	4.5	5.7
41	6.0	6.0	6.0	4.0	5.1
42	8.0	8.0	5.0	3.7	4.5
Okemah:					
43	8.0	8.0	7.5	4.7	6.0
44[2]	6.0	6.5	6.5	4.3	4.5
Osage:					
45	6.5	7.5	7.5	4.0	---
Pits:					
46	---	---	---	---	---
Radley:					
47	8.0	8.0	6.5	4.5	6.0
48[2]	7.5	7.5	7.0	---	5.7
Severn:					
49	8.5	8.5	6.5	4.7	6.0
Shidler:					
50[2]	---	---	---	---	---
Tullahassee:					
51	7.0	8.5	8.0	---	5.1
Urban land:					
52	---	---	---	---	---
Wynona:					
53	7.5	8.5	8.5	4.5	5.7
54[2]	---	---	---	---	---

[1]An animal-unit-month is the amount of forage or feed required to feed one animal unit (one cow, one horse, one mule, five sheep, or five goats) for a period of 30 days.

[2]This mapping unit is made up of two or more dominant kinds of soil. See mapping unit description for the behavior and composition of the whole mapping unit.

TABLE 6.--YIELDS PER ACRE OF CROPS

[All yields were estimated for a high level of management in 1975. Absence of a yield figure indicates the crop is seldom grown or is not suited]

Soil name and map symbol	Wheat	Grain sorghum	Soybeans
	Bu	Bu	Bu
Apperson:			
1	35	65	30
2	30	55	25
Bates:			
3	35	55	25
[1]4	30	40	20
Catoosa:			
5	35	55	25
[1]6	---	---	---
Choska:			
7	45	75	40
[1]8	---	---	---
Cleora:			
9	35	55	30
Coweta:			
[1]10	---	---	---
[1]11	---	---	---
Dennis:			
12	40	70	30
13	35	65	25
14	30	50	20
[1]15	30	50	20
[1]16	---	---	---
[1]17	---	---	---
Enders:			
[1]18	---	---	---
Eram:			
19	25	40	20
[1]20	---	---	---
Glenpool:			
21	---	---	---
Hector:			
[1]22	---	---	---
Kamie:			
23	25	35	20
24	30	45	25
[1]25	---	---	---
Kanima:			
[1]26	---	---	---

See footnote at end of table.

TABLE 6.--YIELDS PER ACRE OF CROPS--Continued

Soil name and map symbol	Wheat	Grain sorghum	Soybeans
	Bu	Bu	Bu
Kiomatia:			
[1]27	---	---	---
Larton:			
[1]28	25	50	20
Latanier:			
29	40	70	35
Lula:			
30	40	65	30
Mason:			
31	45	75	40
Newtonia:			
32	40	70	30
33	30	60	25
Niotaze:			
[1]34	---	---	---
[1]35	---	---	---
[1]36	---	---	---
[1]37	---	---	---
Oil-waste land:			
38.			
Okay:			
39	45	70	35
40	40	65	30
41	30	55	25
42	25	50	20
Okemah:			
43	40	70	35
[1]44	35	60	30
Osage:			
45	30	60	25
Pits:			
46.			
Radley:			
47	40	65	30
[1]48	---	---	---
Severn:			
49	45	75	40
Shidler:			
[1]50	---	---	---

See footnote at end of table.

TABLE 6.--YIELDS PER ACRE OF CROPS--Continued

Soil name and map symbol	Wheat	Grain sorghum	Soybeans
	Bu	Bu	Bu
Tullahassee:			
51	---	---	---
Urban land:			
52.			
Wynona:			
53	40	70	30
[1]54	---	---	---

[1]This mapping unit is made up of two or more dominant kinds of soil. See mapping unit description for the composition and behavior of the whole mapping unit.

TABLE 7.--RANGE PRODUCTIVITY AND COMPOSITION

[Soils not listed are not in range sites; such soils can be used for grazing if grass cover is established]

Soil name and map symbol	Range site name	Potential production: Kind of year	Potential production: Dry weight	Characteristic vegetation	Composition
			Lb/acre		Pct
Apperson:					
1, 2	Loamy prairie	Favorable	6,000	Big bluestem	35
		Normal	4,300	Switchgrass	10
		Unfavorable	3,200	Little bluestem	15
				Indiangrass	10
				Other perennial grasses	23
				Other perennial forbs	7
Bates:					
3	Loamy prairie	Favorable	7,000	Big bluestem	20
		Normal	5,500	Little bluestem	40
		Unfavorable	4,500	Indiangrass	10
				Other perennial grasses	23
				Other perennial forbs	7
[1]4:					
Bates part	Loamy prairie	Favorable	7,000	Big bluestem	20
		Normal	5,500	Little bluestem	40
		Unfavorable	4,500	Indiangrass	10
				Other perennial grasses	23
				Other perennial forbs	7
Coweta part	Shallow prairie	Favorable	3,500	Little bluestem	30
		Normal	2,300	Big bluestem	15
		Unfavorable	1,500	Indiangrass	10
				Switchgrass	10
				Tall dropseed	5
				Other perennial grasses	22
				Other perennial forbs	8
Catoosa:					
5	Loamy prairie	Favorable	6,500	Little bluestem	25
		Normal	5,000	Big bluestem	25
		Unfavorable	4,000	Indiangrass	10
				Switchgrass	5
				Other perennial grasses	28
				Other perennial forbs	7
[1]6:					
Catoosa part	Loamy prairie	Favorable	6,500	Little bluestem	25
		Normal	5,000	Big bluestem	25
		Unfavorable	4,000	Indiangrass	10
				Switchgrass	5
				Other perennial grasses	28
				Other perennial forbs	7
Rock outcrop part.					
Coweta:					
[1]10:					
Coweta part	Shallow prairie	Favorable	3,500	Little bluestem	30
		Normal	2,300	Big bluestem	15
		Unfavorable	1,500	Indiangrass	10
				Switchgrass	10
				Tall dropseed	5
				Other perennial grasses	22
				Other perennial forbs	8
Bates part	Loamy prairie	Favorable	7,000	Big bluestem	20
		Normal	5,500	Little bluestem	40
		Unfavorable	4,500	Indiangrass	10
				Other perennial grasses	23
				Other perennial forbs	7

See footnote at end of table.

TABLE 7.--RANGE PRODUCTIVITY AND COMPOSITION--Continued

Soil name and map symbol	Range site name	Potential production: Kind of year	Potential production: Dry weight	Characteristic vegetation	Composition
			Lb/acre		Pct
Dennis:					
12, 13, 14	Loamy prairie	Favorable	7,000	Big bluestem	20
		Normal	5,500	Switchgrass	10
		Unfavorable	4,500	Little bluestem	30
				Indiangrass	10
				Other perennial grasses	23
				Other perennial forbs	7
[1]15:					
Dennis part	Loamy prairie	Favorable	7,000	Big bluestem	20
		Normal	5,500	Switchgrass	10
			4,500	Little bluestem	30
				Indiangrass	10
				Other perennial grasses	23
				Other perennial forbs	7
Carytown part	Shallow claypan	Favorable	4,000	Little bluestem	20
		Normal	2,800	Big bluestem	10
		Unfavorable	2,000	Switchgrass	15
				Indiangrass	10
				Other perennial grasses	38
				Other perennial forbs	7
Dennis:					
[1]16:					
Dennis part	Loamy prairie	Favorable	7,000	Big bluestem	20
		Normal	5,500	Switchgrass	10
		Unfavorable	4,500	Little bluestem	30
				Indiangrass	10
				Other perennial grasses	23
				Other perennial shrubs	7
Radley part.					
Enders:					
[1]18:					
Enders part	Sandy savannah	Favorable	5,000	Little bluestem	25
		Normal	3,800	Indiangrass	10
		Unfavorable	3,000	Big bluestem	10
				Canada wildrye	10
				Other perennial grasses	25
				Other perennial forbs	5
				Other shrubs	5
				Other trees	10
Hector part	Shallow savannah	Favorable	3,200	Little bluestem	45
		Normal	2,100	Big bluestem	10
		Unfavorable	1,400	Indiangrass	15
				Other perennial grasses	5
				Other perennial forbs	5
				Other perennial shrubs	5
				Other trees	15
Eram:					
19	Loamy prairie	Favorable	6,000	Big bluestem	25
		Normal	4,200	Little bluestem	15
		Unfavorable	3,000	Switchgrass	5
				Indiangrass	25
				Other perennial grasses	23
				Other perennial forbs	7
[1]20:					
Eram part	Loamy prairie	Favorable	6,000	Big bluestem	25
		Normal	4,200	Little bluestem	15
		Unfavorable	3,000	Switchgrass	5
				Indiangrass	25
				Other perennial grasses	23
				Other perennial forbs	7

See footnote at end of table.

TABLE 7.--RANGE PRODUCTIVITY AND COMPOSITION--Continued

Soil name and map symbol	Range site name	Potential production: Kind of year	Potential production: Dry weight	Characteristic vegetation	Composition
			Lb/acre		Pct
Eram:					
[1]20:					
Coweta part	Shallow prairie	Favorable	3,500	Little bluestem	30
		Normal	2,300	Big bluestem	15
		Unfavorable	1,500	Indiangrass	10
				Switchgrass	10
				Tall dropseed	5
				Other perennial grasses	22
				Other perennial forbs	8
Glenpool:					
21	Deep sand savannah	Favorable	4,000	Little bluestem	25
		Normal	2,800	Big bluestem	20
		Unfavorable	2,000	Indiangrass	10
				Other trees	15
				Other perennial grasses	20
				Other perennial forbs	5
				Other shrubs	5
Hector:					
[1]22:					
Hector part	Shallow savannah	Favorable	3,200	Little bluestem	45
		Normal	2,100	Big bluestem	10
		Unfavorable	1,400	Indiangrass	15
				Other perennial grasses	5
				Other perennial forbs	5
				Other shrubs	5
				Other trees	15
Linker part	Sandy savannah	Favorable	5,000	Little bluestem	25
		Normal	3,800	Big bluestem	15
		Unfavorable	3,000	Indiangrass	15
				Other perennial grasses	25
				Other perennial forbs	5
				Other shrubs	5
				Other trees	10
Kamie:					
23	Deep sand savannah	Favorable	4,000	Little bluestem	15
		Normal	2,800	Big bluestem	15
		Unfavorable	2,000	Other trees	20
				Other shrubs	10
				Other perennial grasses	35
				Other perennial forbs	5
				Other trees	15
24	Sandy savannah	Favorable	5,500	Little bluestem	30
		Normal	4,500	Big bluestem	15
		Unfavorable	3,500	Other trees	15
				Other perennial grasses	30
				Other perennial forbs	5
				Other shrubs	5
Larton:					
[1]28:					
Larton part	Deep sand savannah	Favorable	4,000	Little bluestem	15
		Normal	2,800	Big bluestem	15
		Unfavorable	2,000	Indiangrass	10
				Switchgrass	5
				Other perennial grasses	35
				Other perennial forbs	5
				Other shrubs	10
				Other trees	15
Glenpool part	Deep sand savannah	Favorable	4,000	Little bluestem	25
		Normal	2,800	Big bluestem	20
		Unfavorable	2,000	Indiangrass	10
				Other trees	15
				Other perennial grasses	20
				Other perennial forbs	5
				Other shrubs	5

See footnote at end of table.

TABLE 7.--RANGE PRODUCTIVITY AND COMPOSITION--Continued

Soil name and map symbol	Range site name	Potential production: Kind of year	Potential production: Dry weight	Characteristic vegetation	Composition
			Lb/acre		Pct
Lula:					
30	Loamy prairie	Favorable	7,000	Big bluestem	30
		Normal	5,500	Switchgrass	15
		Unfavorable	4,500	Little bluestem	15
				Indiangrass	10
				Other perennial grasses	23
				Other perennial forbs	7
Newtonia:					
32, 33	Loamy prairie	Favorable	7,000	Big bluestem	15
		Normal	4,500	Indiangrass	30
		Unfavorable	3,200	Little bluestem	20
				Switchgrass	5
				Other perennial grasses	18
				Other perennial forbs	12
Niotaze:					
[1]34:					
Niotaze part	Sandy savannah	Favorable	5,000	Little bluestem	25
		Normal	3,800	Big bluestem	20
		Unfavorable	3,000	Post oak	10
				Other trees	20
				Other perennial grasses	20
				Other perennial forbs	5
Darnell part	Shallow savannah	Favorable	3,200	Little bluestem	30
		Normal	2,100	Big bluestem	20
		Unfavorable	1,400	Other trees	10
				Other perennial grasses	20
				Other perennial forbs	10
				Other shrubs	10
[1]35:					
Niotaze part	Sandy savannah	Favorable	4,500	Little bluestem	25
		Normal	3,300	Big bluestem	20
		Unfavorable	2,500	Post oak	10
				Other trees	20
				Other perennial grasses	20
				Other perennial forbs	5
Darnell part	Shallow savannah	Favorable	3,000	Little bluestem	30
		Normal	2,000	Big bluestem	20
		Unfavorable	1,300	Other trees	10
				Other perennial grasses	20
				Other perennial forbs	10
				Other shrubs	10
[1]36:					
Niotaze part	Savannah breaks	Favorable	2,400	Little bluestem	25
		Normal	1,400	Big bluestem	20
		Unfavorable	800	Post oak	10
				Other trees	20
				Other perennial grasses	20
				Other perennial forbs	5
Darnell part	Savannah breaks	Favorable	1,800	Little bluestem	30
		Normal	1,000	Big bluestem	20
		Unfavorable	500	Other trees	10
				Other perennial grasses	20
				Other perennial forbs	10
				Other shrubs	10
Okay:					
39, 40, 41, 42	Loamy prairie	Favorable	7,000	Big bluestem	25
		Normal	5,500	Indiangrass	15
		Unfavorable	4,500	Little bluestem	20
				Switchgrass	10
				Other perennial grasses	22
				Other perennial forbs	8

See footnote at end of table.

TABLE 7.--RANGE PRODUCTIVITY AND COMPOSITION--Continued

Soil name and map symbol	Range site name	Potential production: Kind of year	Potential production: Dry weight	Characteristic vegetation	Composition
			Lb/acre		Pct
Okemah:					
43	Loamy prairie	Favorable	7,000	Big bluestem	25
		Normal	5,500	Switchgrass	15
		Unfavorable	4,500	Little bluestem	10
				Indiangrass	20
				Other perennial grasses	23
				Other perennial forbs	8
[1]44:					
Okemah part	Loamy prairie	Favorable	7,000	Big bluestem	25
		Normal	5,500	Switchgrass	15
		Unfavorable	4,500	Little bluestem	10
				Indiangrass	20
				Other perennial grasses	23
				Other perennial forbs	7
Parsons part	Claypan prairie	Favorable	4,500	Little bluestem	25
		Normal	3,000	Big bluestem	20
		Unfavorable	2,000	Switchgrass	15
				Indiangrass	10
				Other perennial grasses	23
				Other perennial shrubs	7
Carytown part	Shallow claypan	Favorable	4,000	Little bluestem	20
		Normal	2,800	Big bluestem	10
		Unfavorable	2,000	Switchgrass	15
				Indiangrass	10
				Other perennial grasses	38
				Other perennial forbs	7
Shidler:					
[1]50:					
Shidler part	Very shallow	Favorable	2,500	Side-oats grama	30
		Normal	1,300	Little bluestem	25
		Unfavorable	500	Other perennial grasses	33
				Other perennial forbs	12
Rock outcrop part.					

[1]This mapping unit is made up of two or more dominant kinds of soil. See mapping unit description for the composition and behavior of the whole mapping unit.

TABLE 8.--WOODLAND MANAGEMENT AND PRODUCTIVITY

[Only the soils suitable for production of commercial trees are listed in this table. Absence of an entry in a column means the information was not available]

Soil name and map symbol	Ordination symbol	Management concerns: Erosion hazard	Equipment limitation	Seedling mortality	Plant competition	Potential productivity: Important trees	Site index	Trees to plant
Choska:								
7	2o	Slight	Slight	Slight	Slight	Eastern cottonwood Green ash Pecan Black walnut	100 --- --- ---	American sycamore, black walnut, eastern cottonwood, green ash, pecan.
[1]8:								
Choska part	2o	Slight	Slight	Slight	Slight	Eastern cottonwood Green ash Pecan Black walnut	100 --- --- ---	American sycamore, black walnut, eastern cottonwood, green ash, pecan.
Severn part	2o	Slight	Slight	Slight	Moderate	Eastern cottonwood Pecan Hackberry	100 --- ---	Eastern cottonwood, American sycamore, pecan, black walnut, sweetgum.
Urban land part.								
Cleora:								
9	2o	Slight	Slight	Slight	Slight	Eastern cottonwood Northern red oak	100 80	Sweetgum, eastern cottonwood, black walnut, black cherry, American sycamore, white ash.
Dennis:								
[1]16:								
Dennis part	--	--------	--------	--------	--------	----------	---	---
Radley part	2o	Slight	Slight	Slight	Moderate	Black walnut Northern red oak Green ash Hackberry	70 --- 76 ---	Black walnut, pecan, American sycamore, hackberry, green ash.
Enders:								
[1]18:								
Enders part	5x	Slight	Moderate	Slight	Moderate	Northern red oak Eastern redcedar	45 35	Planting not recommended.
Hector part	5x	Slight	Moderate	Moderate	--------	Eastern redcedar	30	Planting not recommended.
Glenpool:								
21	4s	Slight	Slight	Severe	Moderate	Northern red oak Black oak	60	Shortleaf pine, loblolly pine.
Hector:								
[1]22:								
Hector part	5d	Slight	Moderate	Moderate	--------	Eastern redcedar	30	Planting not recommended.
Linker part	5d	Slight	Moderate	Moderate	--------	Eastern redcedar	35	Planting not recommended.
Kamie:								
23, 24	3o	Slight	Slight	Slight	Slight	Northern red oak Black oak	70	Shortleaf pine, loblolly pine.

See footnote at end of table.

TABLE 8.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns: Erosion hazard	Management concerns: Equipment limitation	Management concerns: Seedling mortality	Management concerns: Plant competition	Potential productivity: Important trees	Potential productivity: Site index	Trees to plant
Kamie:								
[1]25:								
Kamie part------	3o	Slight	Slight	Slight	Slight	Northern red oak---- Black oak----------	70 ---	Shortleaf pine, loblolly pine.
Urban land part.								
Kiomatia:								
[1]27----------	2o	Slight	Slight	Slight	Slight	Eastern cottonwood--	100	Cottonwood, sweetgum, black walnut, sycmore.
Larton:								
[1]28:								
Larton part-----	3o	Slight	Slight	Slight	Slight	Northern red oak---- Black oak----------	70 ---	Shortleaf pine, loblolly pine.
Glenpool part---	3o	Slight	Slight	Severe	Moderate	Northern red oak---- Black oak----------	66	Shortleaf pine. loblolly pine.
Latanier:								
29----------	3w	Slight	Moderate	Moderate	--------	Green ash---------- Bur oak---------- American sycamore--- Pecan---------- Eastern cottonwood--	--- --- --- --- 90	Eastern cottonwood, American sycamore.
Mason:								
31----------	3o	Slight	Slight	Slight	Moderate	Eastern cottonwood-- Northern red oak---- Green ash---------- Black walnut--------	90 --- --- ---	Sweetgum, bur oak, green ash, black walnut, pecan, American sycamore.
Niotaze:								
[1]34:								
Niotaze part----	5o	Moderate	Severe	Severe	Slight	Post oak---------- Blackjack oak-------	50 45	Planting not recommended.
Darnell part----	5o	Moderate	Severe	Severe	Slight	Post oak---------- Blackjack oak-------	50 45	Planting not recommended.
[1]35:								
Niotaze part----	5x	Moderate	Severe	Severe	Slight	Post oak---------- Blackjack oak-------	50 45	Planting not recommended.
Darnell part----	5x	Moderate	Severe	Severe	Slight	Post oak---------- Blackjack oak-------	50 45	Planting not recommended.
[1]36:								
Niotaze part----	5x	Moderate	Severe	Severe	Slight	Post oak---------- Blackjack oak-------	50 45	Planting not recommended.
Darnell part----	5x	Moderate	Severe	Severe	Slight	Post oak---------- Blackjack oak-------	50	Planting not recommended.
[1]37:								
Niotaze part----	5x	Moderate	Severe	Severe	Slight	Post oak---------- Blackjack oak-------	50 45	Planting not recommended.
Darnell part----	5x	Moderate	Severe	Severe	Slight	Post oak---------- Blackjack oak-------	50 45	Planting not recommended.

See footnote at end of table.

TABLE 8.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns: Erosion hazard	Equipment limitation	Seedling mortality	Plant competition	Potential productivity: Important trees	Site index	Trees to plant
Niotaze:								
Urban land part.								
Osage:								
45	4w	Slight	Moderate	Severe	Severe	Bur oak Pecan Eastern cottonwood	--- --- 80	Pecan.
Radley:								
47, [1]48	2o	Slight	Slight	Slight	Moderate	Black walnut Northern red oak Green ash Hackberry	--- 75 70 68	Black walnut, pecan, American sycamore, hackberry, green ash.
Severn:								
49	2o	Slight	Slight	Slight	Moderate	Eastern cottonwood Pecan Hackberry	100 --- ---	Eastern cottonwood, American sycamore, pecan, black walnut, sweetgum.
Tullahassee:								
51	3w	Slight	Moderate	Moderate	Moderate	Eastern cottonwood American sycamore	90 85	Eastern cottonwood, American sycamore, sweetgum, water oak.
Wynona:								
53	3w	Slight	Moderate	Moderate	Moderate	Green ash Pecan Eastern cottonwood	76 --- 90	Green ash, bur oak. pecan, eastern cottonwood, American sycamore.
[1]54:								
Wynona part	3w	Slight	Moderate	Moderate	Moderate	Green ash Pecan Eastern cottonwood	76 --- 90	Green ash, bur oak, pecan, eastern cottonwood, American sycamore.
Urban land part.								

[1]This mapping unit is made up of two or more dominant kinds of soil. See mapping unit description for the composition and behavior of the whole mapping unit.

TABLE 9.--WOODLAND UNDERSTORY VEGETATION

[Only the soils suitable for production of commercial trees are listed in this table]

Soil name and map symbol	Potential production: Kind of year	Potential production: Dry weight	Common plant name	Composition
		Lb/acre		Pct
Choska:				
7	Favorable	4,600	Big bluestem	20
	Normal	3,000	Sedge	10
	Unfavorable	2,000	Giant cane	10
			Other trees	20
			Other perennial grasses	20
			Other perennial forbs	10
			Other shrubs	10
[1]8:				
Choska part	Favorable	4,600	Big bluestem	20
	Normal	3,000	Sedge	10
	Unfavorable	2,000	Giant cane	10
			Other trees	20
			Other perennial grasses	20
			Other perennial forbs	10
			Other shrubs	10
Severn part	Favorable	4,500	Little bluestem	25
	Normal	3,000	Big bluestem	10
	Unfavorable	2,000	Canada wildrye	10
			Panicum	10
			Other perennial grasses	15
			Other trees	15
			Other perennial forbs	10
			Other shrubs	5
Urban land part.				
Cleora:				
9	Favorable	4,600	Big bluestem	20
	Normal	3,000	Sedge	10
	Unfavorable	2,000	Giant cane	10
			Other trees	20
			Other perennial grasses	20
			Other perennial forbs	10
			Other shrubs	10
Dennis:				
[1]16:				
Dennis part.				
Radley part	Favorable	4,500	Big bluestem	20
	Normal	3,000	Indiangrass	15
	Unfavorable	2,000	Switchgrass	30
			Other trees	20
			Other perennial grasses	5
			Other perennial forbs	5
			Other shrubs	5
Enders:				
[1]18:				
Enders part	Favorable	3,000	Little bluestem	20
	Normal	2,200	Indiangrass	5
	Unfavorable	1,500	Big bluestem	5
			Canada wildrye	10
			Other perennial grasses	25
			Other perennial forbs	5
			Other shrubs	10
			Other trees	20

See footnote at end of table.

TABLE 9.--WOODLAND UNDERSTORY VEGETATION--Continued

Soil name and map symbol	Potential production: Kind of year	Potential production: Dry weight	Common plant name	Composition
		Lb/acre		Pct
Enders:				
[1]18:				
Hector part	Favorable	2,500	Little bluestem	30
	Normal	2,000	Big bluestem	10
	Unfavorable	1,200	Indiangrass	15
			Switchgrass	5
			Canada wildrye	5
			Other perennial grasses	5
			Other perennial forbs	5
			Other shrubs	5
			Other trees	20
Glenpool:				
21	Favorable	2,500	Little bluestem	25
	Normal	1,600	Big bluestem	15
	Unfavorable	1,000	Other trees	20
			Other perennial grasses	20
			Other shrubs	10
			Other perennial forbs	10
Hector:				
[1]22:				
Hector part	Favorable	2,500	Little bluestem	30
	Normal	2,000	Big bluestem	10
	Unfavorable	1,200	Indiangrass	15
			Switchgrass	5
			Canada wildrye	5
			Other perennial grasses	5
			Other perennial forbs	5
			Other shrubs	5
			Other trees	20
Linker part	Favorable	3,000	Little bluestem	20
	Normal	2,200	Big bluestem	10
	Unfavorable	1,500	Indiangrass	10
			Switchgrass	5
			Canada wildrye	5
			Other perennial grasses	15
			Other perennial forbs	5
			Other shrubs	10
			Other trees	20
Kamie:				
23	Favorable	2,500	Little bluestem	15
	Normal	1,600	Big bluestem	15
	Unfavorable	1,000	Other trees	20
			Other shrubs	10
			Other perennial grasses	30
			Other perennial forbs	10
24	Favorable	3,000	Little bluestem	25
	Normal	2,200	Big bluestem	15
	Unfavorable	1,500	Other trees	20
			Other perennial grasses	25
			Other perennial forbs	5
			Other shrubs	10
[1]25:				
Kamie part	Favorable	2,500	Little bluestem	15
	Normal	1,600	Big bluestem	15
	Unfavorable	1,000	Other trees	20
			Other shrubs	10
			Other perennial grasses	30
			Other perennial forbs	10
Urban land part.				

See footnote at end of table.

TABLE 9.--WOODLAND UNDERSTORY VEGETATION--Continued

Soil name and map symbol	Potential production: Kind of year	Potential production: Dry weight	Common plant name	Composition
		Lb/acre		Pct
Kiomatia:				
27	Favorable	5,000	Big bluestem	30
	Normal	4,000	Little bluestem	20
	Unfavorable	2,000	Indiangrass	10
			Other perennial grasses	5
			Other perennial forbs	5
			Other shrubs	10
			Other trees	20
Larton:				
[1]28:				
Larton part	Favorable	2,000	Little bluestem	15
	Normal	1,400	Panicum	10
	Unfavorable	1,000	Other perennial grasses	20
			Other perennial forbs	15
			Other shrubs	15
			Other trees	25
Glenpool part	Favorable	2,500	Little bluestem	25
	Normal	1,600	Big bluestem	15
	Unfavorable	1,000	Other trees	20
			Other perennial grasses	20
			Other shrubs	10
			Other perennial forbs	10
Latanier:				
29	Favorable	5,500	Switchgrass	10
	Normal	4,500	Indiangrass	5
	Unfavorable	3,500	Big bluestem	5
			Eastern gamagrass	5
			Little bluestem	5
			Prairie cordgrass	20
			Other trees	15
			Other perennial grasses	20
			Other perennial forbs	5
			Other shrubs	10
Mason:				
31	Favorable	4,500	Big bluestem	20
	Normal	3,000	Indiangrass	20
	Unfavorable	2,000	Switchgrass	10
			Little bluestem	10
			Other trees	20
			Other perennial grasses	10
			Other perennial forbs	5
			Other shrubs	5
Niotaze:				
[1]34:				
Niotaze part	Favorable	3,000	Little bluestem	25
	Normal	2,200	Big bluestem	10
	Unfavorable	1,500	Post oak	10
			Other trees	15
			Other perennial grasses	25
			Other perennial forbs	5
			Other shrubs	10
Darnell part	Favorable	2,200	Little bluestem	30
	Normal	1,500	Big bluestem	10
	Unfavorable	1,000	Indiangrass	5
			Switchgrass	5
			Side-oats grama	5
			Other perennial grasses	15
			Other perennial forbs	5
			Other shrubs	10
			Other trees	15

See footnote at end of table.

TABLE 9.--WOODLAND UNDERSTORY VEGETATION--Continued

Soil name and map symbol	Potential production: Kind of year	Potential production: Dry weight	Common plant name	Composition
		Lb/acre		Pct
Niotaze:				
[1]35:				
Niotaze part----	Favorable	3,000	Little bluestem----------	25
	Normal	2,100	Big bluestem----------	10
	Unfavorable	1,500	Post oak----------	10
			Other trees----------	15
			Other perennial grasses----------	25
			Other perennial forbs----------	5
			Other shrubs----------	10
Darnell part----	Favorable	2,200	Little bluestem----------	30
	Normal	1,500	Big bluestem----------	10
	Unfavorable	1,000	Indiangrass----------	5
			Switchgrass----------	5
			Side-oats grama----------	5
			Other perennial grasses----------	15
			Other perennial forbs----------	5
			Other shrubs----------	10
			Other trees----------	15
[1]36:				
Niotaze part----	Favorable	2,000	Little bluestem----------	25
	Normal	1,100	Big bluestem----------	20
	Unfavorable	600	Post oak----------	10
			Other trees----------	20
			Other perennial grasses----------	15
			Other perennial forbs----------	5
			Other shrubs----------	5
Darnell part----	Favorable	1,200	Little bluestem----------	20
	Normal	700	Big bluestem----------	10
	Unfavorable	400	Indiangrass----------	5
			Switchgrass----------	5
			Side-oats grama----------	5
			Other perennial grasses----------	25
			Other perennial forbs----------	5
			Other shrubs----------	10
			Other trees----------	15
[1]37:				
Niotaze part----	Favorable	3,000	Little bluestem----------	25
	Normal	2,100	Big bluestem----------	10
	Unfavorable	1,500	Post oak----------	10
			Other trees----------	15
			Other perennial grasses----------	25
			Other perennial forbs----------	5
			Other shrubs----------	10
Darnell part---	Favorable	2,200	Little bluestem----------	30
	Normal	1,500	Big bluestem----------	10
	Unfavorable	1,000	Indiangrass----------	5
			Switchgrass----------	5
			Side-oats grama----------	5
			Other perennial grasses----------	15
			Other perennial forbs----------	5
			Other shrubs----------	10
			Other trees----------	15
Urban land part.				

See footnote at end of table.

TABLE 9.--WOODLAND UNDERSTORY VEGETATION--Continued

Soil name and map symbol	Potential production: Kind of year	Potential production: Dry weight	Common plant name	Composition
		Lb/acre		Pct
Osage:				
45	Favorable	5,500	Switchgrass	10
	Normal	4,500	Indiangrass	5
	Unfavorable	3,500	Big bluestem	5
			Eastern gamagrass	5
			Little bluestem	5
			Prairie cordgrass	20
			Other trees	15
			Other perennial grasses	20
			Other perennial forbs	5
			Other shrubs	10
Radley:				
47, [1]48	Favorble	4,500	Big bluestem	20
	Normal	3,000	Indiangrass	15
	Unfavorable	2,000	Switchgrass	30
			Other trees	20
			Other perennial grasses	10
			Other perennial forbs	5
			Other shrubs	5
Severn:				
49	Favorable	4,500	Little bluestem	25
	Normal	3,000	Big bluestem	10
	Unfavorable	2,000	Canada wildrye	10
			Panicum	10
			Other perennial grasses	15
			Other trees	15
			Other perennial forbs	10
			Other shrubs	5
Tullahassee:				
51	Favorable	5,500	Giant cane	15
	Normal	4,500	Switchgrass	10
	Unfavorable	3,500	Indiangrass	5
			Eastern gamagrass	10
			Wildrye	10
			Panicum	10
			Other perennial forbs	15
			Other perennial grasses	10
			Other trees	20
			Other shrubs	5
Wynona:				
53	Favorable	4,500	Little bluestem	20
	Normal	3,000	Big bluestem	10
	Unfavorable	2,000	Canada wildrye	10
			Panicum	10
			Other perennial grasses	10
			Other trees	20
			Other perennial forbs	10
			Other shrubs	10
[1]54:				
Wynona part	Favorable	4,500	Little bluestem	20
	Normal	3,000	Big bluestem	10
	Unfavorable	2,000	Canada wildrye	10
			Panicum	10
			Other perennial grasses	10
			Other trees	20
			Other perennial forbs	10
			Other shrubs	10
Urban land part.				

[1]This mapping unit is made up of two or more dominant kinds of soil. See mapping unit description for the composition and behavior of the whole mapping unit.

TABLE 10.--BUILDING SITE DEVELOPMENT

["Shrink-swell" and some of the other terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry means soil was not rated]

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
Apperson:					
1, 2	Severe: too clayey, depth to rock, wetness.	Severe: shrink-swell, low strength, wetness.	Severe: low strength, shrink-swell, wetness.	Severe: low strength, shrink-swell, wetness.	Severe: low strength, shrink-swell.
Bates:					
3	Moderate: depth to rock.	Moderate: shrink-swell.	Moderate: depth to rock, shrink-swell.	Moderate: shrink-swell.	Moderate: depth to rock, shrink-swell.
[1]4:					
Bates part	Moderate: depth to rock.	Moderate: depth to rock.	Moderate: depth to rock.	Moderate: depth to rock.	Moderate: depth to rock.
Coweta part	Moderate: depth to rock.	Moderate: depth to rock.	Moderate: depth to rock.	Moderate: depth to rock.	Moderate: depth to rock.
Catoosa:					
5	Severe: depth to rock.	Moderate: low strength, depth to rock, shrink-swell.	Severe: depth to rock, low strength, shrink-swell.	Moderate: low strength, depth to rock, shrink-swell.	Severe: low strength.
[1]6:					
Catoosa part	Severe: depth to rock.	Moderate: low strength, depth to rock, shrink-swell.	Severe: depth to rock, low strength, shrink-swell.	Moderate: slope, shrink-swell, depth to rock.	Severe: low strength.
Rock outcrop part.					
Choska:					
7	Moderate: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Moderate: floods, low strength.
[1]8:					
Choska part	Moderate: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Moderate: floods, low strength.
Severn part	Moderate: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Moderate: floods, low strength.
Urban land part.					
Cleora:					
9	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Moderate: floods, low strength.
Coweta:					
[1]10:					
Coweta part	Moderate: depth to rock.	Moderate: depth to rock.	Moderate: depth to rock.	Moderate: depth to rock.	Moderate: depth to rock.
Bates part	Moderate: depth to rock.	Moderate: shrink-swell.	Moderate: depth to rock, shrink-swell.	Moderate: shrink-swell.	Moderate: depth to rock, shrink-swell.

See footnote at end of table.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
Coweta:					
[1]11:					
Coweta part	Moderate: slope, depth to rock.	Moderate: depth to rock, slope.	Moderate: depth to rock, slope.	Moderate: depth to rock, slope.	Moderate: depth to rock, slope.
Eram part	Severe: too clayey, wetness.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength, wetness.	Severe: shrink-swell, low strength.	Severe: low strength, shrink-swell.
Urban land part.					
Dennis:					
12, 13, 14	Severe: wetness, too clayey.	Severe: shrink-swell, low strength.	Severe: wetness, shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: low strength, shrink-swell.
[1]15:					
Dennis part	Severe: wetness, too clayey.	Severe: shrink-swell, low strength.	Severe: wetness, shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: low strength, shrink-swell.
Carytown part	Severe: wetness, too clayey, low strength.	Severe: shrink-swell, wetness, low strength.	Severe: shrink-swell, wetness, low strength.	Severe: shrink-swell, wetness, low strength.	Severe: shrink-swell, wetness, low strength.
[1]16:					
Dennis part	Severe: wetness, too clayey.	Severe: shrink-swell, low strength.	Severe: wetness, shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: low strength, shrink-swell.
Radley part	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.
[1]17:					
Dennis part	Severe: wetness, too clayey.	Severe: shrink-swell, low strength.	Severe: wetness, shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: low strength, shrink-swell.
Urban land part.					
Enders:					
[1]18:					
Enders part	Severe: slope, too clayey.	Severe: slope, shrink-swell, low strength.	Severe: slope, depth to rock.	Severe: slope, shrink-swell, low strength.	Severe: slope, shrink-swell.
Hector part	Severe: depth to rock, large stones.	Severe: depth to rock, large stones, slope.	Severe: depth to rock, large stones, slope.	Severe: depth to rock, large stones, slope.	Severe: depth to rock, large stones, slope.
Eram:					
19	Severe: too clayey, wetness.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength, wetness.	Severe: shrink-swell, low strength.	Severe: low strength, shrink-swell.
[1]20:					
Eram part	Severe: too clayey, wetness.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength, wetness.	Severe: shrink-swell, low strength.	Severe: low strength, shrink-swell.

See footnote at end of table.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
Eram:					
[1]20:					
Coweta part	Moderate: slope, depth to rock.	Moderate: depth to rock, slope.	Moderate: depth to rock, slope.	Moderate: depth to rock, slope.	Moderate: depth to rock, slope.
Glenpool:					
21	Severe: too sandy, cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.
Hector:					
[1]22:					
Hector part	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.
Linker part	Severe: depth to rock.	Moderate: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Moderate: depth to rock.
Kamie:					
23	Severe: too sandy.	Slight	Slight	Moderate: slope.	Moderate: low strength.
24	Slight	Slight	Slight	Slight	Moderate: low strength.
[1]25:					
Kamie part	Severe: too sandy.	Slight	Slight	Moderate: slope.	Moderate: low strength.
Urban land part.					
Kanima:					
[1]26	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Kiomatia:					
[1]27	Severe: floods, too sandy.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.
Larton:					
[1]28:					
Larton part	Slight	Slight	Slight	Slight	Moderate: low strength.
Glenpool part	Severe: too sandy, cutbanks cave.	Slight	Slight	Slight	Slight.
Latanier:					
29	Severe: floods, wetness, too clayey.	Severe: floods, shrink-swell, wetness.	Severe: floods, shrink-swell, wetness.	Severe: floods, shrink-swell, wetness.	Severe: shrink-swell, low strength.
Lula:					
30	Moderate: too clayey, depth to rock.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Moderate: low strength, shrink-swell.
Mason:					
31	Moderate: too clayey, floods.	Severe: floods.	Severe: floods.	Severe: floods.	Moderate: floods, shrink-swell, floods.

See footnote at end of table.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
Newtonia:					
32	Severe: too clayey.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: low strength, shrink-swell.
33	Severe: too clayey.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength, slope.	Severe: low strength, shrink-swell.
Niotaze:					
[1]34:					
Niotaze part	Severe: wetness, depth to rock.	Severe: shrink-swell, low strength, wetness.	Severe: shrink-swell, low strength, wetness.	Severe: shrink-swell, low strength, wetness.	Severe: low strength, shrink-swell, depth to rock.
Darnell part	Moderate: depth to rock.	Moderate: depth to rock.	Moderate: depth to rock.	Moderate: depth to rock.	Severe: depth to rock.
[1]35:					
Niotaze part	Severe: wetness, depth to rock, slope.	Severe: shrink-swell, low strength, wetness, slope.	Severe: shrink-swell, low strength, wetness, slope.	Severe: shrink-swell, low strength, wetness, slope.	Severe: low strength, shrink-swell, depth to rock, slope.
Darnell part	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: slope, depth to rock.
[1]36:					
Niotaze part	Severe: wetness, depth to rock, slope.	Severe: shrink-swell, low strength, wetness, slope.	Severe: shrink-swell, low strength, wetness, slope.	Severe: shrink-swell, low strength, wetness, slope.	Severe: low strength, shrink-swell, depth to rock, slope.
Darnell part	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: slope, depth to rock.
[1]37:					
Niotaze part	Severe: wetness, depth to rock, slope.	Severe: shrink-swell, low strength, wetness, slope.	Severe: shrink-swell, low strength, wetness, slope.	Severe: shrink-swell, low strength, wetness, slope.	Severe: low strength, shrink-swell, depth to rock, slope.
Darnell part	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.
Urban land part.					
)il-waste land:					
38.					
)kay:					
39, 40, 41, 42	Slight	Slight	Slight	Slight	Moderate: low strength.
)kemah:					
43	Severe: too clayey, wetness.	Severe: low strength, shrink-swell.	Severe: low strength, wetness, shrink-swell.	Severe: shrink-swell, low strength.	Severe: low strength, shrink-swell.
[1]44:					
Okemah part	Severe: too clayey, wetness.	Severe: low strength, shrink-swell.	Severe: low strength, wetness, shrink-swell.	Severe: shrink-swell, low strength.	Severe: low strength, shrink-swell.

See footnote at end of table.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
Okemah:					
[1]44:					
Parsons part	Severe: wetness, too clayey.	Severe: wetness, shrink-swell, low strength.	Severe: wetness, shrink-swell, low strength.	Severe: wetness, shrink-swell, low strength.	Severe: low strength, shrink-swell.
Carytown part	Severe: wetness, too clayey, low strength.	Severe: shrink-swell, wetness, low strength.	Severe: shrink-swell, wetness, low strength.	Severe: shrink-swell, wetness, low strength.	Severe: shrink-swell, wetness, low strength.
Osage:					
45	Severe: wetness, floods, too clayey.	Severe: wetness, floods, shrink-swell.	Severe: wetness, floods, shrink-swell.	Severe: wetness, floods, shrink-swell.	Severe: wetness, floods, shrink-swell.
Pits:					
46.					
Radley:					
47, [1]48	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.
Severn:					
49	Moderate: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Moderate: floods, low strength.
Shidler:					
[1]50:					
Shidler part	Severe: depth to rock.	Severe: depth to rock, low strength.	Severe: depth to rock, low strength.	Severe: depth to rock, low strength.	Severe: depth to rock, low strength.
Rock outcrop part.					
Tullahassee:					
51	Severe: wetness, floods.	Severe: floods.	Severe: wetness, floods.	Severe: floods.	Severe: floods.
Urban land:					
52.					
Wynona:					
53	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: floods, low strength.
[1]54:					
Wynona part	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: floods, low strength.
Urban land part.					

[1]This mapping unit is made up of two or more dominant kinds of soil. See mapping unit description for the composition and behavior of the whole mapping unit.

TABLE 11.--SANITARY FACILITIES

["Shrink-swell" and some of the other terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," "severe" and other terms used to rate soils. Absence of an entry means soil was not rated]

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
Apperson:					
1, 2	Severe: percs slowly, depth to rock, wetness.	Moderate: depth to rock, wetness.	Severe: too clayey, depth to rock.	Severe: wetness.	Poor: too clayey.
Bates:					
3	Severe: depth to rock.	Severe: depth to rock.	Moderate: depth to rock.	Slight	Fair: thin layer.
[1]4:					
Bates part	Severe: depth to rock.	Severe: depth to rock.	Moderate: depth to rock.	Slight	Fair: thin layer.
Coweta part	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Slight	Poor: thin layer.
Catoosa:					
5	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Slight	Fair: thin layer.
[1]6:					
Catoosa part	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Slight	Fair: thin layer.
Rock outcrop part.					
Choska:					
7	Moderate: floods.	Severe: seepage.	Severe: seepage.	Moderate: floods.	Good.
[1]8:					
Choska part	Moderate: floods.	Severe: seepage.	Severe: seepage.	Moderate: floods.	Good.
Severn part	Moderate: floods.	Severe: seepage, floods.	Severe: seepage.	Severe: seepage.	Good.
Urban land part.					
Cleora:					
9	Severe: floods.	Severe: seepage, floods.	Severe: floods, seepage.	Severe: floods, seepage.	Good.
Coweta:					
[1]10:					
Coweta part	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Slight	Poor: thin layer.
Bates part	Severe: depth to rock.	Severe: depth to rock.	Moderate: depth to rock.	Slight	Fair: thin layer.
[1]11:					
Coweta part	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Slight	Poor: thin layer.
Eram part	Severe: percs slowly, wetness, depth to rock.	Severe: depth to rock, slope.	Severe: too clayey.	Severe: wetness.	Poor: thin layer.
Urban land part.					

See footnote at end of table.

TABLE 11.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
Dennis:					
12, 13, 14	Severe: percs slowly, wetness.	Moderate: slope.	Severe: too clayey.	Severe: wetness.	Poor: thin layer.
[1]15:					
Dennis part	Severe: percs slowly, wetness.	Moderate: slope.	Severe: too clayey.	Severe: wetness.	Poor: thin layer.
Carytown part	Severe: percs slowly, wetness.	Slight	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, wetness, hard to pack.
[1]16:					
Dennis part	Severe: percs slowly, wetness.	Moderate: slope.	Severe: too clayey.	Severe: wetness.	Poor: thin layer.
Radley part	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Good.
[1]17:					
Dennis part	Severe: percs slowly, wetness.	Moderate: slope.	Severe: too clayey.	Severe: wetness.	Poor: thin layer.
Urban land part.					
Enders:					
[1]18:					
Enders part	Severe: percs slowly.	Severe: slope.	Moderate: depth to rock, too clayey.	Severe: slope.	Poor: too clayey.
Hector part	Severe: depth to rock, large stones.	Severe: depth to rock, seepage.	Severe: depth to rock, seepage, large stones.	Severe: seepage, slope.	Poor: thin layer, large stones, slope.
Eram:					
19	Severe: percs slowly, wetness, depth to rock.	Severe: depth to rock.	Severe: too clayey.	Severe: wetness.	Poor: thin layer.
[1]20:					
Eram part	Severe: percs slowly, wetness, depth to rock.	Severe: depth to rock, slope.	Severe: too clayey.	Severe: wetness.	Poor: thin layer.
Coweta part	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Moderate: slope.	Poor: thin layer.
Glenpool:					
21	Moderate: slope.	Severe: seepage, slope.	Severe: seepage.	Severe: seepage.	Fair: too sandy.
Hector:					
[1]22:					
Hector part	Severe: depth to rock.	Severe: depth to rock, seepage.	Severe: depth to rock, seepage.	Severe: seepage.	Poor: thin layer.

See footnote at end of table.

TABLE 11.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
Hector:					
[1]22:					
Linker part	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Slight	Fair: thin layer.
Kamie:					
23	Slight	Moderate: slope, seepage.	Slight	Slight	Fair: too sandy.
24	Slight	Moderate: slope, seepage.	Slight	Slight	Good.
[1]25:					
Kamie part	Slight	Moderate: slope, seepage.	Slight	Slight	Fair: too sandy.
Urban land part.					
Kanima:					
[1]26	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
Kiomatia:					
[1]27	Severe: floods.	Severe: floods, seepage.	Severe: floods, seepage.	Severe: floods, seepage.	Fair: too sandy.
Larton:					
[1]28:					
Larton part	Slight	Moderate: seepage, slope.	Slight	Slight	Fair: too sandy.
Glenpool part	Slight	Severe: seepage.	Severe: seepage.	Severe: seepage.	Fair: too sandy.
Latanier:					
29	Severe: floods, percs slowly, wetness.	Severe: floods.	Severe: floods, wetness, too clayey.	Severe: floods, wetness.	Poor: too clayey.
Lula:					
30	Moderate: depth to rock.	Moderate: seepage, depth to rock.	Severe: depth to rock.	Slight	Fair: too clayey.
Mason:					
31	Severe: percs slowly.	Slight	Moderate: floods, too clayey.	Moderate: floods.	Fair: thin layer.
Newtonia:					
32, 33	Moderate: percs slowly.	Moderate: seepage, slope.	Severe: too clayey.	Slight	Fair: too clayey.
Niotaze:					
[1]34:					
Niotaze part	Severe: depth to rock, percs slowly.	Severe: depth to rock, slope.	Severe: too clayey, wetness, depth to rock.	Severe: wetness.	Poor: thin layer.
Darnell part	Severe: depth to rock.	Severe: depth to rock, seepage, slope.	Severe: seepage, depth to rock.	Severe: seepage.	Poor: thin layer.

See footnote at end of table.

TABLE 11.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
Niotaze:					
[1]35:					
Niotaze part	Severe: depth to rock, percs slowly, slope.	Severe: depth to rock, slope.	Severe: too clayey, wetness, depth to rock.	Severe: slope, wetness.	Poor: thin layer, slope.
Darnell part	Severe: depth to rock, slope.	Severe: depth to rock, seepage, slope.	Severe: seepage, depth to rock.	Severe: seepage, slope.	Poor: thin layer, slope.
[1]36:					
Niotaze part	Severe: depth to rock, percs slowly, slope.	Severe: depth to rock. slope.	Moderate: too clayey, wetness, depth to rock, slope.	Severe: slope, wetness.	Poor: thin layer, slope.
Darnell part	Severe: depth to rock, slope.	Severe: depth to rock, seepage, slope.	Severe: seepage, slope, depth to rock.	Severe: seepage, slope.	Poor: thin layer, slope.
[1]37:					
Niotaze part	Severe: depth to rock, percs slowly, slope.	Severe: depth to rock, slope.	Moderate: too clayey, wetness, depth to rock.	Severe: wetness, slope.	Poor: thin layer. slope.
Darnell part	Severe: depth to rock, slope.	Severe: depth to rock, seepage, slope.	Severe: seepage, depth to rock.	Severe: seepage, slope.	Poor: thin layer, slope.
Urban land part.					
Oil-waste land: 38.					
Okay: 39, 40, 41, 42	Slight	Severe: seepage.	Severe: seepage.	Slight	Good.
Okemah: 43	Severe: percs slowly, wetness.	Slight	Severe: too clayey.	Severe: wetness.	Fair: thin layer.
[1]44:					
Okemah part	Severe: percs slowly, wetness.	Slight	Severe: too clayey.	Severe: wetness.	Fair: thin layer.
Parsons part	Severe: percs slowly, wetness.	Slight	Severe: too clayey.	Severe: wetness.	Poor: too clayey.
Carytown part	Severe: percs slowly, wetness.	Slight	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, wetness, hard to pack.
Osage: 45	Severe: percs slowly, floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness, too clayey.	Severe: floods, wetness.	Poor: wetness, too clayey.
Pits: 46.					

See footnote at end of table.

TABLE 11.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
Radley:					
47, [1]48	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Good.
Severn:					
49	Moderate: floods.	Severe: seepage, floods.	Severe: seepage.	Severe: seepage.	Good.
Shidler:					
[1]50:					
Shidler part	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Slight	Poor: thin layer, area reclaim.
Rock outcrop part.					
Tullahassee:					
51	Severe: floods, wetness.	Severe: wetness, floods, seepage.	Severe: floods, wetness, seepage.	Severe: wetness, floods, seepage.	Good.
Urban land:					
52.					
Wynona:					
53	Severe: percs slowly, wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Fair: too clayey.
[1]54:					
Wynona part	Severe: percs slowly, wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Fair: too clayey.
Urban land part.					

[1]This mapping unit is made up of two or more dominant kinds of soil. See mapping unit description for the composition and behavior of the whole mapping unit.

TABLE 12.--CONSTRUCTION MATERIALS

["Shrink-swell" and some of the other terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," and "poor." Absence of an entry means soil was not rated]

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
Apperson:				
1, 2	Poor: low strength, shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: too clayey, thin layer.
Bates:				
3	Poor: thin layer.	Unsuited	Unsuited	Good.
[1]4:				
Bates part	Poor: thin layer.	Unsuited	Unsuited	Good.
Coweta part	Fair: low strength, slope.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer.
Catoosa:				
5	Poor: low strength.	Unsuited	Unsuited	Fair: thin layer.
[1]6:				
Catoosa part	Poor: low strength.	Unsuited	Unsuited	Fair: thin layer.
Rock outcrop part.				
Choska:				
7	Fair: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
[1]8:				
Choska part	Fair: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
Severn part	Fair: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
Urban land part.				
Cleora:				
9	Fair: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
Coweta:				
[1]10:				
Coweta part	Fair: low strength, slope.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer.
Bates part	Poor: thin layer.	Unsuited	Unsuited	Good.
[1]11:				
Coweta part	Fair: low strength, slope.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer.
Eram part	Poor: low strength, shrink-swell, thin layer.	Unsuited	Unsuited	Fair: thin layer, too clayey.
Urban land part.				

See footnote at end of table.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
Dennis:				
12, 13, 14	Poor: low strength, shrink-swell.	Unsuited	Unsuited	Fair: thin layer.
[1]15:				
Dennis part	Poor: low strength, shrink-swell.	Unsuited	Unsuited	Fair: thin layer.
Carytown part	Poor: shrink-swell, wetness, excess sodium, low strength.	Unsuited	Unsuited	Fair: thin layer, wetness, excess sodium.
[1]16:				
Dennis part	Poor: low strength, shrink-swell.	Unsuited	Unsuited	Fair: thin layer.
Radley part	Fair: low strength, shrink-swell.	Unsuited	Unsuited	Good.
[1]17:				
Dennis part	Poor: low strength, shrink-swell.	Unsuited	Unsuited	Fair: thin layer.
Urban land part.				
Enders:				
[1]18:				
Enders part	Poor: shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: slope, thin layer.
Hector part	Poor: thin layer, large stones.	Poor	Poor	Poor: thin layer, large stones.
Eram:				
19	Poor: low strength, shrink-swell, thin layer.	Unsuited	Unsuited	Fair: thin layer, too clayey.
[1]20:				
Eram part	Poor: low strength, shrink-swell, thin layer.	Unsuited	Unsuited	Fair: thin layer, too clayey.
Coweta part	Fair: low strength, slope.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer.
Glenpool:				
21	Good	Poor: excess fines.	Unsuited: excess fines.	Poor: too sandy.
Hector:				
[1]22:				
Hector part	Poor: thin layer.	Poor	Poor	Poor: thin layer.

See footnote at end of table.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
Hector:				
[1]22:				
Linker part	Fair: low strength, thin layer.	Poor: excess fines.	Unsuited: excess fines.	Fair: thin layer.
Kamie:				
23	Fair: low strength.	Poor	Unsuited	Poor: too sandy.
24	Fair: low strength.	Poor	Unsuited	Good.
[1]25:				
Kamie part	Fair: low strength.	Poor	Unsuited	Poor: too sandy.
Urban land part.				
Kanima:				
[1]26	Poor: slope.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: slope, too clayey.
Kiomatia:				
[1]27	Good	Good	Unsuited: excess fines.	Poor: too sandy.
Larton:				
[1]28:				
Larton part	Fair: low strength.	Poor: excess fines.	Unsuited: excess fines.	Poor: too sandy.
Glenpool part	Good	Poor: excess fines.	Unsuited: excess fines.	Poor: too sandy.
Latanier:				
29	Poor: low strength, shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: too clayey.
Lula:				
30	Fair: low strength, shrink-swell.	Unsuited	Unsuited	Fair: thin layer.
Mason:				
31	Fair: low strength, shrink-swell.	Unsuited	Unsuited	Fair: thin layer.
Newtonia:				
32, 33	Poor: low strength, shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer.
Niotaze:				
[1]34:				
Niotaze part	Poor: low strength, shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer, small stones.
Darnell part	Fair: low strength, thin layer.	Unsuited	Unsuited	Fair: thin layer, small stones.
[1]35:				
Niotaze part	Poor: low strength, shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: small stones, slope.

See footnote at end of table.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
Niotaze:				
[1]35:				
Darnell part	Fair: low strength, thin layer.	Unsuited	Unsuited	Poor: slope, small stones.
[1]36:				
Niotaze part	Poor: low strength, shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: small stones, slope.
Darnell part	Poor: slope.	Unsuited	Unsuited	Poor: small stones, slope.
[1]37:				
Niotaze part	Poor: low strength, shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: small stones, slope.
Darnell part	Fair: low strength, shrink-swell.	Unsuited	Unsuited	Poor: slope, small stones.
Urban land part.				
Oil-waste land: 38.				
Okay: 39, 40, 41, 42	Good	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer.
Okemah:				
43	Poor: low strength, shrink-swell.	Unsuited	Unsuited	Good.
[1]44:				
Okemah part	Poor: low strength, shrink-swell.	Unsuited	Unsuited	Good.
Parsons part	Poor: low strength, shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer.
Carytown part	Poor: shrink-swell, wetness, excess sodium.	Unsuited	Unsuited	Fair: thin layer, wetness, excess sodium.
Osage:				
45	Poor: wetness, low strength, shrink-swell.	Unsuited	Unsuited	Poor: wetness, too clayey.
Pits: 46.				
Radley:				
47, [1]48	Fair: low strength, shrink-swell.	Unsuited	Unsuited	Good.
Severn:				
49	Fair: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.

See footnote at end of table.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
Shidler:				
[1]50:				
Shidler part	Poor: thin layer, low strength.	Unsuited: excess fines.	Unsuited: excess fine.	Poor: area reclaim.
Rock outcrop part.				
Tullahassee:				
51	Fair: wetness, low strength.	Unsuited	Unsuited	Good.
Urban land:				
52.				
Wynona:				
53	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: too clayey.
[1]54:				
Wynona part	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: too clayey.
Urban land part.				

[1]This mapping unit is made up of two or more dominant kinds of soil. See mapping unit description for the composition and behavior of the whole mapping unit.

TABLE 13.--WATER MANAGEMENT

["Seepage" and some of the other terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry means soil was not evaluated]

Soil name and map symbol	Limitations for--			Features affecting--		
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Terraces and diversions	Grassed waterways
Apperson:						
1, 2	Moderate: depth to rock.	Moderate: unstable fill, thin layer, compressible.	Severe: slow refill.	Wetness, percs slowly.	Percs slowly, wetness.	Percs slowly, wetness.
Bates:						
3	Moderate: depth to rock, erodes easily.	Moderate: thin layer.	Severe: no water.	Not needed	Slope, depth to rock, erodes easily.	Slope, erodes easily, rooting depth.
14:						
Bates part	Moderate: depth to rock, erodes easily.	Moderate: thin layer.	Severe: no water.	Not needed	Slope, depth to rock, erodes easily.	Slope, erodes easily, rooting depth.
Coweta part	Severe: depth to rock.	Severe: thin layer.	Severe: no water.	Not needed	Depth to rock, rooting depth, slope.	Droughty, rooting depth, slope.
Catoosa:						
5	Severe: depth to rock.	Moderate: unstable fill, piping, thin layer.	Severe: no water.	Not needed	Depth to rock, rooting depth, droughty.	Rooting depth, droughty.
16:						
Catoosa part	Severe: depth to rock.	Moderate: unstable fill, piping, thin layer.	Severe: no water.	Not needed	Depth to rock, rooting depth, droughty.	Rooting depth, droughty.
Rock outcrop part.						
Choska:						
7	Moderate: seepage.	Moderate: unstable fill, compressible, piping.	Severe: deep to water.	Not needed	Favorable	Favorable.
18:						
Choska part	Moderate: seepage.	Moderate: unstable fill, compressible, piping.	Severe: deep to water.	Not needed	Favorable	Favorable.
Severn part	Severe: seepage.	Moderate: unstable fill, piping, compressible.	Severe: deep to water.	Not needed	Favorable	Favorable.
Urban land part.						
Cleora:						
9	Severe: seepage.	Moderate: piping, unstable fill, seepage.	Severe: deep to water.	Not needed	Favorable	Favorable.

See footnote at end of table.

TABLE 13.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Features affecting-- Drainage	Terraces and diversions	Grassed waterways
Coweta:						
[1]10:						
Coweta part	Severe: depth to rock.	Severe: thin layer.	Severe: no water.	Not needed	Depth to rock, rooting depth, slope.	Droughty, rooting depth, slope.
Bates part	Moderate: depth to rock, erodes easily.	Moderate: thin layer.	Severe: no water.	Not needed	Slope, depth to rock, erodes easily.	Slope, erodes easily, rooting depth.
[1]11:						
Coweta part	Severe: depth to rock.	Severe: thin layer.	Severe: no water.	Not needed	Depth to rock, rooting depth, slope.	Droughty, rooting depth, slope.
Eram part	Slight	Moderate: unstable fill, thin layer.	Severe: no water.	Percs slowly	Percs slowly	Percs slowly.
Urban land part.						
Dennis:						
12, 13, 14	Slight	Moderate: unstable fill, compressible, piping.	Severe: no water.	Percs slowly	Percs slowly	Percs slowly.
[1]15:						
Dennis part	Slight	Moderate: unstable fill, compressible, piping.	Severe: no water.	Percs slowly	Percs slowly	Percs slowly.
Carytown part	Slight	Severe: unstable fill, compressible, shrink-swell, excess sodium.	Severe: no water.	Percs slowly, wetness, excess sodium.	Percs slowly, wetness, excess sodium.	Percs slowly, wetness, excess sodium.
[1]16:						
Dennis part	Slight	Moderate: unstable fill, compressible, piping.	Severe: no water.	Percs slowly	Percs slowly	Percs slowly.
Radley part	Moderate: seepage.	Moderate: low strength, piping.	Severe: deep to water.	Floods	Floods	Favorable.
[1]17:						
Dennis part	Slight	Moderate: unstable fill, compressible, piping.	Severe: no water.	Percs slowly	Percs slowly	Percs slowly.
Urban land part.						
Enders:						
[1]18:						
Enders part	Moderate: depth to rock.	Severe: shrink-swell, low strength.	Severe: deep to water.	Not needed	Slope, depth to rock.	Slope, erodes easily.
Hector part	Severe: depth to rock, seepage.	Severe: thin layer, large stones.	Severe: no water.	Not needed	Slope, depth to rock, large stones.	Droughty, large stones, slope.

See footnote at end of table.

TABLE 13.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Features affecting-- Drainage	Terraces and diversions	Grassed waterways
Eram:						
19	Slight	Moderate: unstable fill, thin layer.	Severe: no water.	Percs slowly	Percs slowly	Percs slowly.
[1]20:						
Eram part	Slight	Moderate: unstable fill, thin layer.	Severe: no water.	Percs slowly	Percs slowly	Percs slowly.
Coweta part	Severe: depth to rock.	Severe: thin layer.	Severe: no water.	Not needed	Depth to rock, rooting depth, slope.	Droughty, rooting depth, slope.
Glenpool:						
21	Severe: seepage.	Severe: unstable fill, piping.	Severe: no water.	Not needed	Seepage, fast intake.	Seepage.
Hector:						
[1]22:						
Hector part	Severe: depth to rock, seepage.	Severe: thin layer.	Severe: no water.	Not needed	Slope, depth to rock.	Droughty, slope.
Linker part	Severe: depth to rock.	Moderate: thin layer, compressible.	Severe: no water.	Not needed	Slope, depth to rock, erodes easily.	Erodes easily, slope.
Kamie:						
23, 24	Moderate: seepage.	Moderate: unstable fill, compressible, piping.	Severe: no water.	Not needed	Piping, complex slope.	Erodes easily, slope.
[1]25:						
Kamie part	Moderate: seepage.	Moderate: unstable fill, compressible, piping.	Severe: no water.	Not needed	Piping, complex slope.	Erodes easily, slope.
Urban land part.						
Kanima:						
[1]26	Moderate: seepage.	Moderate: seepage, low strength.	Severe: deep to water.	Not needed	Not needed	Not needed.
Kiomatia:						
[1]27	Severe: seepage.	Severe: piping.	Moderate: deep to water.	Floods, cutbanks cave.	Too sandy	Floods.
Larton:						
[1]28:						
Larton part	Moderate: seepage.	Moderate: unstable fill, compressible, piping.	Severe: no water.	Not needed	Erodes easily	Erodes easily, droughty.
Glenpool part	Severe: seepage.	Severe: unstable fill, piping.	Severe: no water.	Not needed	Seepage, fast intake.	Seepage.
Latanier:						
29	Slight	Moderate: shrink-swell, low strength, compressible.	Severe: no water.	Floods, percs slowly.	Not needed	Favorable.

See footnote at end of table.

TABLE 13.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Features affecting-- Drainage	Terraces and diversions	Grassed waterways
Lula:						
30	Moderate: thin layer, seepage.	Moderate: thin layer, piping.	Severe: no water.	Not needed	Favorable	Favorable.
Mason:						
31	Moderate: seepage.	Moderate: unstable fill, piping, compressible.	Severe: no water.	Not needed	Not needed	Not needed.
Newtonia:						
32, 33	Moderate: seepage.	Moderate: compressible, unstable fill.	Severe: no water.	Not needed	Favorable	Favorable.
Niotaze:						
[1]34:						
Niotaze part	Moderate: depth to rock.	Severe: low strength, shrink-swell, thin layer.	Severe: no water.	Wetness	Slope	Slope, small stones.
Darnell part	Severe: depth to rock, seepage.	Severe: thin layer.	Severe: no water.	Not needed	Depth to rock, erodes easily, slope.	Rooting depth, slope.
[1]35:						
Niotaze part	Moderate: depth to rock.	Severe: low strength, shrink-swell, thin layer.	Severe: no water.	Wetness	Slope	Slope, small stones.
Darnell part	Severe: depth to rock, seepage.	Severe: thin layer.	Severe: no water.	Not needed	Slope, depth to rock, erodes easily.	Slope, rooting depth.
[1]36:						
Niotaze part	Moderate: depth to rock.	Severe: low strength, shrink-swell, thin layer.	Severe: no water.	Wetness	Slope	Slope, small stones.
Darnell part	Severe: depth to rock, seepage.	Severe: thin layer.	Severe: no water.	Not needed	Slope, depth to rock, erodes easily.	Slope, rooting depth.
[1]37:						
Niotaze part	Moderate: depth to rock.	Severe: low strength, shrink-swell, thin layer.	Severe: no water.	Wetness	Slope	Slope, small stones.
Darnell part	Severe: depth to rock, seepage.	Severe: thin layer.	Severe: no water.	Not needed	Depth to rock, erodes easily, slope.	Rooting depth, slope.
Urban land part.						
Oil-waste land: 38.						
Okay:						
39	Severe: seepage.	Moderate: unstable fill, piping.	Severe: no water.	Not needed	Favorable	Favorable.

See footnote at end of table.

TABLE 13.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Features affecting-- Drainage	Terraces and diversions	Grassed waterways
Okay:						
40, 41, 42	Severe: seepage.	Moderate: unstable fill, piping.	Severe: no water.	Not needed	Erodes easily	Erodes easily.
Okemah:						
43	Slight	Moderate: unstable fill.	Severe: no water.	Percs slowly	Percs slowly	Percs slowly.
[1]44:						
Okemah part	Slight	Moderate: unstable fill.	Severe: no water.	Percs slowly	Percs slowly	Percs slowly.
Parsons part	Slight	Moderate: unstable fill, compressible.	Severe: no water.	Percs slowly, wetness.	Percs slowly, wetness.	Percs slowly, wetness.
Carytown part	Slight	Severe: unstable fill, compressible, shrink-swell, excess sodium.	Severe: no water.	Percs slowly, wetness, excess sodium.	Percs slowly, wetness, excess sodium.	Percs slowly, wetness, excess sodium.
Osage:						
45	Slight	Severe: shrink-swell, low strength, compressible.	Severe: slow refill.	Floods, percs slowly, wetness.	Percs slowly, wetness.	Percs slowly, wetness.
Pits:						
46.						
Radley:						
47, [1]48	Moderate: seepage.	Moderate: low strength, piping.	Severe: deep to water.	Floods	Floods	Favorable.
Severn:						
49	Severe: seepage.	Moderate: unstable fill, piping, compressible.	Severe: deep to water.	Not needed	Favorable	Favorable.
Shidler:						
[1]50:						
Shidler part	Severe: depth to rock.	Severe: depth to rock.	Severe: no water.	Not needed	Depth to rock	Rooting depth.
Rock outcrop part.						
Tullahassee:						
51	Severe: seepage.	Moderate: unstable fill, piping.	Moderate: deep to water.	Floods	Not needed	Favorable.
Urban land:						
52.						
Wynona:						
53	Slight	Moderate: compressible, unstable fill.	Severe: slow refill.	Floods, percs slowly.	Not needed	Wetness.
[1]54:						
Wynona part	Slight	Moderate: compressible, unstable fill.	Severe: slow refill.	Floods, percs slowly.	Not needed	Wetness.
Urban land part.						

[1]This mapping unit is made up of two or more dominant kinds of soil. See mapping unit description for the composition and behavior of the whole mapping unit.

TABLE 14.--YIELDS PER ACRE OF IRRIGATED VEGETABLE CROPS

[All yields were estimated for a high level of management for vegetables under irrigation in 1974. Yields are for selected soils; absence of yields for the other soils in the county indicates that vegetable crops are seldom grown or are not suited]

Soil name and map symbol	Sweet corn	Green beans	Spinach	Cabbage	Tomatoes
	Ton	Bu	Bu	Crates	Lbs
Choska:					
7	4.0	100	450	190	30,000
Kamie:					
24	3.0	80	350	150	24,000
Mason:					
31	4.0	100	450	190	30,000
Okay:					
39	4.0	90	400	180	27,000
40	3.0	85	375	160	25,000
Severn:					
49	4.0	100	450	185	28,000

TABLE 15.--RECREATIONAL DEVELOPMENT

["Shrink-swell" and some of the other terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe"]

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
Apperson:				
1, 2	Moderate: too clayey, wetness, percs slowly.	Moderate: wetness, too clayey.	Moderate: too clayey, wetness, percs slowly.	Moderate: too clayey.
Bates:				
3	Slight	Slight	Moderate: slope.	Slight.
[1]4:				
Bates part	Slight	Slight	Moderate: slope.	Slight.
Coweta part	Slight	Slight	Severe: depth to rock, slope.	Slight.
Catoosa:				
5	Slight	Slight	Moderate: depth to rock, slope.	Slight.
[1]6:				
Catoosa part	Slight	Slight	Severe: slope.	Slight.
Rock outcrop part.				
Choska:				
7	Moderate: floods.	Moderate: floods.	Moderate: floods.	Slight.
[1]8:				
Choska part	Moderate: floods.	Moderate: floods.	Moderate: floods.	Slight.
Severn part	Moderate: floods.	Moderate: floods.	Moderate: floods.	Slight.
Urban land part.				
Cleora:				
9	Severe: floods.	Moderate: floods.	Moderate: floods.	Slight.
Coweta:				
[1]10:				
Coweta part	Slight	Slight	Severe: depth to rock, slope.	Slight
Bates part	Slight	Slight	Moderate: slope.	Slight.
[1]11:				
Coweta part	Slight	Slight	Severe: depth to rock, slope.	Slight.

See footnote at end of table.

TABLE 15.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
Coweta:				
[1]11:				
Eram part	Moderate: percs slowly, too clayey, wetness.	Moderate: too clayey.	Severe: slope.	Moderate: too clayey.
Urban land part.				
Dennis:				
12, 13, 14	Moderate: wetness, percs slowly.	Slight	Moderate: percs slowly, slope, wetness.	Slight.
[1]15:				
Dennis part	Moderate: wetness, percs slowly.	Slight	Moderate: percs slowly, slope, wetness.	Slight.
Carytown part	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness, percs slowly.	Severe: wetness.
[1]16:				
Dennis part	Moderate: wetness, percs slowly.	Slight	Severe: slope.	Slight.
Radley part	Severe: floods.	Moderate: floods.	Severe: floods.	Slight.
[1]17:				
Dennis part	Moderate: wetness, percs slowly.	Slight	Moderate: percs slowly, slope, wetness.	Slight.
Urban land part.				
Enders:				
[1]18:				
Enders part	Severe: slope, percs slowly.	Severe: slope.	Severe: slope.	Severe: slope.
Hector part	Severe: large stones, slope.	Severe: large stones, slope.	Severe: slope, large stones, depth to rock.	Severe: large stones, slope.
Eram:				
19	Moderate: percs slowly, too clayey, wetness.	Moderate: too clayey.	Moderate: slope, percs slowly, wetness.	Moderate: too clayey.
[1]20:				
Eram part	Moderate: percs slowly, too clayey, wetness.	Moderate: too clayey.	Severe: slope.	Moderate: too clayey.
Coweta part	Moderate: slope.	Moderate: slope.	Severe: depth to rock, slope.	Slight.

See footnote at end of table.

TABLE 15.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
Glenpool:				
21	Moderate: slope, too sandy.	Moderate: slope, too sandy.	Severe: slope.	Moderate: too sandy.
Hector:				
[1]22:				
Hector part	Slight	Slight	Severe: depth to rock.	Slight.
Linker part	Slight	Slight	Moderate: slope.	Slight.
Kamie:				
23, 24	Slight	Slight	Moderate: slope.	Slight.
[1]25:				
Kamie part	Slight	Slight	Moderate: slope.	Slight.
Urban land part.				
Kanima:				
[1]26	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Kiomatia:				
[1]27	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.
Larton:				
[1]28:				
Larton part	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy, slope.	Moderate: too sandy.
Glenpool part	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy, slope.	Moderate: too sandy.
Latanier:				
29	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.
Lula:				
30	Slight	Slight	Moderate: slope.	Slight.
Mason:				
31	Severe: floods.	Moderate: floods.	Moderate: percs slowly, floods.	Slight.
Newtonia:				
32, 33	Slight	Slight	Moderate: slope.	Slight.
Niotaze:				
[1]34:				
Niotaze part	Moderate: percs slowly, wetness, slope.	Moderate: wetness, slope.	Severe: slope.	Moderate: wetness.
Darnell part	Moderate: slope.	Moderate: slope.	Severe: depth to rock, slope.	Slight.

See footnote at end of table.

TABLE 15.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
Niotaze:				
[1]35:				
Niotaze part	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope, wetness.
Darnell part	Severe: slope.	Severe: slope.	Severe: depth to rock, slope.	Moderate: slope.
[1]36:				
Niotaze part	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Darnell part	Severe: slope.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.
[1]37:				
Niotaze part	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope, wetness.
Darnell part	Severe: slope.	Severe: slope.	Severe: depth to rock, slope.	Moderate: slope.
Urban land part.				
Oil-waste land: 38.				
Okay: 39	Slight	Slight	Slight	Slight.
40, 41, 42	Slight	Slight	Moderate: slope.	Slight.
Okemah: 43	Moderate: percs slowly, wetness.	Slight	Moderate: percs slowly, wetness.	Slight.
[1]44:				
Okemah part	Moderate: percs slowly, wetness.	Slight	Moderate: percs slowly, wetness.	Slight.
Parsons part	Severe: percs slowly.	Moderate: wetness.	Severe: percs slowly.	Moderate: wetness.
Carytown part	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness, percs slowly.	Severe: wetness.
Osage: 45	Severe: floods, wetness, percs slowly.	Severe: wetness, floods, too clayey.	Severe: wetness, floods, percs slowly.	Severe: wetness, too clayey.
Pits: 46.				
Radley: 47	Severe: floods.	Moderate: floods.	Moderate: floods.	Slight.
[1]48	Severe: floods.	Moderate: floods.	Severe: floods.	Slight.

See footnote at end of table.

TABLE 15.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
Severn:				
49	Severe: floods.	Moderate: floods.	Slight	Slight.
Shidler:				
[1]50:				
Shidler part	Moderate: too clayey.	Moderate: too clayey.	Severe: depth to rock.	Moderate: too clayey.
Rock outcrop part.				
Tullahassee:				
51	Severe: floods.	Severe: floods.	Severe: floods.	Moderate: wetness, floods.
Urban land:				
52.				
Wynona:				
53	Severe: floods, wetness.	Moderate: wetness, floods, too clayey.	Severe: floods, wetness.	Moderate: too clayey, wetness, floods.
[1]54:				
Wynona part	Severe: floods, wetness.	Moderate: wetness, floods, too clayey.	Severe: floods, wetness.	Moderate: too clayey, wetness, floods.
Urban land part.				

[1]This mapping unit is made up of two or more dominant kinds of soil. See mapping unit description for the composition and behavior of the whole mapping unit.

TABLE 16.--WILDLIFE HABITAT POTENTIALS

[See text for definitions of "good," "fair," "poor," and "very poor." Absence of an entry indicates the soil was not rated]

Soil name and map symbol	Potential for habitat elements								Potential as habitat for--			
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife	Rangeland wildlife
Apperson:												
1, 2	Good	Good	Fair	Good	Good	---	Poor	Poor	Good	Good	Poor	Fair.
Bates:												
3	Good	Good	Good	Good	Good	---	Poor	Very poor.	Good	Good	Very poor.	Fair.
[1]4:												
Bates part	Good	Good	Good	Good	Good	---	Poor	Very poor.	Good	Good	Very poor.	Fair.
Coweta part	Very poor.	Poor	Poor	Very poor.	Very poor.	---	Very poor.	Very poor.	Poor	Very poor.	Very poor.	Poor.
Catoosa:												
5	Fair	Good	Good	Good	Good	---	Poor	Very poor.	Good	Good	Very poor.	Fair.
[1]6:												
Catoosa part	Fair	Good	Good	Good	Good	---	Poor	Very poor.	Good	Good	Very poor.	Fair.
Rock outcrop part.												
Choska:												
7	Good	Good	Good	Good	Good	---	Very poor.	Very poor.	Good	Good	Very poor.	---
[1]8:												
Choska part	Good	Good	Good	Good	Good	---	Very poor.	Very poor.	Good	Good	Very poor.	---
Severn part	Good	Good	Good	Good	Good	---	Poor	Very poor.	Good	Good	Very poor.	---
Urban land part.												
Cleora:												
9	Good	Good	Good	Good	Good	---	Poor	Very poor.	Good	Good	Very poor.	---
Coweta:												
[1]10:												
Coweta part	Very poor.	Poor	Poor	Very poor.	Very poor.	---	Very poor.	Very poor.	Poor	Very poor.	Very poor.	Poor.
Bates part	Good	Good	Good	Good	Good	---	Poor	Very poor.	Good	Good	Very poor.	Fair.
[1]11:												
Coweta part	Very poor.	Poor	Poor	Very poor.	Very poor.	---	Very poor.	Very poor.	Poor	Very poor.	Very poor.	Poor.
Eram part	Fair	Good	Fair	Good	Good	---	Poor	Very poor.	Fair	Good	Very poor.	Fair.
Urban land part.												
Dennis:												
12	Good	Good	Good	Good	Good	---	Poor	Poor	Good	Good	Poor	Good.
13, 14	Good	Good	Good	Good	Good	---	Poor	Very poor.	Good	Good	Very poor.	Good.

See footnote at end of table.

TABLE 16.--WILDLIFE HABITAT POTENTIALS--Continued

Soil name and map symbol	Potential for habitat elements								Potential as habitat for--			
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife	Rangeland wildlife
Dennis:												
[1]15:												
Dennis part	Good	Good	Good	Good	Good	---	Poor	Poor	Good	Good	Poor	Good.
Carytown part	Poor	Fair	Fair	Poor	Poor	---	Good	Good	Fair	Poor	Good	Poor.
[1]16:												
Dennis part	Good	Good	Good	Good	Good	---	Poor	Very poor.	Good	Good	Very poor.	Good.
Radley part	Poor	Fair	Fair	Good	Good	Good	Fair	Fair	Fair	Good	Fair	---
[1]17:												
Dennis part	Good	Good	Good	Good	Good	---	Poor	Poor	Good	Good	Poor	Good.
Urban land part.												
Enders:												
[1]18:												
Enders part	Poor	Fair	Good	Good	Good	---	Very poor.	Very poor.	Fair	Good	Very poor.	Very poor.
Hector part	Very poor.	Poor	Poor	Poor	Very poor.	---	Very poor.	Very poor.	Poor	Poor	Very poor.	Very poor.
Eram:												
19	Good	Good	Fair	Good	Good	---	Poor	Very poor.	Good	Good	Very poor.	Fair.
[1]20:												
Eram part	Fair	Good	Fair	Good	Good	---	Poor	Very poor.	Fair	Good	Very poor.	Fair.
Coweta part	Very poor.	Poor	Poor	Very poor.	Very poor.	---	Very poor.	Very poor.	Poor	Very poor.	Very poor.	Poor.
Glenpool:												
21	Fair	Fair	Good	Fair	Fair	---	Very poor.	Very poor.	Fair	Fair	Very poor.	Poor.
Hector:												
[1]22:												
Hector part	Very poor.	Poor	Poor	Poor	Very poor.	---	Very poor.	Very poor.	Poor	Poor	Very poor.	Very poor.
Linker part	Fair	Good	Good	Fair	Fair	---	Poor	Very poor.	Good	Good	Very poor.	Very poor.
Kamie:												
23	Fair	Fair	Good	Good	Good	---	Very poor.	Very poor.	Fair	Good	Very poor.	Poor.
24	Good	Good	Good	Good	Good	---	Poor	Very poor.	Good	Good	Very poor.	Poor.
[1]25:												
Kamie part	Fair	Good	Good	Good	Good	---	Very poor.	Very poor.	Good	Good	Very poor.	Poor.
Urban land part.												
Kanima:												
[1]26	Very poor.	Poor	Fair	Poor	Poor	---	Very poor.	Very poor.	Poor	Poor	Very poor.	---
Kiomatia:												
[1]27	Poor	Fair	Fair	Fair	---	---	Poor	Very poor.	Fair	Fair	Very poor.	---

See footnote at end of table.

TABLE 16.--WILDLIFE HABITAT POTENTIALS--Continued

Soil name and map symbol	Potential for habitat elements								Potential as habitat for--			
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife	Rangeland wildlife
Larton:												
[1]28:												
Larton part	Fair	Fair	Good	Good	Good	---	Very poor.	Very poor.	Fair	Good	Very poor.	Poor.
Glenpool part	Fair	Fair	Good	Fair	Fair	---	Very poor.	Very poor.	Fair	Fair	Very poor.	Poor.
Latanier:												
29	Fair	Fair	Fair	Good	---	---	Good	Good	Fair	Good	Good	---
Lula:												
30	Good	Good	Good	Good	Good	---	Poor	Very poor.	Good	Good	Very poor.	Good.
Mason:												
31	Good	Good	Good	Good	Good	---	Poor	Very poor.	Good	Good	Very poor.	---
Newtonia:												
32, 33	Good	Good	Good	Good	Good	---	Poor	Very poor.	Good	Good	Very poor.	Good.
Niotaze:												
[1]34:												
Niotaze part	Fair	Good	Good	Fair	Fair	Fair	Very poor.	Very poor.	Good	Fair	Very poor.	Very poor.
Darnell part	Poor	Poor	Fair	---	---	Fair	Very poor.	Very poor.	Poor	---	Very poor.	Very poor.
[1]35:												
Niotaze part	Poor	Fair	Good	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.	Very poor.
Darnell part	Poor	Poor	Fair	---	---	Fair	Very poor.	Very poor.	Poor	---	Very poor.	Very poor.
[1]36:												
Niotaze part	Poor	Fair	Good	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.	Very poor.
Darnell part	Very poor.	Poor	Fair	---	---	Fair	Very poor.	Very poor.	Poor	---	Very poor.	Very poor.
[1]37:												
Niotaze part	Poor	Fair	Good	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.	Very poor.
Darnell part	Poor	Poor	Fair	---	---	Fair	Very poor.	Very poor.	Poor	---	Very poor.	Very poor.
Urban land part.												
Oil-waste land: 38.												
Okay:												
39, 40, 41, 42	Good	Good	Good	Good	Good	---	Poor	Very poor.	Good	Good	Very poor.	Good.
Okemah:												
43	Good	Good	Good	Good	Good	---	Poor	Poor	Good	Good	Poor	Good.
[1]44:												
Okemah part	Good	Good	Good	Good	Good	---	Poor	Poor	Good	Good	Poor	Good.
Parsons part	Fair	Good	Good	Good	Good	---	Fair	Fair	Good	Good	Fair	Fair.
Carytown part	Poor	Fair	Fair	Poor	Poor	---	Good	Good	Fair	Poor	Good	Poor.

See footnote at end of table.

TABLE 16.--WILDLIFE HABITAT POTENTIALS--Continued

Soil name and map symbol	Potential for habitat elements								Potential as habitat for--			
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife	Rangeland wildlife
Osage:												
45	Fair	Fair	Fair	Fair	Fair	---	Poor	Good	Fair	Fair	Fair	---
Pits:												
46.												
Radley:												
47	Good	Good	Good	Good	Good	Good	Poor	Fair	Good	Good	Poor	---
[1]48	Poor	Fair	Fair	Good	Good	Good	Fair	Fair	Fair	Good	Fair	---
Severn:												
49	Good	Good	Good	Good	Good	---	Poor	Very poor.	Good	Good	Very poor.	---
Shidler:												
[1]50:												
Shidler part	Very poor.	Very poor.	Poor	---	---	Poor	Very poor.	Very poor.	Very poor.	---	Very poor.	Poor.
Rock outcrop part.												
Tullahassee:												
51	Very poor.	Poor	Poor	Good	Good	---	Fair	Poor	Poor	Fair	Poor	---
Urban land:												
52.												
Wynona:												
53	Good	Good	Good	Good	Good	---	Fair	Fair	Good	Good	Fair	---
[1]54:												
Wynona part	Good	Good	Good	Good	Good	---	Fair	Fair	Good	Good	Fair	---
Urban land part.												

[1]This mapping unit is made up of two or more dominant kinds of soil. See mapping unit description for the composition and behavior of the whole mapping unit.

TABLE 17.--ENGINEERING PROPERTIES AND CLASSIFICATIONS

[The symbol < means less than; > means greater than. Absence of an entry means data were not estimated]

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
Apperson:											
1, 2	0-8	Silty clay loam	CL, ML	A-6, A-7	0	100	100	95-100	75-98	33-44	12-20
	8-16	Silty clay loam, silty clay.	CL, CH, MH	A-7	0	90-100	90-100	90-100	80-99	41-70	20-40
	16-52	Silty clay	CL, CH, MH	A-7	0	85-100	83-100	80-100	75-99	41-70	20-40
	52-60	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Bates:											
3	0-10	Loam	ML, CL	A-4	0	90-100	90-100	90-100	55-90	20-40	3-10
	10-34	Loam, clay loam, sandy clay loam.	ML, CL	A-4, A-6	0	90-100	90-100	90-100	50-85	25-40	3-20
	34-40	Weathered bedrock.	---	---	---	---	---	---	---	---	---
[1]4:											
Bates part	0-9	Loam	ML, CL	A-4	0	90-100	90-100	90-100	55-90	20-40	3-10
	9-32	Loam, clay loam, sandy clay loam.	ML, CL	A-4, A-6	0	90-100	90-100	90-100	50-85	25-40	3-20
	32-40	Weathered bedrock.	---	---	---	---	---	---	---	---	---
Coweta part	0-7	Loam	ML, CL, SM, SC	A-4	5-10	70-100	70-100	60-90	36-85	<31	NP-10
	7-16	Fine sandy loam, loam, clay loam.	ML, CL, SM, SC	A-2, A-4, A-6	0-15	55-75	55-75	45-70	30-65	<31	NP-12
	16-28	Weathered bedrock.	---	---	---	---	---	---	---	---	---
Catoosa:											
5	0-10	Silt loam	ML, CL	A-4, A-6	0	100	100	96-100	80-97	30-37	9-13
	10-15	Silt loam, silty clay loam, clay loam.	ML, CL	A-4, A-6, A-7	0	100	100	96-100	80-98	30-43	9-20
	15-28	Silty clay loam, clay loam.	CL	A-6, A-7	0	100	100	96-100	80-98	33-43	12-20
	28-40	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
[1]6:											
Catoosa part	0-7	Silt loam	ML, CL	A-4, A-6	0	100	100	96-100	80-97	30-37	9-13
	7-12	Silt loam, loam, silty clay loam.	ML, CL	A-4, A-6, A-7	0	100	100	96-100	80-98	30-43	9-20
	12-28	Silty clay loam, clay loam.	CL	A-6, A-7	0	100	100	96-100	80-98	33-43	12-20
	28-40	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Rock outcrop part.											
Choska:											
7	0-14	Very fine sandy loam.	CL, ML, CL-ML	A-4	0	100	100	94-100	51-75	<31	NP-10
	14-35	Silt loam, very fine sandy loam.	CL, ML, CL-ML	A-4	0	100	100	94-100	51-97	<31	NP-9
	35-62	Loamy fine sand, very fine sandy loam.	SM, SC, SM-SC	A-2, A-4	0	100	98-100	90-100	15-50	<30	NP-9

See footnote at end of table.

TABLE 17.--ENGINEERING PROPERTIES AND CLASSIFICATIONS--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Frag- ments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plas- ticity index
	In				Pct					Pct	
Choska:											
[1]8:											
Choska part-----	0-14	Very fine sandy loam.	CL, ML, CL-ML	A-4	0	100	100	94-100	51-75	<31	NP-10
	14-35	Silt loam, very fine sandy loam.	CL, ML, CL-ML	A-4	0	100	100	94-100	51-97	<31	NP-9
	35-62	Loamy fine sand, very fine sandy loam.	SM, SC, SM-SC	A-2, A-4	0	100	98-100	90-100	15-50	<30	NP-9
Severn part-----	0-8	Very fine sandy loam.	ML, CL-ML, CL	A-4, A-6	0	100	100	94-100	65-97	22-31	2-14
	8-60	Very fine sandy loam to loamy very fine sand.	ML, CL-ML	A-4	0	100	100	94-100	65-97	<28	NP-7
Urban land part.											
Cleora:											
9----------	0-11	Fine sandy loam	SM, SC, ML, CL	A-4	0	100	98-100	94-100	36-60	<31	NP-10
	11-31	Loam, fine sandy loam.	SM, SC, ML, CL	A-4	0	100	98-100	94-100	36-85	<31	NP-10
	31-62	Loam, fine sandy loam, loamy fine sand.	SM, SC, ML, CL	A-2, A-4	0	100	98-100	90-100	15-85	<31	NP-10
Coweta:											
[1]10:											
Coweta part-----	0-6	Loam----------	ML, CL, SM, SC	A-4	5-20	80-100	70-100	60-90	36-85	<31	NP-10
	6-17	Fine sandy loam, loam, clay loam.	ML, CL, SM, SC	A-2, A-4, A-6	0-15	55-75	55-75	45-70	30-65	<31	NP-12
	17-31	Weathered bedrock.	---	---	---	---	---	---	---	---	---
Bates part------	0-12	Loam----------	ML, CL	A-4	0	85-100	85-100	85-100	55-90	20-40	3-10
	12-25	Loam, clay loam, sandy clay loam.	ML, CL	A-4, A-6	0	85-100	85-100	85-100	50-85	25-40	3-20
	25-40	Weathered bedrock.	---	---	---	---	---	---	---	---	---
[1]11:											
Coweta part-----	0-6	Loam----------	ML, CL, SM, SC	A-4	5-20	80-100	70-100	60-90	36-85	<31	NP-10
	6-17	Fine sandy loam, loam, clay loam.	ML, CL, SM, SC	A-2, A-4, A-6	0-15	55-75	55-75	45-70	30-65	<31	NP-12
	17-31	Weathered bedrock.	---	---	---	---	---	---	---	---	---
Eram part-------	0-14	Silty clay loam	CL	A-6, A-7	0	85-100	85-100	85-100	80-95	33-48	12-25
	14-34	Clay, silty clay, silty clay loam.	ML, CL, CH, MH	A-7, A-6	0	95-100	95-100	90-100	85-98	37-65	15-35
	34-40	Weathered bedrock.	---	---	---	---	---	---	---	---	---
Urban land part.											

See footnote at end of table.

TABLE 17.--ENGINEERING PROPERTIES AND CLASSIFICATIONS--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Frag- ments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plas- ticity index
	In				Pct					Pct	
Dennis:											
12, 13, 14--------	0-15	Silt loam--------	ML, CL, CL-ML	A-4, A-6	0	100	100	96-100	80-97	20-37	1-15
	15-25	Silty clay loam, clay loam.	CL	A-6, A-7	0	98-100	98-100	94-100	75-98	33-48	13-25
	25-65	Clay, silty clay, silty clay loam, clay loam.	CL, CH, ML, MH	A-7, A-6	0	98-100	98-100	94-100	75-98	37-65	15-35
[1]15:											
Dennis part------	0-14	Silt loam--------	ML, CL, CL-ML	A-4, A-6	0	100	100	96-100	80-97	20-37	1-15
	14-18	Silty clay loam, clay loam.	CL	A-6, A-7	0	98-100	98-100	94-100	75-98	33-48	13-25
	18-66	Clay, silty clay, silty clay loam, clay loam.	CL, CH, ML, MH	A-7, A-6	0	98-100	98-100	94-100	75-98	37-65	15-35
Carytown part---	0-12	Silt loam--------	CL-ML, CL	A-4, A-6	0	100	95-100	95-100	80-95	20-30	5-15
	12-64	Silty clay-------	CH	A-7	0	100	95-100	90-100	90-100	51-70	30-45
[1]16:											
Dennis part------	0-8	Silt loam--------	ML, CL, CL-ML	A-4, A-6	0	100	100	96-100	80-97	20-37	1-15
	8-14	Silty clay loam, clay loam.	CL	A-6, A-7	0	98-100	98-100	94-100	75-98	33-48	13-25
	14-60	Clay, silty clay, silty clay loam, clay loam.	CL, CH, ML, MH	A-7, A-6	0	98-100	98-100	94-100	75-98	37-65	15-35
Radley part------	0-10	Silt loam--------	ML, CL	A-4, A-6	0	100	100	96-100	80-100	30-37	8-13
	10-60	Silt loam, silty clay loam.	ML, CL	A-4, A-6, A-7	0	100	100	94-100	65-100	30-45	8-20
[1]17:											
Dennis part------	0-15	Silt loam--------	ML, CL, CL-ML	A-4, A-6	0	100	100	96-100	80-97	20-37	1-15
	15-25	Silty clay loam, clay loam.	CL	A-6, A-7	0	98-100	98-100	94-100	75-98	33-48	13-25
	25-65	Clay, silty clay, silty clay loam, clay loam.	CL, CH, ML, MH	A-7, A-6	0	98-100	98-100	94-100	75-98	37-65	15-35
Urban land part.											
Enders:											
[1]18:											
Enders part------	0-8	Loam----------	SM, ML	A-4	5-15	80-90	70-80	65-75	40-60	20-35	4-10
	8-10	Silt loam, silty clay loam, clay loam, loam.	CL	A-6	2-15	85-95	80-90	75-85	70-80	30-40	11-15
	10-44	Silty clay, clay	CH	A-7	2-30	95-100	85-100	85-100	70-95	50-65	30-40
	44-47	Weathered shale	---	---	---	---	---	---	---	---	---
Hector part------	0-7	Stony loam-------	GM, GM-GC	A-2	0-30	40-50	35-45	30-40	20-30	<30	NP-6
	7-18	Fine sandy loam, gravelly fine sandy loam, gravelly loam, loam.	SM, ML, GM	A-4, A-2	0-30	55-100	55-100	45-100	30-65	<30	NP-4
	18-20	Unweathered bedrock.	---	---	---	---	---	---	---	---	---

See footnote at end of table.

TABLE 17.--ENGINEERING PROPERTIES AND CLASSIFICATIONS--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
Eram:											
19	0-14	Silty clay loam	CL	A-6, A-7	0	85-100	85-100	85-100	80-95	33-48	12-25
	14-34	Clay, silty clay, silty clay loam.	ML, CL, CH, MH	A-7, A-6	0	95-100	95-100	90-100	85-98	37-65	15-35
	34-40	Weathered bedrock.	---	---	---	---	---	---	---	---	---
[1]20:											
Eram part	0-12	Silty clay loam	CL	A-6, A-7	0	85-100	85-100	85-100	80-95	33-48	12-25
	12-26	Clay, silty clay, silty clay loam.	ML, CL, CH, MH	A-7, A-6	0	95-100	95-100	90-100	85-98	37-65	15-35
	26-30	Weathered bedrock.	---	---	---	---	---	---	---	---	---
Coweta part	0-11	Loam, fine sandy loam.	ML, CL, SM, SC	A-4	5-20	80-100	70-100	60-90	36-85	<31	NP-10
	11-17	Fine sandy loam, loam, clay loam.	ML, CL, SM, SC	A-2, A-4, A-6	0-15	55-75	55-75	45-70	30-65	<31	NP-12
	17-28	Weathered bedrock.	---	---	---	---	---	---	---	---	---
Glenpool:											
21	0-41	Loamy fine sand, fine sand.	SM, SP-SM	A-2, A-3	0	100	98-100	82-100	5-35	---	NP
	41-80	Loamy fine sand, fine sand.	SM	A-2, A-4	0	100	98-100	90-100	15-45	<26	NP-4
Hector:											
[1]22:											
Hector part	0-9	Loam, gravelly loam.	GM, GM-GC	A-2	0-20	40-50	35-45	30-40	20-30	<30	NP-6
	9-15	Fine sandy loam, gravelly fine sandy loam, gravelly loam, loam.	SM, ML-CL, GM	A-4, A-2	0-20	55-100	55-100	45-100	30-65	<30	NP-4
	15-20	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Linker part	0-5	Loam	SM, ML, GM	A-2, A-4	0-5	65-100	60-100	55-100	25-70	<30	NP-7
	5-26	Clay loam, loam, sandy clay loam.	CL, SC, ML	A-4, A-6	0-5	90-100	80-100	70-100	40-80	<40	NP-18
	26-31	Gravelly sandy clay loam, gravelly loam, sandy clay loam.	CL, SC, GC, ML	A-4, A-6	0-15	65-100	60-100	55-100	40-80	<40	NP-18
	31-35	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Kamie:											
23	0-18	Loamy fine sand	SM	A-2	0	100	98-100	90-100	15-35	---	NP
	18-54	Sandy clay loam, clay loam.	CL, SC	A-4, A-6	0	100	100	90-100	36-90	25-40	7-18
	54-64	Clay loam, sandy clay loam.	SM, ML, SC, CL	A-4, A-6	0	100	98-100	90-100	36-90	25-40	7-16

See footnote at end of table.

TABLE 17.--ENGINEERING PROPERTIES AND CLASSIFICATIONS--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Frag- ments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plas- ticity index
	In				Pct					Pct	
Kamie:											
24----------	0-16	Fine sandy loam	SM, ML, SC, CL	A-4	0	100	98-100	94-100	36-60	<30	NP-10
	16-54	Sandy clay loam, clay loam.	CL, SC	A-4, A-6	0	100	100	90-100	36-90	25-40	7-18
	54-66	Clay loam, sandy clay loam.	SM, ML, SC, CL	A-4, A-6	0	100	98-100	90-100	36-90	25-40	7-16
[1]25:											
Kamie part------	0-18	Loamy fine sand, fine sandy loam, sandy clay loam.	SM, ML, SC, CL	A-4, A-2	0	100	98-100	90-100	15-60	<30	NP-10
	18-54	Sandy clay loam, clay loam.	CL, SC	A-4, A-6	0	100	100	90-100	36-90	25-40	7-18
	54-64	Clay loam, sandy clay loam.	SM, ML, SC, CL	A-4, A-6	0	100	98-100	90-100	36-90	<37	7-16
Urban land part.											
Kanima:											
[1]26----------	0-3	Shaly silty clay loam, silty clay loam.	ML, CL, SM, SC	A-2, A-4, A-6	0-7	10-80	5-75	5-70	5-70	15-35	1-14
	3-72	Very shaly clay loam, very shaly silty clay loam, shaly silty clay loam.	ML, CL, SM, SC	A-2, A-4, A-6	7-40	10-60	5-55	5-55	5-55	15-35	1-14
Kiomatia:											
[1]27----------	0-10	Loamy fine sand, fine sandy loam.	SM, SM-SC	A-4, A-2-4	0	100	95-100	80-100	30-45	18-26	NP-7
	10-61	Stratified fine sand to loam.	SM, SM-SC	A-2-4	0	100	95-100	80-90	13-35	<22	NP-5
Larton:											
[1]28:											
Larton part-----	0-30	Loamy fine sand	SM	A-2	0	100	98-100	90-100	15-35	---	NP
	30-54	Sandy clay loam	SM, ML, SM, SC	A-4	0	100	98-100	94-100	36-85	<31	NP-10
	54-66	Sandy clay loam	CL, SC	A-4, A-6	0	100	100	90-100	36-65	25-37	7-16
Glenpool part---	0-46	Loamy fine sand	SM, SP-SM	A-2, A-3	0	100	98-100	82-100	5-35	---	NP
	46-73	Loamy fine sand, fine sand.	SM	A-2, A-4	0	100	98-100	90-100	15-45	<26	NP-4
Latanier:											
29----------	0-11	Clay----------	CH	A-7-6	0	100	100	100	95-100	51-75	26-45
	11-32	Clay, silty clay	CH	A-7-6	0	100	100	100	95-100	51-75	26-45
	32-66	Loam, silty clay loam, very fine sandy loam.	ML-CL, CL, ML	A-4, A-6	0	100	100	100	80-100	<40	NP-17
Lula:											
30----------	0-14	Silt loam-------	CL, ML	A-4, A-6	0	100	100	96-100	65-97	21-37	1-15
	14-19	Silty clay loam, silt loam.	CL, ML	A-6, A-4, A-7	0	100	100	96-100	65-98	30-43	9-20
	19-54	Silty clay loam	CL	A-6, A-7	0	95-100	95-100	96-100	75-98	33-50	12-26
	54-60	Unweathered bedrock.	---	---	---	---	---	---	---	---	---

See footnote at end of table.

TABLE 17.--ENGINEERING PROPERTIES AND CLASSIFICATIONS--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Frag- ments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plas- ticity index
	In				Pct					Pct	
Mason:											
31----------	0-13	Silt loam--------	ML, CL	A-4, A-6	0	100	100	96-100	65-98	20-35	1-13
	13-64	Silty clay loam, silt loam.	CL, ML	A-6, A-4, A-7	0	98-100	98-100	96-100	65-98	30-43	9-20
Newtonia:											
32, 33----------	0-11	Silt loam--------	CL, ML	A-4, A-6	0	100	100	96-100	80-97	30-37	9-14
	11-18	Silt loam, silty clay loam.	CL, ML	A-4, A-6	0	100	100	96-100	80-98	30-40	8-19
	18-26	Silty clay loam	CL	A-6, A-7	0	100	100	98-100	90-98	33-42	12-19
	26-46	Silty clay loam, silty clay, clay.	CL, CH	A-6, A-7	0	100	100	96-100	90-98	37-60	15-34
	46-62	Silty clay loam, silty clay, clay.	CL, CH	A-6, A-7	0	75-100	75-100	70-98	70-98	37-60	15-34
Niotaze:											
[1]34:											
Niotaze part----	0-11	Gravelly fine sandy loam, fine sandy loam, cobbly fine sandy loam.	SM, SM-SC, ML, CL-ML	A-2-4, A-4	0-25	55-100	50-100	40-95	30-95	<30	NP-7
	11-34	Silty clay, silty clay loam, clay.	CH, CL	A-7-6, A-6	0-5	95-100	95-100	90-100	90-100	35-65	15-40
	34-60	Weathered bedrock.	---	---	---	---	----	---	---	---	---
Darnell part----	0-4	Fine sandy loam, cobbly fine sandy loam.	SM, SC, ML, CL	A-4	0-20	90-100	90-100	85-100	36-60	<30	NP-10
	4-17	Fine sandy loam, loam, cobbly loam.	SM, SC, ML, CL	A-4	0-20	70-100	70-100	60-100	36-60	<30	NP-10
	17-20	Weathered bedrock.	---	---	---	---	---	---	---	---	---
[1]35:											
Niotaze part----	0-12	Fine sandy loam, cobbly fine sandy loam.	SM, SM-SC, ML, CL-ML	A-2-4, A-4	0-25	55-100	50-100	40-95	30-95	<30	NP-7
	12-35	Silty clay, silty clay loam, clay.	CH, CL	A-7-6, A-6	0-5	95-100	95-100	90-100	90-100	35-65	15-40
	35-60	Weathered bedrock.	---	---	---	---	---	---	---	---	---
Darnell part----	0-4	Fine sandy loam, cobbly fine sandy loam.	SM, SC, ML, CL	A-4	0-20	90-100	90-100	85-100	36-60	<30	NP-10
	4-15	Fine sandy loam, loam, cobbly loam.	SM, SC, ML, CL	A-4	0-20	70-100	70-100	60-100	36-60	<30	NP-10
	15-26	Weathered bedrock.	---	---	---	---	---	---	---	---	---
[1]36:											
Niotaze part----	0-13	Fine sandy loam, cobbly fine sandy loam.	SM, SM-SC, ML, CL-ML	A-2-4, A-4	0-25	55-100	50-100	40-95	30-95	<30	NP-7
	13-32	Silty clay, silty clay loam, clay.	CH, CL	A-7-6, A-6	0-5	95-100	95-100	90-100	90-100	35-65	15-40
	32-60	Weathered bedrock.	---	---	---	---	---	---	---	---	---

See footnote at end of table.

TABLE 17.--ENGINEERING PROPERTIES AND CLASSIFICATIONS--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Frag- ments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plas- ticity index
	In				Pct					Pct	
Niotaze:											
[1]36:											
Darnell part----	0-3	Cobbly fine sandy loam.	SM, SC, ML, CL	A-4	0-20	90-100	90-100	85-100	36-60	<30	NP-10
	3-12	Fine sandy loam, loam, cobbly loam.	SM, SC, ML, CL	A-4	0-20	70-100	70-100	60-100	36-60	<30	NP-10
	12-22	Weathered bedrock.	---	---	---	---	---	---	---	---	---
[1]37:											
Niotaze part----	0-13	Cobbly fine sandy loam, fine sandy loam.	SM, ML, SM-SC, CL-ML	A-2-4, A-4	0-25	55-100	50-100	40-95	30-95	<30	NP-7
	13-32	Silty clay, silty clay loam, clay.	CH, CL	A-7-6, A-6	0-5	95-100	95-100	90-100	90-100	35-65	15-40
	32-60	Weathered bedrock.	---	---	---	---	---	---	---	---	---
Darnell part----	0-3	Cobbly fine sandy loam.	SM, SC, ML, CL	A-4	0-20	90-100	90-100	85-100	36-60	<30	NP-10
	3-12	Fine sandy loam, loam, cobbly loam.	SM, SC, ML, CL	A-4	0-20	70-100	70-100	60-100	36-60	<30	NP-10
	12-22	Weathered bedrock.	---	---	---	---	---	---	---	---	---
Urban land part.											
Oil-waste land: 38.											
Okay:											
39, 40, 41, 42----	0-12	Loam----------	ML, CL	A-4	0	100	98-100	94-100	65-85	22-31	2-10
	12-46	Clay loam, loam, sandy clay loam.	SC, CL, ML, SM	A-4, A-6	0	100	100	90-100	36-90	25-40	7-18
	46-70	Loam, sandy clay loam, fine sandy loam.	SM, SC, ML, CL	A-4, A-6	0	100	98-100	90-100	36-90	<34	NP-13
Okemah:											
43----------	0-20	Silt loam-------	CL, ML	A-4, A-6	0	98-100	98-100	96-100	80-98	20-37	1-13
	20-48	Silty clay, clay, silty clay loam.	CL, CH, MH, ML	A-7	0	98-100	98-100	96-100	80-99	45-70	19-44
	48-68	Silty clay------	CL, CH	A-7	0	98-100	98-100	96-100	90-99	48-65	21-38
[1]44:											
Okemah part-----	0-17	Silt loam-------	CL, ML	A-4, A-6	0	98-100	98-100	96-100	80-98	20-37	1-13
	17-54	Silty clay, clay, silty clay loam.	CL, CH, MH, ML	A-7	0	98-100	98-100	96-100	80-99	45-70	19-44
	54-66	Silty clay------	CL, CH	A-7	0	98-100	98-100	96-100	90-99	48-65	21-38
Parsons part----	0-14	Silt loam-------	ML, CL, CL-ML	A-4, A-6	0	100	96-100	96-100	80-97	20-37	1-12
	14-74	Clay----------	CL, CH	A-7	0	100	96-100	96-100	80-99	45-70	19-38
Carytown part---	0-14	Silt loam-------	CL-ML, CL	A-4, A-6	0	100	95-100	95-100	80-95	20-30	5-15
	14-41	Silty clay------	CH	A-7	0	100	95-100	90-100	90-100	51-70	30-45
	41-64	Silty clay------	CH	A-7	0	100	95-100	90-100	85-100	51-65	30-40

See footnote at end of table.

TABLE 17.--ENGINEERING PROPERTIES AND CLASSIFICATIONS--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
Osage:											
45----------	0-18	Silty clay------	CH	A-7	0	100	100	100	95-100	50-75	30-55
	18-62	Silty clay, clay, silty clay loam.	CH, CL	A-7	0	100	100	100	95-100	50-80	30-55
Pits:											
46.											
Radley:											
47, [1]48----------	0-10	Silt loam-------	ML, CL	A-4, A-6	0	100	100	96-100	80-100	30-37	8-13
	10-62	Silt loam, silty clay loam.	ML, CL	A-4, A-6, A-7	0	100	100	94-100	65-100	30-45	8-20
Severn:											
49----------	0-8	Very fine sandy loam.	ML, CL, CL-ML	A-4, A-6	0	100	100	94-100	65-97	22-31	2-14
	8-60	Very fine sandy loam to loamy very fine sand.	ML, CL-ML	A-4	0	100	100	94-100	65-97	<28	NP-7
Shidler:											
[1]50:											
Shidler part----	0-16	Silt loam, stony silty clay loam, silty clay loam.	CL, ML	A-4, A-6, A-7	0-35	90-100	90-100	90-100	80-98	33-42	12-19
	16-20	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Rock outcrop part.											
Tullahassee:											
51----------	0-8	Fine sandy loam	SM, SC, ML, CL	A-4	0	100	98-100	90-100	36-60	<30	NP-10
	8-64	Fine sandy loam, loam.	SM, SC, ML, CL	A-4	0	100	98-100	90-100	36-85	<30	NP-10
Urban land:											
52.											
Wynona:											
53----------	0-42	Silty clay loam	CL	A-6, A-7	0	100	100	98-100	90-98	33-42	12-19
	42-64	Silty clay loam, silty clay.	CL, CH	A-6, A-7	0	100	100	98-100	90-99	33-55	12-30
[1]54:											
Wynona part-----	0-42	Silty clay loam	CL	A-6, A-7	0	100	100	98-100	90-98	33-42	12-19
	42-64	Silty clay loam, silty clay.	CL, CH	A-6, A-7	0	100	100	98-100	90-99	33-55	12-30
Urban land part.											

[1]This mapping unit is made up of two or more dominant kinds of soil. See mapping unit description for the composition and behavior of the whole mapping unit.

TABLE 18.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS

[Dashes indicate data were not available. The symbol < means less than; > means greater than. The erosion tolerance factor (T) is for the entire profile. Absence of an entry means data were not estimated]

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Risk of corrosion: Uncoated steel	Risk of corrosion: Concrete	Erosion factors: K	Erosion factors: T
	In	In/hr	In/in	pH					
Apperson:									
1, 2	0-8	0.2-0.6	0.16-0.20	5.6-6.5	Moderate	High	Low	0.37	3
	8-16	0.2-0.6	0.16-0.20	5.6-7.8	High	High	Low	0.37	
	16-52	0.06-0.2	0.14-0.18	6.1-7.8	High	High	Low	0.32	
	52-60	---	---	---	---	---	---	---	
Bates:									
3	0-10	0.6-2.0	0.20-0.22	5.1-6.5	Low	Low	Moderate	0.37	3
	10-34	0.6-2.0	0.15-0.19	5.1-6.5	Moderate	Low	Moderate	0.37	
	34-40	---	---	---	---	---	---	---	
4:									
Bates part	0-9	0.6-2.0	0.20-0.22	5.1-6.5	Low	Low	Moderate	0.37	3
	9-32	0.6-2.0	0.15-0.19	5.1-6.5	Moderate	Low	Moderate	0.37	
	32-40	---	---	---	---	---	---	---	
Coweta part	0-7	2.0-6.0	0.09-0.16	5.1-6.5	Low	Low	Moderate	0.24	2
	7-16	0.6-2.0	0.09-0.18	5.1-6.5	Low	Low	Moderate	0.24	
	16-28	---	---	---	---	---	---	---	
Catoosa:									
5	0-10	0.60-2.0	0.15-0.24	5.6-6.5	Low	Low	Moderate	0.32	2
	10-15	0.60-2.0	0.15-0.24	5.6-6.5	Moderate	Moderate	Moderate	---	
	15-28	0.60-2.0	0.15-0.22	5.6-7.3	Moderate	Moderate	Moderate	---	
	28-40	---	---	---	---	---	---	---	---
6:									
Catoosa part	0-7	0.60-2.0	0.15-0.24	5.6-6.5	Low	Low	Moderate	0.32	2
	7-12	0.60-2.0	0.15-0.24	5.6-6.5	Moderate	Moderate	Moderate	---	
	12-28	0.60-2.0	0.15-0.22	5.6-7.3	Moderate	Moderate	Moderate	---	
	28-40	---	---	---	---	---	---	---	---
Rock outcrop part.									
Choska:									
7	0-14	0.6-2.0	0.13-0.24	6.1-7.8	Low	Low	Low	---	---
	14-35	0.6-2.0	0.13-0.24	6.6-8.4	Low	Low	Low	---	
	35-62	2.0-6.0	0.07-0.11	6.6-8.4	Low	Low	Low	---	
8:									
Choska part	0-14	0.6-2.0	0.13-0.24	6.1-7.8	Low	Low	Low	---	---
	14-35	0.6-2.0	0.13-0.24	6.6-8.4	Low	Low	Low	---	
	35-62	2.0-6.0	0.07-0.11	6.6-8.4	Low	Low	Low	---	
Severn part	0-8	2.0-6.0	0.13-0.20	7.4-8.4	Low	Low	Low	---	---
	8-60	2.0-6.0	0.11-0.20	7.9-8.4	Low	Low	Low	---	
Urban land part.									
Cleora:									
9	0-11	2.0-6.0	0.11-0.20	5.6-6.5	Low	Low	Moderate	---	---
	11-31	2.0-6.0	0.11-0.20	5.6-7.3	Low	Low	Moderate	---	
	31-62	2.0-6.0	0.07-0.20	5.6-7.3	Low	Low	Moderate	---	
Coweta:									
10:									
Coweta part	0-6	2.0-6.0	0.09-0.16	5.1-6.5	Low	Low	Moderate	0.24	2
	6-17	0.6-2.0	0.09-0.18	5.1-6.5	Low	Low	Moderate	0.24	
	17-31	---	---	---	---	---	---	---	
Bates part	0-12	0.6-2.0	0.20-0.22	5.1-6.5	Low	Low	Moderate	0.37	3
	12-25	0.6-2.0	0.15-0.19	5.1-6.5	Moderate	Low	Moderate	0.37	
	25-40	---	---	---	---	---	---	---	

See footnote at end of table.

TABLE 18.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS--Continued

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Risk of corrosion: Uncoated steel	Risk of corrosion: Concrete	Erosion factors: K	Erosion factors: T
	In	In/hr	In/in	pH					
Coweta:									
[1]11:									
Coweta part	0-6	2.0-6.0	0.09-0.16	5.1-6.5	Low	Low	Moderate	0.24	2
	6-17	0.6-2.0	0.09-0.18	5.1-6.5	Low	Low	Moderate	0.24	
	17-31	---	---	---	---	---	---	---	
Eram part	0-14	0.2-0.6	0.15-0.19	5.6-6.5	Moderate	High	Moderate	0.43	3
	14-34	0.06-0.2	0.14-0.18	5.1-7.3	High	High	Moderate	---	
	34-40	---	---	---	---	---	---	---	
Urban land part.									
Dennis:									
12, 13, 14	0-15	0.6-2.0	0.15-0.20	5.1-6.0	Low	Low	Moderate	0.37	5
	15-25	0.2-0.6	0.15-0.20	4.5-6.0	Moderate	Moderate	Moderate	---	
	25-65	0.06-0.2	0.15-0.20	5.1-7.8	High	High	Moderate	---	
[1]15:									
Dennis part	0-14	0.6-2.0	0.15-0.20	5.1-6.0	Low	Low	Moderate	0.37	5
	14-18	0.2-0.6	0.15-0.20	4.5-6.0	Moderate	Moderate	Moderate	---	
	18-66	0.06-0.2	0.15-0.20	5.1-7.8	High	High	Moderate	---	
Carytown part	0-12	0.6-2.0	0.21-0.23	5.6-7.3	Low	High	Moderate	0.43	3
	12-64	<0.06	0.09-0.11	5.6-8.4	High	High	Low	---	
[1]16:									
Dennis part	0-8	0.6-2.0	0.15-0.20	5.1-6.0	Low	Low	Moderate	0.37	5
	8-14	0.2-0.6	0.15-0.20	4.5-6.0	Moderate	Moderate	Moderate	---	
	14-60	0.06-0.2	0.15-0.20	5.1-7.8	High	High	Moderate	---	
Radley part	0-10	0.6-2.0	0.22-0.24	5.6-7.3	Moderate	Low	Low	---	---
	10-60	0.6-2.0	0.17-0.22	5.6-7.3	Moderate	Low	Low	---	
[1]17:									
Dennis part	0-15	0.6-2.0	0.15-0.20	5.1-6.0	Low	Low	Moderate	0.37	5
	15-25	0.2-0.6	0.15-0.20	4.5-6.0	Moderate	Moderate	Moderate	---	
	25-65	0.06-0.2	0.15-0.20	5.1-7.8	High	High	Moderate	---	
Urban land part.									
Enders:									
[1]18:									
Enders part	0-8	0.6-2.0	0.15-0.22	4.5-5.5	Low	Low	Moderate	0.43	3
	8-10	0.2-0.6	0.15-0.20	4.5-5.5	Low	Moderate	High	0.28	
	10-44	<0.06	0.09-0.13	4.5-5.5	High	High	High	0.24	
	44-47	---	---	---	---	---	---	---	
Hector part	0-7	2.0-6.0	0.05-0.10	5.1-6.5	Low	Low	Moderate	0.20	1
	7-18	2.0-6.0	0.08-0.15	4.5-5.5	Low	Low	Moderate	---	
	18-20	---	---	---	---	---	---	---	
Eram:									
19	0-14	0.2-0.6	0.15-0.19	5.6-6.5	Moderate	High	Moderate	0.43	3
	14-34	0.06-0.2	0.14-0.18	5.1-7.3	High	High	Moderate	---	
	34-40	---	---	---	---	---	---	---	
[1]20:									
Eram part	0-12	0.2-0.6	0.15-0.19	5.6-6.5	Moderate	High	Moderate	0.43	3
	12-26	0.06-0.2	0.14-0.18	5.1-7.3	High	High	Moderate	---	
	26-30	---	---	---	---	---	---	---	
Coweta part	0-11	2.0-6.0	0.09-0.16	5.1-6.5	Low	Low	Moderate	0.24	2
	11-17	0.6-2.0	0.09-0.18	5.1-6.5	Low	Low	Moderate	0.24	
	17-28	---	---	---	---	---	---	---	

See footnotes at end of table.

TABLE 18.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS--Continued

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Risk of corrosion: Uncoated steel	Risk of corrosion: Concrete	Erosion factors: K	Erosion factors: T
	In	In/hr	In/in	pH					
Glenpool:									
21	0-41	6.0-20	0.05-0.11	5.6-6.5	Low	Low	Moderate	0.17	5
	41-80	6.0-20	0.07-0.14	4.5-5.5	Low	Low	High	0.20	
Hector:									
[1]22:									
Hector part	0-9	2.0-6.0	0.05-0.10	5.1-6.5	Low	Low	Moderate	0.20	1
	9-15	2.0-6.0	0.08-0.15	4.5-5.5	Low	Low	Moderate	---	
	15-20	---	---	---	---	---	---	---	
Linker part	0-5	0.6-2.0	0.11-0.17	4.5-5.5	Low	Low	High	0.28	3
	5-26	0.6-2.0	0.11-0.20	4.5-5.5	Low	Low	High	---	
	26-31	0.6-2.0	0.08-0.20	4.5-5.5	Low	Low	High	---	
	31-35	---	---	---	---	---	---	---	
Kamie:									
23	0-18	2.0-6.0	0.07-0.11	5.6-7.3	Low	Low	Moderate	0.20	5
	18-54	0.6-2.0	0.12-0.20	4.5-6.0	Low	Moderate	Moderate	---	
	54-64	0.6-2.0	0.11-0.17	4.5-6.0	Low	Moderate	Moderate	---	
24	0-16	2.0-6.0	0.11-0.15	5.6-7.3	Low	Low	Moderate	0.24	5
	16-54	0.6-2.0	0.12-0.20	4.5-6.0	Low	Moderate	Moderate	---	
	54-66	0.6-2.0	0.11-0.17	4.5-6.0	Low	Moderate	Moderate	---	
[1]25:									
Kamie part	0-18	2.0-6.0	0.11-0.15	5.6-7.3	Low	Low	Moderate	0.24	5
	18-54	0.6-2.0	0.12-0.20	4.5-6.0	Low	Moderate	Moderate	---	
	54-64	0.6-2.0	0.11-0.17	4.5-6.0	Low	Moderate	Moderate	---	
Urban land part.									
Kanima:									
[1]26	0-3	0.6-6.0	0.02-0.15	5.6-8.4	Low	Moderate	Low	0.28	5
	3-72	0.6-6.0	0.02-0.12	5.6-8.4	Low	Moderate	Low	0.28	
Kiomatia:									
[1]27	0-10	0.6-2.0	0.10-0.15	7.9-8.4	Low	Low	Low	---	---
	10-61	6.0-20	0.05-0.10	7.9-8.4	Low	Low	Low	---	
Larton:									
[1]28:									
Larton part	0-30	2.0-6.0	0.07-0.11	5.6-6.5	Low	Low	Moderate	0.20	5
	30-54	2.0-6.0	0.11-0.20	5.6-6.5	Low	Low	Moderate	0.24	
	54-66	0.6-2.0	0.12-0.17	5.6-6.5	Low	Low	Moderate	0.32	
Glenpool part	0-46	6.0-20	0.05-0.11	5.6-6.5	Low	Low	Moderate	0.17	5
	46-73	6.0-20	0.07-0.14	4.5-5.5	Low	Low	High	0.20	
Latanier:									
29	0-11	<0.06	0.18-0.20	6.6-7.8	Very high	High	Low	---	---
	11-32	<0.06	0.18-0.20	6.6-8.4	Very high	High	Low	---	
	32-66	0.06-2.0	0.18-0.22	7.4-8.4	Low	High	Low	---	
Lula:									
30	0-14	0.6-2.0	0.16-0.20	5.6-6.5	Low	Low	Moderate	0.32	3
	14-19	0.6-2.0	0.16-0.20	5.6-6.5	Moderate	Moderate	Moderate	---	
	19-54	0.6-2.0	0.16-0.20	5.1-6.5	Moderate	Moderate	Moderate	---	
	54-60	---	---	---	---	---	---	---	
Mason:									
31	0-13	0.6-2.0	0.16-0.20	5.6-7.3	Low	Low	Moderate	0.32	5
	13-64	0.2-0.6	0.16-0.20	6.1-7.8	Moderate	Moderate	Moderate	---	

See footnote at end of table.

TABLE 18.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS--Continued

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Risk of corrosion: Uncoated steel	Risk of corrosion: Concrete	Erosion factors: K	Erosion factors: T
	In	In/hr	In/in	pH					
Newtonia:									
32, 33	0-11	0.6-2.0	0.15-0.24	5.6-6.5	Low	Moderate	Low	0.37	5
	11-18	0.6-2.0	0.16-0.22	5.1-6.5	Moderate	Moderate	Moderate	---	
	18-26	0.6-2.0	0.18-0.22	5.1-6.0	Moderate	Moderate	Moderate	---	
	26-46	0.6-2.0	0.12-0.20	5.1-6.0	High	Moderate	Moderate	---	
	46-62	0.6-2.0	0.12-0.20	6.1-6.5	High	Moderate	Moderate	---	
Niotaze:									
[1]34:									
Niotaze part	0-11	0.6-6.0	0.16-0.24	5.1-6.0	Low	Moderate	Moderate	0.32	3
	11-34	0.06-0.2	0.10-0.18	4.5-7.3	High	High	Moderate	0.32	
	34-60	---	---	---	---	---	---	---	
Darnell part	0-4	2.0-6.0	0.12-0.16	5.1-7.3	Low	Low	Moderate	0.24	2
	4-17	2.0-6.0	0.12-0.16	5.1-7.3	Low	Low	Moderate	---	
	17-20	---	---	---	---	---	---	---	
[1]35:									
Niotaze part	0-12	0.6-6.0	0.10-0.16	5.1-6.0	Low	Moderate	Moderate	0.28	3
	12-35	0.06-0.2	0.10-0.18	4.5-7.3	High	High	Moderate	0.32	
	35-60	---	---	---	---	---	---	---	
Darnell part	0-4	2.0-6.0	0.12-0.16	5.1-7.3	Low	Low	Moderate	0.24	2
	4-15	2.0-6.0	0.12-0.16	5.1-7.3	Low	Low	Moderate	---	
	15-26	---	---	---	---	---	---	---	
[1]36:									
Niotaze part	0-13	0.6-6.0	0.10-0.16	5.1-6.0	Low	Moderate	Moderate	0.28	3
	13-32	0.06-0.2	0.10-0.18	4.5-7.3	High	High	Moderate	0.32	
	32-60	---	---	---	---	---	---	---	
Darnell part	0-3	2.0-6.0	0.12-0.16	5.1-7.3	Low	Low	Moderate	0.24	2
	3-12	2.0-6.0	0.12-0.16	5.1-7.3	Low	Low	Moderate	---	
	12-22	---	---	---	---	---	---	---	
37:									
Niotaze part	0-13	0.6-6.0	0.10-0.16	5.1-6.0	Low	Moderate	Moderate	0.28	3
	13-32	0.06-0.2	0.10-0.18	4.5-7.3	High	High	Moderate	0.32	
	32-60	---	---	---	---	---	---	---	
Darnell part	0-3	2.0-6.0	0.12-0.16	5.1-7.3	Low	Low	Moderate	0.24	2
	3-12	2.0-6.0	0.12-0.16	5.1-7.3	Low	Low	Moderate	---	
	12-22	---	---	---	---	---	---	---	
Urban land part.									
Oil-waste land:									
38.									
Okay:									
39, 40, 41, 42	0-12	2.0-6.0	0.11-0.16	5.6-6.5	Low	Low	Moderate	0.37	5
	12-46	0.6-2.0	0.12-0.18	5.1-6.5	Low	Moderate	Moderate	---	
	46-70	0.6-6.0	0.11-0.17	5.1-7.3	Low	Low	Moderate	---	
Okemah:									
43	0-20	0.2-2.0	0.16-0.20	5.6-7.3	Low	Moderate	Moderate	0.37	5
	20-48	0.06-0.2	0.15-0.19	5.6-7.8	High	High	Low	---	
	48-68	0.06-0.2	0.15-0.19	6.6-8.4	High	High	Low	---	
[1]44:									
Okemah part	0-17	0.2-2.0	0.16-0.20	5.6-7.3	Low	Moderate	Moderate	0.37	5
	17-54	0.06-0.2	0.15-0.19	5.6-7.8	High	High	Low	---	
	54-66	0.06-0.2	0.15-0.19	6.6-8.4	High	High	Low	---	
Parsons part	0-14	0.6-2.0	0.16-0.24	6.1-6.5	Low	High	Moderate	0.37	4
	14-74	<0.06	0.14-0.22	6.1-7.8	High	High	Moderate	0.43	

See footnote at end of table.

TABLE 18.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS--Continued

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Risk of corrosion: Uncoated steel	Risk of corrosion: Concrete	Erosion factors: K	Erosion factors: T
	In	In/hr	In/in	pH					
Okemah:									
[1]44:									
Carytown part---	0-14	0.6-2.0	0.21-0.23	5.6-7.3	Low-------	High------	Moderate	0.43	3
	14-41	<0.06	0.09-0.11	5.6-8.4	High------	High------	Low-------	---	
	41-64	<0.06	0.11-0.13	6.6-8.4	High------	High------	Low-------	---	
Osage:									
45----------	0-18	<0.06	0.12-0.14	5.1-7.3	Very high	High------	Moderate	---	---
	18-62	<0.06	0.08-0.12	5.6-7.8	Very high	High------	Moderate	---	
Pits:									
46.									
Radley:									
47, [1]48----------	0-10	0.6-2.0	0.22-0.24	6.6-7.3	Moderate	Low-------	Low-------	---	---
	10-62	0.6-2.0	0.17-0.22	6.6-7.3	Moderate	Low-------	Low-------	---	
Severn:									
49----------	0-8	2.0-6.0	0.14-0.20	7.4-8.4	Low-------	Low-------	Low-------	---	---
	8-60	2.0-6.0	0.11-0.20	7.9-8.4	Low-------	Low-------	Low-------	---	
Shidler:									
[1]50:									
Shidler part----	0-16	0.6-2.0	0.12-0.22	6.6-8.4	Moderate	Moderate	Low-------	0.32	
	16-20	---	---	---	----------	----------	----------	---	
Rock outcrop part.									
Tullahassee:									
51----------	0-8	2.0-6.0	0.12-0.16	5.1-6.1	Low-------	Moderate	Moderate	---	---
	8-64	2.0-6.0	0.12-0.16	5.1-6.1	Low-------	Moderate	Moderate	---	
Urban land:									
52.									
Wynona:									
53----------	0-42	0.2-0.6	0.18-0.22	5.6-6.5	Moderate	High------	Moderate	---	---
	42-64	0.06-0.2	0.14-0.20	5.1-6.5	Moderate	High------	Moderate	---	
[1]54:									
Wynona part-----	0-42	0.2-0.6	0.18-0.22	5.6-6.5	Moderate	High------	Moderate	---	---
	42-64	0.06-0.2	0.14-0.20	5.1-6.5	Moderate	High------	Moderate	---	
Urban land part.									

[1]This mapping unit is made up of two or more dominant kinds of soil. See mapping unit description for the composition and behavior of the whole mapping unit.

TABLE 19.--SOIL AND WATER FEATURES

[Absence of an entry indicates the feature is not a concern. The symbol < means less than; > means greater than]

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness
					Ft			In	
Apperson:									
1, 2	C	None	---	---	1.5-2.0	Perched	Dec-Apr	40-60	Hard
Bates:									
3	B	None	---	---	>6.0	---	---	20-40	Rippable
[1]4:									
Bates part	B	None	---	---	>6.0	---	---	20-40	Rippable
Coweta part	C	None	---	---	>6.0	---	---	10-20	Rippable
Catoosa:									
5	B	None	---	---	>6.0	---	---	20-40	Hard
[1]6:									
Catoosa part	B	None	---	---	>6.0	---	---	20-40	Hard
Rock outcrop part.									
Choska:									
7	B	Rare	Very brief	Jan-Jul	>6.0	---	---	>60	---
[1]8:									
Choska part	B	Rare	Very brief	Jan-Jul	>6.0	---	---	>60	---
Severn part	B	Rare	Very brief	Jan-Oct	>6.0	---	---	>60	---
Urban land part.									
Cleora:									
9	B	Occasional	Very brief	Jan-Jul	>6.0	---	---	>60	---
Coweta:									
[1]10:									
Coweta part	C	None	---	---	>6.0	---	---	10-20	Rippable
Bates part	B	None	---	---	>6.0	---	---	20-40	Rippable
[1]11:									
Coweta part	C	None	---	---	>6.0	---	---	10-20	Rippable
Eram part	C	None	---	---	2.0-3.0	Perched	Dec-Apr	20-40	Rippable
Urban land part.									
Dennis:									
12, 13, 14	C	None	---	---	2.0-3.0	Perched	Dec-Apr	>60	---
[1]15:									
Dennis part	C	None	---	---	2.0-3.0	Perched	Dec-Apr	>60	---
Carytown part	D	None	---	---	0-1.0	Perched	Dec-Apr	>60	---
[1]16:									
Dennis part	C	None	---	---	2.0-3.0	Perched	Dec-Apr	>60	---
Radley part	B	Frequent	Very brief	Dec-Jul	>6.0	---	---	>60	---

See footnote at end of table.

TABLE 19.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness
					Ft			In	
Dennis:									
[1]17:									
Dennis part----	C	None---------	---	---	2.0-3.0	Perched	Dec-Apr	>60	---
Urban land part.									
Enders:									
[1]18:									
Enders part----	C	None---------	---	---	>6.0	---	---	40-60	Rippable
Hector part----	D	None---------	---	---	>6.0	---	---	10-20	Hard
Eram:									
19----------	C	None---------	---	---	2.0-3.0	Perched	Dec-Apr	20-40	Rippable
[1]20:									
Eram part------	C	None---------	---	---	2.0-3.0	Perched	Dec-Apr	20-40	Rippable
Coweta part----	C	None---------	---	---	>6.0	---	---	10-20	Rippable
Glenpool:									
21----------	B	None---------	---	---	>6.0	---	---	>60	---
Hector:									
[1]22:									
Hector part----	D	None---------	---	---	>6.0	---	---	10-20	Hard
Linker part----	B	None---------	---	---	>6.0	---	---	20-40	Hard
Kamie:									
23, 24----------	B	None---------	---	---	>6.0	---	---	>60	---
[1]25:									
Kamie part-----	B	None---------	---	---	>6.0	---	---	>60	---
Urban land part.									
Kanima:									
[1]26----------	C	None---------	---	---	>6.0	---	---	>60	---
Kiomatia:									
[1]27----------	A	Frequent----	Brief-----	Feb-Jun	3.0-5.0	Apparent	Dec-Jul	>60	---
Larton:									
[1]28:									
Larton part----	B	None---------	---	---	>6.0	---	---	>60	---
Glenpool part--	B	None---------	---	---	>6.0	---	---	>60	---
Latanier:									
29----------	D	Occasional	Brief-----	Nov-May	2.5-5.0	Apparent	Nov-Apr	>60	---
Lula:									
30----------	B	None---------	---	---	>6.0	---	---	40-60	Hard
Mason:									
31----------	B	Rare---------	Very brief	Dec-Apr	>6.0	---	---	>60	---
Newtonia:									
32, 33----------	B	None---------	---	---	>6.0	---	---	>60	---
Niotaze:									
[1]34:									
Niotaze part---	C	None---------	---	---	1.0-3.0	Perched	Nov-Apr	20-40	Rippable

See footnote at end of table.

TABLE 19.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness
					Ft			In	
Niotaze:									
[1]34:									
Darnell part---	C	None--------	---	---	>6.0	---	---	10-20	Rippable
[1]35:									
Niotaze part---	C	None--------	---	---	1.0-3.0	Perched	Nov-Apr	20-40	Rippable
Darnell part---	C	None--------	---	---	>6.0	---	---	10-20	Rippable
[1]36:									
Niotaze part---	C	None--------	---	---	1.0-3.0	Perched	Nov-Apr	20-40	Rippable
Darnell part---	C	None--------	---	---	>6.0	---	---	10-20	Rippable
[1]37:									
Niotaze part---	C	None--------	---	---	1.0-3.0	Perched	Nov-Apr	20-40	Rippable
Darnell part---	C	None--------	---	---	>6.0	---	---	10-20	Rippable
Urban land part.									
Oil-waste land: 38.									
Okay: 39, 40, 41, 42---	B	None--------	---	---	>6.0	---	---	>60	---
Okemah: 43----------	C	None--------	---	---	2.0-3.0	Perched	Dec-Apr	>60	---
[1]44:									
Okemah part----	C	None--------	---	---	2.0-3.0	Perched	Dec-Apr	>60	---
Parsons part---	D	None--------	---	---	0.5-1.5	Perched	Dec-Apr	>60	---
Carytown part--	D	None--------	---	---	0-1.0	Perched	Dec-Apr	>60	---
Osage: 45----------	D	Occasional	Very brief	Nov-May	0-1.0	Perched	Nov-May	>60	---
Pits: 46.									
Radley: 47----------	B	Common------	Very brief	Dec-Jul	>6.0	---	---	>60	---
[1]48----------	B	Frequent-----	Very brief	---	>6.0	---	---	>60	---
Severn: 49----------	B	Rare--------	Very brief	Jan-Oct	>6.0	---	---	>60	---
Shidler:									
[1]50:									
Shidler part---	D	None--------	---	---	>6.0	---	---	4-20	Hard
Rock outcrop part.									
Tullahassee: 51----------	C	Frequent----	Very brief	Mar-Aug	2.0-3.0	Apparent	Nov-May	>60	---
Urban land: 52.									
Wynona: 53----------	C	Occasional	Very brief	Jan-Jul	0-2.0	Perched	Nov-Apr	>60	---

See footnote at end of table.

TABLE 19.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness
					Ft			In	
Wynona:									
[1]54:									
Wynona part----	C	Occasional	Very brief	Jan-Jul	0-2.0	Perched	Nov-Apr	>60	---
Urban land part.									

[1]This mapping unit is made up of two or more dominant kinds of soil. See mapping unit description for the composition and behavior of the whole mapping unit.

TABLE 20.--CLASSIFICATION OF THE SOILS

Soil name	Family or higher taxonomic class
Apperson----------	Fine, montmorillonitic, thermic Vertic Argiudolls
Bates----------	Fine-loamy, siliceous, thermic Typic Argiudolls
Carytown----------	Fine, mixed, thermic Albic Natraqualfs
Catoosa----------	Fine-silty, mixed, thermic Typic Argiudolls
Choska----------	Coarse-silty, mixed, thermic Fluventic Hapludolls
Cleora----------	Coarse-loamy, mixed, thermic Fluventic Hapludolls
Coweta----------	Loamy, siliceous, thermic, shallow Typic Hapludolls
Darnell----------	Loamy, siliceous, thermic, shallow Udic Ustochrepts
Dennis----------	Fine, mixed, thermic Aquic Paleudolls
Enders----------	Clayey, mixed, thermic Typic Hapludults
Eram----------	Fine, mixed, thermic Aquic Argiudolls
Glenpool----------	Sandy, siliceous, thermic Psammentic Paleudalfs
Hector----------	Loamy, siliceous, thermic Lithic Dystrochrepts
Kamie----------	Fine-loamy, mixed, thermic Typic Paleudalfs
Kanima----------	Loamy-skeletal, mixed, nonacid, thermic Udalfic Arents
Kiomatia----------	Sandy, mixed, thermic Typic Udifluvents
Larton----------	Loamy, siliceous, thermic Arenic Paleudalfs
Latanier----------	Clayey over loamy, mixed, thermic Vertic Hapludolls
Linker----------	Fine-loamy, siliceous, thermic Typic Hapludults
Lula----------	Fine-silty, mixed, thermic Typic Argiudolls
Mason----------	Fine-silty, mixed, thermic Typic Argiudolls
Newtonia----------	Fine-silty, mixed, thermic Typic Paleudolls
Niotaze----------	Fine, montmorillonitic, thermic Aquic Paleustalfs
Okay----------	Fine-loamy, mixed, thermic Typic Argiudolls
Okemah----------	Fine, mixed, thermic Aquic Paleudolls
Osage----------	Fine, montmorillonitic, thermic Vertic Haplaquolls
Parsons----------	Fine, mixed, thermic Mollic Albaqualfs
Radley----------	Fine-silty, mixed, thermic Fluventic Hapludolls
Severn----------	Coarse-silty, mixed (calcareous), thermic Typic Udifluvents
Shidler----------	Loamy, mixed, thermic Lithic Haplustolls
Tullahassee----------	Coarse-loamy, mixed, nonacid, thermic Aquic Udifluvents
Wynona----------	Fine-silty, mixed, thermic Cumulic Haplaquolls

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