United States
Department of
Agriculture

Soil
Conservation
Service

In cooperation with
United States
Department of Agriculture,
Forest Service,
Louisiana Agricultural
Experiment Station,
Louisiana Soil and
Water Conservation Committee

Soil Survey of Natchitoches Parish, Louisiana

How To Use This Soil Survey

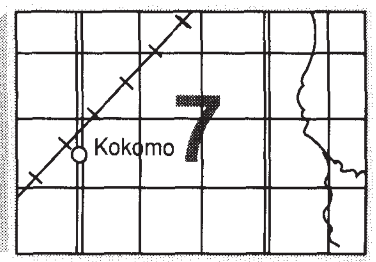
General Soil Map

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

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

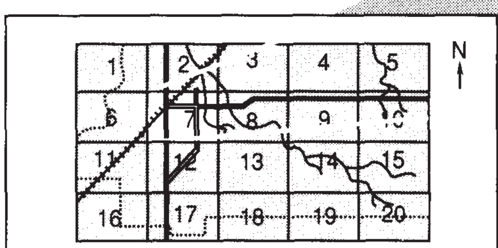
Detailed Soil Maps

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



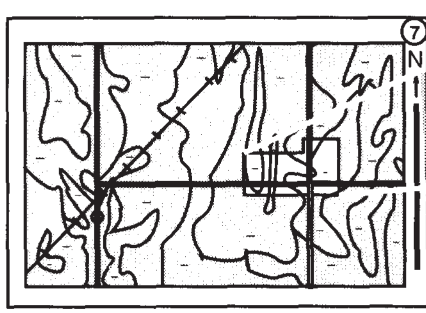
MAP SHEET

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

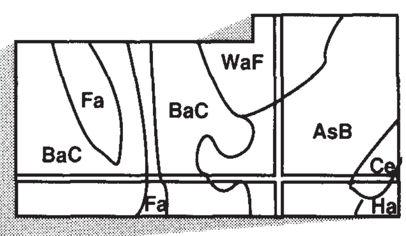


INDEX TO MAP SHEETS

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



MAP SHEET



AREA OF INTEREST

NOTE: Map unit symbols in a soil survey may consist only of numbers or letters, or they may be a combination of numbers and letters.

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

This soil survey is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other federal agencies, state agencies including the Agricultural Experiment Stations, and local agencies. The Soil Conservation Service has leadership for the federal part of the National Cooperative Soil Survey.

Major fieldwork for this soil survey was completed in 1984. Soil names and descriptions were approved in 1985. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1984. This soil survey was made cooperatively by the Soil Conservation Service and United States Department of Agriculture, Forest Service, the Louisiana Agricultural Experiment station, and the Louisiana Soil and Water Conservation Committee. It is part of the technical assistance furnished to the Natchitoches Soil and Water Conservation District.

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

All programs and services of the Soil Conservation Service are offered on a nondiscriminatory basis, without regard to race, color, national origin, religion, sex, age, marital status, or handicap.

Cover: Clear flowing streams that have outcroppings of sandstone and siltstone bedrock, such as the Kisatchie Bayou, are unique to the area of the Catahoula and Fleming Formations in southwestern Natchitoches Parish.

Contents

Index to map units iv
Summary of tables v
Foreword vii
General nature of the survey area 1
How this survey was made 4
  Map unit composition 4
General soil map units 7
Detailed soil map units 17
Prime farmland 67
Use and management of the soils 69
  Crops and pasture 69
  Woodland management and productivity 72
  Recreation 75
  Wildlife habitat 76
  Engineering 78
Soil properties 83
  Engineering index properties 83
  Physical and chemical properties 84
  Soil and water features 85
  Soil fertility levels 86
  Physical and chemical analyses of selected soils... 90
Classification of the soils 93
Soil series and their morphology 93
Formation of the soils 117
  The genesis of the soils 117
  Processes of soil formation 117
  Factors of soil formation 118
  Landforms and surface geology 121
References 125
Glossary 127
Tables 135

Soil Series

Acadia series 93
Anacoco series 94
Armistead series 95
Beauregard series 96
Bellwood series 97
Betis series 97
Bienville series 98
Briley series 98
Caddo series 99
Cahaba series 100
Caspiana series 100
Gallion series 101
Gore series 101
Guyton series 102
Keithville series 103
Kisatchie series 104
Latanier series 104
Lotus series 105
Malbis series 105
Moreland series 106
Morse series 107
Natchitoches series 107
Oula series 108
Perry series 109
Roxana series 109
Ruston series 110
Sacul series 111
Severn series 112
Shatta series 112
Smithdale series 113
Wrightsville series 114
Yorktown series 114

Issued February 1990

Index to Map Units

Ac—Acadia silt loam 17
An—Anacoco loam, 1 to 5 percent slopes 18
Ar—Armistead clay 19
Ba—Beauregard silt loam, 1 to 3 percent slopes 20
Bc—Bellwood clay, 1 to 5 percent slopes 21
Bd—Bellwood clay, 5 to 12 percent slopes 22
Be—Betis loamy fine sand, 1 to 5 percent slopes 23
Bf—Betis loamy fine sand, 5 to 12 percent slopes 23
Bn—Bienville loamy fine sand, 1 to 5 percent slopes 24
Br—Briley loamy fine sand, 1 to 5 percent slopes 25
Bt—Briley loamy fine sand, 5 to 12 percent slopes 26
By—Briley loamy fine sand, 12 to 20 percent slopes. 27
Ca—Caddo very fine sandy loam 28
Cb—Cahaba fine sandy loam, 1 to 5 percent slopes. 28
Cn—Caspiana silty clay loam 29
Ga—Gallion silt loam 30
Gn—Gallion silty clay loam 31
Gr—Gore silt loam, 1 to 5 percent slopes 32
Gt—Guyton silt loam 33
Gy—Guyton silt loam, frequently flooded 34
GZ—Guyton-Lotus association, frequently flooded 35
Ke—Keithville loam, 1 to 5 percent slopes 36
Kt—Kisatchie clay, 1 to 15 percent slopes, severely eroded 38
Kw—Kisatchie-Anacoco complex, 1 to 5 percent slopes 39
Kz—Kisatchie-Oula fine sandy loams, 5 to 40 percent slopes 40
La—Latanier clay 42
Ma—Malbis fine sandy loam, 1 to 5 percent slopes .. 43
Md—Moreland silt loam 44
Mn—Moreland clay 46
Mo—Moreland clay, gently undulating 48
Mp—Moreland clay, occasionally flooded 49
Mr—Moreland clay, frequently flooded 50
Ms—Morse clay, 5 to 12 percent slopes 51
Na—Natchitoches sandy clay loam, 1 to 5 percent slopes 53
Nh—Natchitoches sandy clay loam, 5 to 12 percent slopes 53
Pe—Perry clay, occasionally flooded 54
Ro—Roxana very fine sandy loam 55
Ru—Ruston fine sandy loam, 1 to 5 percent slopes .. 57
Sa—Sacul fine sandy loam, 1 to 5 percent slopes 58
Sc—Sacul fine sandy loam, 5 to 12 percent slopes ... 58
Se—Severn very fine sandy loam, occasionally flooded 59
Sf—Severn very fine sandy loam, frequently flooded 60
Sh—Shatta very fine sandy loam, 1 to 5 percent slopes 61
Sm—Smithdale fine sandy loam, 8 to 20 percent slopes 62
Wr—Wrightsville silt loam 62
Yo—Yorktown clay, frequently flooded 63

Summary of Tables

Temperature and precipitation (table 1) 136

Freeze dates in spring and fall (table 2) 137

Probability. Temperature.

Growing season (table 3) 137

Suitability and limitations of general soil map units (table 4) 138

Extent of area. Cultivated crops. Pasture. Woodland. Urban uses.

Acreage and proportionate extent of the soils (table 5) 140

Acres. Percent.

Land capability classes and yields per acre of crops and pasture (table 6) 141

Cotton lint. Soybeans. Wheat. Grain sorghum. Improved bermudagrass. Bahaiagrass. Common bermudagrass.

Capability classes and subclasses (table 7) 144

Total acreage. Major management concerns.

Woodland management and productivity (table 8) 145

Ordination symbol. Management concerns. Potential productivity. Trees to plant.

Recreational development (table 9) 149

Camp areas. Picnic areas. Playgrounds. Paths and trails. Golf fairways.

Wildlife habitat (table 10) 153

Potential for habitat elements. Potential as habitat for—Openland wildlife, Woodland wildlife, Wetland wildlife.

Building site development (table 11) 156

Shallow excavations. Dwellings without basements. Small commercial buildings. Local roads and streets. Lawns and landscaping.

Sanitary facilities (table 12) 160

Septic tank absorption fields. Sewage lagoon areas. Trench sanitary landfill. Area sanitary landfill. Daily cover for landfill.

Construction materials (table 13) 164

Roadfill. Sand. Gravel. Topsoil.

Water management (table 14) 167

Limitations for—Pond reservoir areas; Embankments, dikes, and levees. Features affecting—Drainage, Irrigation, Terraces and diversions, Grassed waterways.

Engineering index properties (table 15) 170
Depth. USDA texture. Classification—Unified, AASHTO. Fragments greater than 3 inches. Percentage passing sieve—4, 10, 40, 200. Liquid limit. Plasticity index.

Physical and chemical properties of the soils (table 16) 175
Depth. Clay. Moist bulk density. Permeability. Available water capacity. Soil reaction. Shrink-swell potential. Erosion factors. Organic matter.

Soil and water features (table 17) 178
Hydrologic group. Flooding. High water table. Bedrock. Risk of corrosion.

Fertility test data on selected soils (table 18) 181

Physical analyses of selected soils (table 19) 185

Chemical analyses of selected soils (table 20) 188

Mineral composition of the clay fraction of selected soils (table 21) 191
Depth. Horizon. Relative amounts of minerals.

Classification of the soils (table 22) 192
Family or higher taxonomic class.

Formative elements and adjectives of the higher taxonomic classes (table 23) 193
Formative element or adjective. Connotation (simplified explantation) or meaning.

Foreword

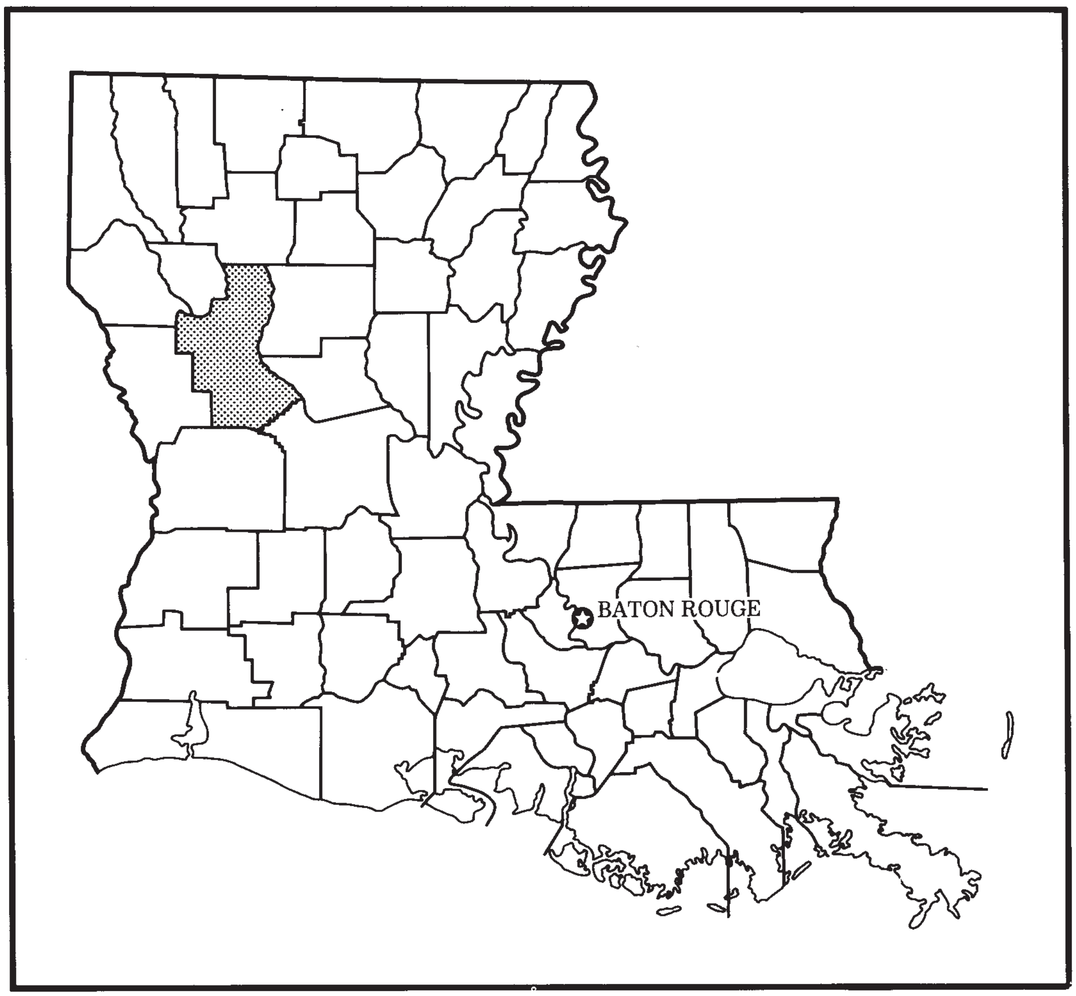
This soil survey contains information that can be used in land-planning programs in Natchitoches Parish. It contains predictions of soil behavior for selected land uses. The survey also highlights limitations and hazards inherent in the soil, improvements needed to overcome the limitations, and the impact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

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

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

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

Horace J. Austin
State Conservationist
Soil Conservation Service



Location of Natchitoches Parish in Louisiana.

Soil Survey of
Natchitoches Parish, Louisiana

By P. George Martin, Jr., C. Larry Butler, Ed Scott, and James E. Lyles, Soil Conservation Service; Michael Mariano, Louisiana Soil and Water Conservation Committee; and Jerry Ragus, Perry Mason, and Lynn Schoelerman, United States Department of Agriculture, Forest Service

United States Department of Agriculture, Soil Conservation Service
In cooperation with
United States Department of Agriculture, Forest Service
Louisiana Agricultural Experiment Station
Louisiana Soil and Water Conservation Committee

NATCHITOCHES PARISH is in northwestern Louisiana about 40 miles southeast of Shreveport. The total area is 834,195 acres, of which 812,885 acres is land and 21,310 acres is lakes, reservoirs, streams, and other waterways. The Red River crosses the parish from northwest to southeast and forms the eastern boundary of the parish in the southern half of the parish. According to the Bureau of Census, the population of the parish in 1980 was 39,863. Natchitoches, with a population of 16,664, is the largest city and the parish seat. Except for the urban and industrial area around Natchitoches, the parish is mostly rural.

The parish consists of three major physiographic areas: the level to gently undulating flood plains, the level to steep terrace uplands, and the level to gently sloping, low stream terraces. The elevation ranges from about 350 feet above sea level on the terrace uplands north of Provencal to about 80 feet along the Red River in the southeastern part of the parish.

The flood plains are mainly in a wide band along the Red River and also in narrow bands along the major tributaries of the Red River. They make up nearly two-fifths of the parish. The soils on these flood plains range from loamy to clayey and from well drained to very poorly drained. Most of the acreage is in cultivated crops, such as soybeans. Small acreages are used as homesites, pasture, pecan orchards, or woodland. Most of the woodland is in areas of frequently flooded soils. The loamy soils are on higher, natural levees of rivers and bayous. These soils are fertile and have few limitations for crops. The clayey soils, which are in the lower areas, are limited by wetness. Some of the clayey soils are flooded by runoff and stream overflow, and drainage is needed for most crops.

The terrace uplands are throughout the parish and make up more than two-fifths of the parish. The soils on these uplands range from sandy to clayey. They are generally low in natural fertility. Most of the acreage is woodland. Small acreages are used as homesites, pasture, or cropland. Wetness and slope are the main limitations for woodland, and low fertility is an additional limitation for crops and pasture. The hazard of erosion is slight to severe.

The low stream terraces make up the remainder of the parish and are in narrow bands that parallel the flood plains of major streams. The soils of these terraces are mainly sandy and loamy. They are low in natural fertility. Most of the acreage is woodland. Small acreages are used for cultivated crops or pasture. Soil droughtiness in the sandy soils and wetness in the loamy soils are additional limitations for crops, pasture, and woodland.

General Nature of the Survey Area

This section gives general information about the parish. It describes the history and development, agriculture, climate, transportation, and landscape resources.

History and Development

The Red River, flowing through the heart of Natchitoches Parish, carries with it the history and development of the parish and its land.

The city of Natchitoches is the oldest settlement in the Louisiana Purchase. It was founded on the banks of the Red River in 1714 by the French explorer, Louis Juchereau de St. Denis.

Red River, an early trading post, was established by the French to facilitate trade with the Spanish to the west of the Red River. Local people also used this trading post to carry on commerce with others in the lower Mississippi Valley.

During the 1720's, the Spanish settled just outside the present-day town of Robeline in west Natchitoches Parish. The Spaniards called this settlement Los Adeas. Los Adeas served as the capital of Spanish Texas. An illicit commerce soon developed between Natchitoches and Los Adeas.

The land along the Red River provided livelihood for many temporary and permanent residents of Natchitoches Parish. Fur trappers brought hides, skins, and furs to local trading posts or transported them to New Orleans for sale. The fur business contributed much to the economy of the parish, but it also disrupted life on this frontier and slowed the settlement of family farmers and other pioneers. The fur trappers and traders provided a dangerous and unsettled environment to other pioneers because of their "dissolute habits." Natchitoches was the center for fur trading during Spain's control of Louisiana following the territory's transfer from the French in 1763.

Indigo and tobacco were important crops during most of the 18th century. Planters received handsome profits from the sale of these crops. Toward the end of the century, tobacco declined somewhat in importance in Natchitoches Parish, partly because of competition by tobacco farmers from Kentucky.

Cotton became the major crop in Natchitoches Parish soon after Eli Whitney developed the cotton gin in 1790. The cotton gin provided an efficient method of separating the cotton seed from the fiber. Some of the richest cotton land in the south is on the flood plains of the Red River and Cane River in Natchitoches Parish. Many fortune seekers immigrated from east of the Mississippi River to Natchitoches Parish, and the cultivation of cotton fields led to the development of plantations. Some of the plantation homes survive today as gracious reminders of Natchitoches Parish's antebellum past.

With the coming of the Civil War in 1864, Natchitoches Parish experienced war's destructiveness, mostly because of the Red River Campaign. During this time, parish farmers and planters witnessed the destruction of their crops. Rebuilding followed in the wake of war, and cotton continued as the major crop and supported the parish's economy into the second half of the twentieth century.

Natchitoches enjoys industrial growth along with a continued reliance on agriculture. Northwestern State University and the Louisiana School of Math, Science, and the Arts are in Natchitoches and establish the city as one of the state's major educational centers.

The residents of Natchitoches Parish are very conscious of the region's historical heritage. Tours of antebellum homes within the city and along the Cane River are conducted each fall. Fort Saint John de Baptist has been restored to uncover an earlier history of the parish. The Fort Festival and the Christmas Festival attract tourists each year from all over the world.

Agriculture

Agriculture is the dominant land use in Natchitoches Parish. In 1986, the average farm was about 367 acres. The number of farms in the parish is decreasing, and the average size is increasing.

Cropland acreage has shown little change. The value of agricultural products produced annually in the Natchitoches Parish is between 60 and 70 million dollars. In 1985, about 21,000 acres of cotton, 35,000 acres of soybeans, 9,000 acres of wheat, and 4,000 acres of corn were planted in the parish. Small acreages of grain sorghum, oats, and other crops were also planted. Hayland and pastureland make up about 100,000 acres in the parish. Common bermudagrass, Coastal bermudagrass, and Alicia bermudagrass are the principal grasses grown for hay and pasture.

About 63 poultry farmers in the parish raise over a million birds. Forestry is a big income producer with about 620,000 acres of commercial woodland. Many small to large pecan orchards are on the Red River bottom land. About 500 acres is used to produce crawfish.

The present trend in Natchitoches Parish appears to be an increase in the acreage planted to grain sorghum and a decrease in the acreage planted to soybeans. In recent years, the construction of good farm-to-market roads, modern grain elevators and cotton gins, and the improvement of drainage systems have strengthened the production and marketing abilities of farmers in the parish.

All of the industries in the parish are agriculturally based. They support the production and marketing of poultry, forest products, and cottonseed oil and by-products.

Climate

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

Table 1 gives data on temperature and precipitation for the survey area as recorded at Natchitoches in the period 1951 to 1973. 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 51 degrees F, and the average daily minimum temperature is 39 degrees. The lowest temperature on record, which occurred at Natchitoches on February 2, 1951, is 3 degrees. In summer the average temperature is 82 degrees, and the average daily maximum temperature is 94 degrees. The highest recorded temperature, which occurred at Natchitoches on July 24, 1954, is 108 degrees.

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

The total annual precipitation is 50 inches. Of this, 25 inches, or 50 percent, usually falls in April through September. The growing season for most crops falls within this period. In 2 years out of 10, the rainfall in April through September is less than 17 inches. The heaviest 1-day rainfall during the period of record was 8.7 inches at Natchitoches on April 29. 1953. Thunderstorms occur on about 60 days each year, and most occur in summer.

Snowfall is rare. In 50 percent of the winters, there is no measurable snowfall. In 15 percent, the snowfall, usually of short duration, is more than 2 inches. The heaviest 1-day snowfall on record was more than 5 inches.

The average relative humidity in midafternoon is about 60 percent. Humidity is higher at night, and the average at dawn is about 90 percent. The sun shines 70 percent of the time possible in summer and 50 percent in winter. The prevailing wind is from the south. Average windspeed is highest, 9 miles per hour, in spring.

Transportation

Natchitoches Parish is served by a network of highways and roads. Louisiana Highway 1 and U.S. Highways 71 and 84 service the major through-traffic in the parish. Interstate 49, which is under construction, will run north to south through the parish. It will connect to Interstate 10 in the southern part of the state and Interstate 20 in the northern part.

The parish is served by one airport, three major railroads, two major bus lines, and numerous motor freight carriers. The Red River is being developed by the U.S. Army Corp of Engineers to provide navigation north to Shreveport. The navigation project is expected to be completed by the early 1990's.

Landscape Resources

The Natchitoches Parish landscape is changing because of woodland clearings, different methods of cultivating and planting, urban expansion, and commercial developments. The changes are sometimes dramatic, but often subtle. Visual appearance of the landscape, a resource quality, is directly related to these changes.

Landscape resource is a composite of ecological, social, and visual resources. The composition and topography of the soils are basic in the landscape resource. The ecological resource is the function of the landscape life-cycle processes. The social resource is the use of the landscape for economic, functional, and cultural purposes. The visual resource is the classifiable appearance of a landscape unit *(35)*.

The visual resource can be described and measured by four elements— landform, water, vegetation, and structures. These elements determine the visual diversity of a landscape. For example, a landscape that has a measurable slope, height, and shape can be compared and rated with other landscapes in the same geographic area. Visual diversity is a value rating of landscape elements and their pattern within a frame of reference developed for a local geographic area.

In the section "General Soil Map Units," each map unit has been described by the visual elements of landform, water, vegetation, and structures. The map unit has been classified as having a low, moderate, or high degree of visual diversity.

The visual character of Natchitoches Parish landscapes is a product of the soil characteristics. Visual appearance of the landscape, a resource quality, is directly related to such land use. Visual diversity can be used in conservation planning and in establishing a desirable continuity of landscape elements.

Soils within the parish are rated according to their use capability. This use is directly related to the visual resource quality. In most cases, if soils are used according to their capability, the visual appearance is acceptable. For example, farmland in this parish provides food and fiber. Farming also adds landscape diversity to landform, vegetation, water, and structures. The elements often separate one use from another.

The quality of landscape resource should be a consideration along with soil capability in planning farmland or urban use. Some tillage methods can create a hazard of erosion and a decline in visual quality. Planting crops on soils not suitable for row crops and then leaving the soil uncovered during the winter months could result in deep rills and gullies. Sand and silt from these eroding soils could clog streams and result in a rapid decline of the visual quality.

Structures also alter the visual appearance. Urban and commercial development require roads, highways, and utilities. Stripmining may become commonplace in some parts of the parish.

How This Survey Was Made

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

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

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

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

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

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

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

Map Unit Composition

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

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

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

General Soil Map Units

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

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

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

The soils in the survey area vary widely in their suitability for major land uses. Table 4 shows the extent of the map units shown on the general soil map. It lists the suitability of each, in relation to that of the other map units, for major land uses and shows soil properties that limit use. Soil suitability ratings are based on the practices commonly used in the survey area to overcome soil limitations. These ratings reflect the ease of overcoming the limitations. They also reflect the problems that will persist even if such practices are used.

Each map unit is rated for *cultivated crops, pasture, woodland,* and *urban uses,* . Cultivated crops are those grown extensively in the survey area. Pasture refers to pastures of native and improved grasses for livestock. Woodland refers to areas of native or introduced trees. Urban uses include residential, commercial, and industrial developments.

The boundaries of the general soil map units in Natchitoches Parish were matched, where possible, with those of the previously completed surveys of Grant, Rapides, and Red River Parishes. In a few places, however, the lines do not join and the names of the map units differ. These differences resulted mainly because of changes in soil series concepts, differences in map unit design, and changes in soil patterns near survey area boundaries.

The general soil map units in this survey have been grouped into five general landscapes. Descriptions of each of the broad groups and the map units in each group follow.

Dominantly Level and Nearly Level, Loamy Soils; on Flood Plains

This group of map units consists of well drained and poorly drained soils that are loamy throughout. The three map units in this group make up about 16.5 percent of the parish. Most areas that seldom or never flood and some areas that flood occasionally are in crops or pasture. Most areas that flood frequently and some areas that flood occasionally are woodland. Seasonal wetness and the hazard of flooding are the main limitations for most uses.

1. Roxana-Gallion

Level, well drained soils that are loamy throughout; formed in Red River alluvium

In this map unit, the landscape typically has very little relief. It is level flood plains and consists of high ridges or natural levees adjacent to the Red River and former channels and distributaries of the Red River. Slopes are 0 to 1 percent. Streams are mostly permanent and flow in meandering courses. The soils are protected from flooding by a network of levees. Many farmsteads, homes, and several cities and villages are prominently visible within the broad expanses of open farmland. The degree of visual variety is generally low.

This map unit makes up about 6.5 percent of the parish. It is about 49 percent Roxana soils, 45 percent Gallion soils, and 6 percent soils of minor extent.

The Roxana soils are in high positions on natural levees of the Red River. The surface layer is yellowish red very fine sandy loam. The underlying material is yellowish red very fine sandy loam and silt loam in the upper part and dark brown and strong brown silt loam and fine sandy loam in the lower part.

The Gallion soils are in high positions on natural levees of former channels and distributaries of the Red River. The surface layer is brown silt loam or reddish brown silty clay loam. The subsoil is yellowish red silt loam and loam. The substratum is yellowish red and strong brown very fine sandy loam.

Of minor extent are the Armistead, Latanier, Moreland, Caspiana, and Severn soils. The Armistead, Latanier, and Moreland soils are in lower positions than Roxana and Gallion soils and are clayey and somewhat poorly drained. The Caspiana soils are in intermediate positions, and the Severn soils are in positions similar to those of the Roxana soils. The Caspiana and Severn soils are loamy and well drained.

Most of the soils in this map unit are used for cultivated crops, mainly cotton, corn, and soybeans. Small acreages are used as pasture, woodland, or urban areas.

The soils in this map unit are well suited to cultivated crops and pasture. The loamy surface layer, high and medium fertility, and level slopes favor these uses. Wetness is a slight limitation for crops in some areas of the Gallion soils. Land grading or smoothing and a surface drainage system can reduce wetness.

These soils are well suited to use as woodland. The potential productivity of eastern cottonwood and American sycamore is very high. These soils have few limitations for timber production.

The soils in this map unit that are not subject to flooding are well suited to building site development and most sanitary facilities. The main limitations are moderate permeability and the moderate shrink-swell potential in the Gallion soils. The soils that are subject to flooding are poorly suited to most urban uses.

2. Severn

Level and nearly level, well drained soils that are loamy throughout; formed in Red River alluvium

In this map unit, the landscape typically has very little relief. It is natural levees and low sandbars between the Red River and the high manmade levees along the river. Slopes range from 0 to 2 percent. The Red River is a permanent stream that follows a meandering course. All of the soils in this map unit are subject to occasional or frequent flooding in winter and spring. The frequently flooded soils are mostly forested with hardwoods. Structures are few and are minimally visible. The degree of visual variety is low to moderate.

This map unit makes up about 2 percent of the parish. It is about 92 percent Severn soils and 8 percent soils of minor extent.

The Severn soils have a reddish brown or brown very fine sandy loam surface layer. The underlying material is stratified, yellowish red loamy very fine sand and very fine sandy loam.

Of minor extent are the Latanier, Moreland, and Roxana soils. The Latanier and Moreland soils are in low positions and are clayey and somewhat poorly drained. The Roxana soils are in positions similar to those of the Severn soils and are loamy and well drained.

The soils in this map unit are mainly used for cultivated crops or pasture. Soybeans and grain sorghum are the main crops grown. In frequently flooded areas, the soils are used mainly as native pasture or woodland.

The occasionally flooded soils in this map unit are moderately well suited to cultivated crops and are well suited to use as pasture. Flooding limits the choice of crops and pasture plants and can delay or prevent planting or harvesting in some years. The frequently flooded soils are poorly suited to these uses.

Most of the soils in this map unit are well suited to use as woodland. The potential productivity of eastern cottonwood and American sycamore is very high. The hazard of flooding is a concern in managing these soils for timber production.

Most of these soils are poorly suited to urban uses because of flooding. It is difficult to overcome the problems caused by flooding because the soils are in a designated flood plain on the unprotected side of the Red River levee system.

3. Guyton

Level, poorly drained soils that are loamy throughout; formed in local stream alluvium

In this map unit, the landscape typically has very little relief. It is narrow flood plains of small perennial streams wandering through narrow valleys bounded by bluff-like hills of the terrace uplands. Slopes are less than 1 percent. The soils are frequently flooded by runoff from higher-lying soils. Bottom land hardwoods are at a low elevation, and pines are at a higher elevation. Occasional open areas are used as pasture. The degree of visual variety is generally low. Because of the flooding hazard, no structures and land use changes create any additional visual variety not expected in most areas of this map unit.

This map unit makes up about 8 percent of the parish. It is about 98 percent Guyton soils and 2 percent soils of minor extent.

The Guyton soils have a dark grayish brown silt loam surface layer and a grayish brown and light brownish gray, mottled silt loam subsurface layer. The subsoil is gray, grayish brown, and light brownish gray, mottled silty clay loam and clay loam.

Of minor extent are the Bienville, Cahaba, and Lotus soils. The Bienville and Cahaba soils are on low stream terraces. The Bienville soils are somewhat excessively drained, and the Cahaba soils are well drained. Lotus soils are on natural levees and are moderately well drained to somewhat poorly drained.

The soils in this map unit are mainly used as woodland. In a few small areas, they are used as pasture.

These soils are moderately well suited to the production of hardwood and pine trees. Wetness and flooding limit the use of equipment and increase seedling mortality. The dominant trees are loblolly pine, shortleaf pine, water oak, sweetgum, willow oak, and swamp chestnut oak.

These soils are poorly suited to cultivated crops and pasture. The choice of crops and pasture plants and the period of grazing are limited by soil wetness and the frequency and duration of flooding.

These soils are poorly suited to most urban uses because of flooding and wetness.

Dominantly Level and Gently Undulating, Clayey and Loamy Soils; on Flood Plains

This group of map units consists of somewhat poorly drained and very poorly drained soils that have a clayey or loamy surface layer and a clayey or loamy subsoil. The two map units in this group make up about 20 percent of the parish. Most of the soils that are rarely or occasionally flooded are used for crops or pasture. Frequently flooded areas and some small areas that are occasionally flooded are woodland. Wetness and the hazard of flooding are the main limitations for most uses.

4. Moreland-Yorktown

Level, somewhat poorly drained and very poorly drained soils that are clayey throughout; formed in Red River alluvium

In this map unit, the landscape typically has little relief. It is broad flats and backswamps on the flood plain of the Red River. Slopes are generally less than 1 percent. Many narrow sloughs, channel scars, and depressional areas are throughout the landscape. The higher areas of this map unit are occasionally flooded, and the lower areas are frequently flooded. Some depressional areas are ponded most of the time. Cropland and pasture are dominant in the higher areas, and the lower areas are forested with bottom land hardwoods. Structures are few and are minimally visible. The degree of visual variety is generally low, but land use changes that create patterns will produce high contrast.

This map unit makes up about 6 percent of the parish. It is about 85 percent Moreland soils, 13 percent Yorktown soils, and 2 percent soils of minor extent.

The Moreland soils are somewhat poorly drained and are in low positions on natural levees and in backswamps. The surface layer is dark reddish brown clay. The subsoil is dark reddish brown and reddish brown clay.

The Yorktown soils are very poorly drained and are in old stream channel scars and depressional areas. These soils remain wet throughout the year. The surface layer is gray clay. The subsoil is dark gray, mottled clay in the upper part and reddish brown and dark reddish brown, mottled clay in the lower part.

Of minor extent are the Gallion, Roxana, Latanier, and Perry soils. Gallion and Roxana soils are in high positions on natural levees and are well drained and loamy. The Latanier soils are in intermediate positions and are somewhat poorly drained. The Perry soils are in low positions on natural levees and are poorly drained.

The soils in this map unit are used about equally as cropland and woodland. Most areas of the occasionally flooded Moreland soils have been cleared and are used for cultivated crops or pasture. Soybeans and grain sorghum are the main crops. The frequently flooded Moreland and Yorktown soils are used as woodland for timber production and as wildlife habitat.

The frequently flooded Moreland soils are poorly suited to cultivated crops and pasture. The Yorktown soils are not suited to crops. The occasionally flooded Moreland soils are somewhat poorly suited to crops and are moderately well suited to use as pasture. Wetness and the hazard of flooding are the main limitations. Choice of crops and pasture grasses and the period of grazing are limited because of wetness and the frequency and duration of flooding.

The Moreland soils in this map unit are moderately well suited to use as woodland. The Yorktown soils are poorly suited to this use. The dominant trees are overcup oak, water hickory, baldcypress, black willow, and green ash. Flooding and wetness severely restrict the use of equipment during winter and spring and increase seedling mortality.

The Moreland soils are poorly suited and the Yorktown soils are not suited to most urban uses because of flooding and wetness. Major flood control structures are needed.

5. Moreland-Latanier-Armistead

Level to gently undulating, somewhat poorly drained soils that have a clayey or loamy surface layer and a clayey or loamy subsoil; formed in Red River alluvium

In this map unit, the landscape typically has very little relief. It is mainly broad flats and natural levees and backswamps on the Red River alluvial plain. In a few small areas, it is low, parallel ridges and swales. Slopes are generally less than 1 percent, but they can range from 0 to 3 percent. A few narrow channel scars and depressions are on the landscape. Most of the soils in this map unit are subject to rare flooding during the cropping season; Moreland soils in low areas are occasionally flooded. Small scattered blocks of bottom land hardwoods add some variety to the landscape. Farmsteads, homes, and small villages are also visible. The degree of visual variety is generally low.

This map unit makes up about 14 percent of the parish. It is about 56 percent Moreland soils, 33 percent Latanier soils, 8 percent Armistead soils, and 3 percent soils of minor extent.

The Moreland soils are in low positions on natural levees. The surface layer is dark reddish brown clay or reddish brown silt loam. The subsoil is reddish brown clay.

The Latanier soils are in intermediate positions on natural levees. The surface layer is dark brown clay. The subsoil is dark reddish brown and reddish brown clay. The substratum is yellowish red silt loam.

The Armistead soils are in intermediate positions on natural levees. The surface layer is dark reddish brown clay. The subsoil is reddish brown, mottled silty clay loam.

Of minor extent are the Gallion, Roxana, Perry, and Yorktown soils. The Gallion and Roxana soils are loamy and well drained. They are in high positions on natural levees. The Perry soils are poorly drained and are in low positions on flood plains. The Yorktown soils are very poorly drained and are in depressions.

Most areas of the soils in this map unit have been cleared and are used for crops, mainly soybeans and grain sorghum. Small acreages are used as pasture or woodland.

The soils in this map unit are moderately well suited to cultivated crops and well suited to pasture. Wetness and poor tilth are the main limitations. A surface drainage system is needed to remove excess water. Choice of crops and pasture grasses is limited in low areas that flood occasionally.

These soils are well suited to use as woodland. The dominant trees are sugarberry, Nuttall oak, pecan, sweetgum, water oak, green ash, and American elm. Logging operations during winter and early in spring are limited by wet soil conditions.

These soils are poorly suited to most urban uses. The main limitations are wetness, very slow and moderately slow permeability, and the very high shrink-swell potential. Surface drainage is needed to remove excess water. Flood control is needed in some areas.

Dominantly Level to Gently Sloping, Loamy and Sandy Soils; on Low Stream Terraces

This group consists of well drained, somewhat excessively drained, and poorly drained soils that are loamy and sandy throughout the profile. The map unit makes up about 2.5 percent of the parish. Most of the acreage is woodland. Pastureland and cropland areas are small and scattered. Low soil fertility, droughtiness, and wetness are the main limitations for agricultural uses. Wetness and the hazard of flooding are the main limitations for urban uses.

6. Cahaba-Bienville-Guyton

Level to gently sloping, well drained, somewhat excessively drained, and poorly drained soils that are loamy or sandy throughout; formed in old stream deposits

In this map unit, the landscape typically has slight to moderate relief. It is low, convex ridges and broad flats on low stream terraces that parallel some of the larger streams. A few shallow drainageways dissect the landscape in most places. Slopes range from 0 to 5 percent. Most areas are forested with pine or mixed pine and hardwoods. Occasional open areas are pasture or cropland. Farmsteads and homes are visible along most roadways. The degree of visual variety is moderately low, but land use changes that create patterns, such as clearcuts for timber or right-of-way for utilities, will produce high contrast.

This map unit makes up about 2.5 percent of the parish. It is about 49 percent Cahaba soils, 20 percent Bienville soils, 20 percent Guyton soils, and 11 percent soils of minor extent.

The Cahaba soils are well drained and gently sloping. The surface layer is dark brown fine sandy loam, and the subsurface layer is yellowish brown and yellowish red sandy loam. The subsoil is red sandy clay loam in the upper part and yellowish red loam in the lower part. The substratum is strong brown fine sandy loam.

The Bienville soils are somewhat excessively drained and gently sloping. The surface layer is dark brown loamy fine sand, and the subsurface layer is yellowish brown loamy fine sand. The subsoil is strong brown loamy fine sand.

The Guyton soils are poorly drained and level. The Guyton soils in this map unit are in drainageways. The surface layer is dark grayish brown silt loam, and the subsurface layer is grayish brown and light brownish gray, mottled silt loam. The subsoil is gray, grayish brown, and light brownish gray, mottled silty clay loam.

Of minor extent are the Acadia, Gore, and Ruston soils. The Acadia soils are on broad ridgetops and are somewhat poorly drained. The Gore soils are on ridgetops and short side slopes and are moderately well drained. The Ruston soils are in high positions on the adjacent terrace uplands and are well drained.

The soils in this map unit are used mainly as woodland. Small acreages are used for pasture, cultivated crops, or homesites.

These soils are well suited to use as woodland. The potential productivity of loblolly pine and hardwoods is high and very high. The dominant trees are loblolly pine, shortleaf pine, white oak, and southern red oak. The dominant trees on the narrow flood plains are water oak, sweetgum, and willow oak. Logging operations are limited by poor trafficability when the Bienville soils are dry and the Guyton soils are wet.

These soils are well suited to cultivated crops and pasture. A moderate hazard of erosion and soil droughtiness are the main limitations. Wetness and the hazard of flooding are also limitations of the Guyton soils in drainageways. In gently sloping areas, conservation tillage, contour farming, and grassed waterways can minimize soil losses from erosion. Lime and fertilizer are needed for crops and pasture.

Most of the soils in this map unit are well suited to urban uses. The Guyton soils are poorly suited to these uses because of wetness and the hazard of flooding.

Dominantly Level to Gently Sloping, Loamy Soils; on Uplands

This group of map units consists of moderately well drained to poorly drained soils that have a loamy surface layer and a loamy and clayey subsoil. The five map units in this group make up about 12 percent of the parish. Most of the acreage is woodland. In a few large areas and many small areas, these soils are used for pasture, cultivated crops, or homesites. Susceptibility to erosion, wetness, and the high shrink-swell potential are the main limitations for most uses of these soils.

7. Beauregard-Malbis-Guyton

Level to gently sloping, moderately well drained and poorly drained soils that are loamy throughout; formed in old stream deposits

In this map unit, the landscape typically has moderate relief. It is gently rolling terrace uplands that have broad convex ridgetops, gentle side slopes, and broad flats. Slopes are long and smooth and range from 0 to 5 percent. The landscape is slightly dissected by shallow drainageways that lead to the narrow flood plains of meandering, mostly intermittent streams. Land use is a mixture of woodland, which is pines with intermingled hardwoods, and open areas of pasture and cropland. Farm structures and other homes are visibly significant. Cleared corridors for utility lines and roadways are also visible. The degree of visual variety is moderate.

This map unit makes up about 3 percent of the parish. It is about 59 percent Beauregard soils, 16 percent Malbis soils, 15 percent Guyton soils, and 10 percent soils of minor extent.

The Beauregard soils are moderately well drained and very gently sloping. These soils are on broad, slightly convex ridgetops. The surface layer is very dark gray silt loam, and the subsurface layer is dark grayish brown silt loam. The subsoil is yellowish brown, mottled silt loam in the upper part and mottled light brownish gray and light gray silty clay loam in the lower part.

The Malbis soils are moderately well drained and gently sloping. These soils are on convex ridgetops and on side slopes. The surface layer is grayish brown fine sandy loam, and the subsurface layer is yellowish brown, mottled fine sandy loam. The subsoil is brownish loam and sandy clay loam in the upper part and mottled grayish and reddish sandy clay loam in the lower part.

The Guyton soils are poorly drained and level. These soils are mainly in low, flat areas. Some areas of these soils are in drainageways and are subject to frequent flooding. The surface layer is dark grayish brown silt loam, and the subsurface layer is light brownish gray, mottled silt loam. The subsoil is light brownish gray silt loam in the upper part, and gray and grayish brown, mottled silty clay loam in the lower part.

Of minor extent are the Caddo, Cahaba, and Ruston soils. The Caddo soils are in level, slightly convex positions and are poorly drained. The Cahaba soils are on low stream terraces and are well drained. The Ruston soils are in higher positions than the Beauregard, Malbis, and Guyton soils and are well drained.

The soils in this map unit are mainly used as woodland. Small acreages are used for pasture, cultivated crops, or homesites.

The soils in this map unit are well suited to use as woodland. The potential productivity of loblolly pine is high or very high. Logging operations during winter and early in spring are limited by wet soil conditions.

These soils are well suited to cultivated crops and pasture. Wetness is a limitation in the level areas, and erosion is a hazard in the sloping areas. Where these soils are used for crops, conservation tillage, contour farming, and grassed waterways can minimize soil losses from erosion. Surface drainage is needed for the Guyton soils. Lime and fertilizer are needed for crops and pasture.

These soils are moderately well suited to most urban uses. Wetness and moderately slow and slow permeability are the main limitations. Most areas of the Guyton soils are subject to flooding and are poorly suited to urban uses.

8. Gore-Acadia-Wrightsville

Level to gently sloping, moderately well drained, somewhat poorly drained, and poorly drained soils that have a loamy surface layer and a clayey subsoil; formed in old stream deposits

In this map unit, the landscape typically has slight to moderate relief. It is convex ridgetops, side slopes, and broad flats and depressional areas on the uplands. Long, smooth slopes are on the broad ridgetops and flats. A complex landscape of narrow ridgetops and short slopes is in other areas. Slopes range from 0 to 5 percent. The heads of many shallow drainageways lead from areas of this map unit to the narrow flood plains of meandering, mostly intermittent streams. Land use is mainly pine woodlands. Open areas of pasture and cropland are small and scattered. Structures are few and are minimally visible. The degree of visual variety is moderately low.

This map unit makes up about 4 percent of the parish. It is about 46 percent Gore soils, 29 percent Acadia soils, 22 percent Wrightsville soils, and 3 percent soils of minor extent.

The Gore soils are gently sloping and moderately well drained. They are on convex ridgetops and on side slopes. The surface layer is dark brown silt loam, and the subsurface layer is reddish yellow, mottled silt loam. The subsoil is yellowish red, light brownish gray, and red, mottled clay. The substratum is yellowish red, mottled clay.

The Acadia soils are nearly level and somewhat poorly drained. They are on broad, slightly convex ridgetops. The surface layer is dark grayish brown silt loam, and the subsurface layer is light yellowish brown silt loam. The upper part of the subsoil is yellowish brown, mottled clay loam and light brownish gray, mottled silty clay loam. The lower part of the subsoil and the substratum are light brownish gray, mottled clay.

The Wrightsville soils are level and poorly drained. They are on broad flats and in depressional areas. The surface layer is dark grayish brown silt loam, and the subsurface layer is light grayish brown, mottled silt loam. The subsoil is light brownish gray, mottled silty clay loam and clay. The substratum is reddish brown clay.

Of minor extent are the Guyton, Keithville, Shatta, and Morse soils. The Guyton soils are in drainageways and on broad flats. They are poorly drained. The Keithville and Shatta soils are in higher positions than the Gore, Acadia, and Wrightsville soils, and they are moderately well drained. The Morse soils are on strongly sloping side slopes and are well drained.

The soils in this map unit are mainly used as woodland. Small acreages are used for pasture or cultivated crops.

The soils in this map unit are moderately well suited to use as woodland. The potential productivity of loblolly pine and hardwoods is high. Logging operations during winter and early in spring are limited by wet soil conditions. Erosion is a hazard along logging roads and skid trails in the gently sloping areas.

These soils are moderately well suited to cultivated crops and well suited to use as pasture. Wetness is a limitation on nearly level soils, and erosion is a hazard on the gently sloping soils. Where these soils are used for crops, conservation tillage, contour farming, and grassed waterways can minimize soil losses from erosion. Surface drainage is needed for the level and nearly level soils. Lime and fertilizer are needed for crops and pasture.

These soils are poorly suited to most urban uses. Wetness, very slow permeability, and the high shrink-swell potential are the main limitations.

9. Shatta

Gently sloping, moderately well drained soils that are loamy throughout; formed in old stream deposits

In this map unit, the landscape typically has slight to moderate relief. It is long, smooth slopes on interstream divides on the uplands and broad, convex ridgetops and gentle side slopes. The heads of shallow drainageways lead from areas of this map unit to the narrow flood plains of mostly intermittent streams. Slopes range from 1 to 5 percent. Land use is a nearly equal mixture of pine forests and open areas of pasture. Small areas of openland are used as cropland or for homesites. Structures are few and are minimally visible. The degree of visual variety is moderately low. Clearcuts for timber and right-of-way for roads and utilities provide contrasting open areas in the forest.

This map unit makes up about 1 percent of the parish. It is about 74 percent Shatta soils and 26 percent soils of minor extent.

The Shatta soils have a brown very fine sandy loam surface layer and a pale brown very fine sandy loam subsurface layer. The subsoil is strong brown and yellowish brown clay loam in the upper part. It is at a depth of 32 inches. The fragipan is yellowish brown loam and clay loam.

Of minor extent are the Acadia, Gore, Guyton, and Ruston soils. The Acadia and Gore soils are in lower positions than the Shatta soils. The Acadia soils are somewhat poorly drained, and the Gore soils are moderately well drained. The Guyton soils are in drainageways and are poorly drained. The Ruston soils are in higher positions than the Shatta soils and are well drained.

The soils in this map unit are used about equally as woodland and pasture. Small acreages are used for cultivated crops or homesites.

These soils are well suited to use as woodland. The potential productivity of loblolly pine and shortleaf pine is high. These soils have few limitations for woodland use and management.

These soils are moderately well suited to cultivated crops and well suited to use as pasture. The hazard of soil erosion is a limitation in most areas, but conservation tillage, contour farming, and grassed waterways can minimize soil losses. Fertilizer and lime are generally needed for crops and pasture.

These soils are moderately well suited to most urban uses. Wetness and slow permeability are the main limitations.

10. Anacoco-Malbis

Gently sloping, somewhat poorly drained and moderately well drained soils that have a loamy surface layer and a loamy or clayey subsoil; formed in old stream and marine deposits

In this map unit, the landscape typically has slight to moderate relief. It is long, smooth slopes on interstream divides of the uplands and broad ridgetops and gentle side slopes. Slopes range from 1 to 5 percent. The heads of numerous shallow drainageways lead from areas of this map unit to the narrow flood plains of streams. Most areas of this map unit are pine forests. Small, scattered, open areas are used for pasture or homesites. Structures are few and are not prominently visible. A few clearcut corridors for utilities provide interesting open areas. The degree of visual variety is moderately low.

This map unit makes up about 4 percent of the parish. It is about 50 percent Anacoco soils, 39 percent Malbis soils, and 11 percent soils of minor extent.

The Anacoco soils are somewhat poorly drained. The surface layer is dark gray loam, and the subsurface layer is light brownish gray, mottled loam. The subsoil is light brownish gray, mottled silty clay and grayish brown, mottled clay. The substratum is light olive gray clay that has common thin strata of siltstone.

The Malbis soils are moderately well drained. The surface layer is grayish brown fine sandy loam, and the subsurface layer is yellowish brown fine sandy loam. The subsoil is brownish and yellowish loam and sandy clay loam in the upper part and mottled grayish and reddish sandy clay loam in the lower part.

Of minor extent are the Betis, Ruston, Kisatchie, Oula, and Guyton soils. The Betis and Ruston soils are on high ridgetops. The Betis soils are somewhat excessively drained, and the Ruston soils are well drained. The Kisatchie and Oula soils are on side slopes that are lower or steeper than those of the Anacoco and Malbis soils. The Kisatchie soils are well drained, and the Oula soils are moderately well drained. The Guyton soils are in narrow drainageways and are poorly drained.

The soils in this map unit are used mainly as woodland. Small acreages are used as pasture or homesites.

These soils are moderately well suited to use as woodland. The potential productivity of loblolly pine is high or moderate. Logging operations during winter and spring are limited by wet soil conditions in some areas. Erosion is a hazard along logging roads and skid trails in the more sloping areas.

The soils in this map unit are somewhat poorly suited to cultivated crops and moderately well suited to use as pasture. The main limitations are low fertility and a severe hazard of erosion. Wetness is a limitation in some areas. Lime and fertilizer are needed for crops and pasture. Conservation tillage, contour farming, and grassed waterways can minimize soil losses.

These soils are poorly suited to most urban uses. The main limitations are very slow and moderately slow permeability, wetness, and the high shrink-swell potential.

Dominantly Gently Sloping to Steep, Loamy, Sandy, and Clayey Soils; on Uplands

This group of map units consists of somewhat excessively drained to somewhat poorly drained soils that have a clayey, loamy, or sandy surface layer and a clayey, loamy, or sandy subsoil. The five map units in this group make up about 49 percent of the parish. Most areas are woodland. Soil droughtiness, susceptibility to erosion, and slope are the main limitations for most uses of these soils.

11. Bellwood-Natchitoches-Keithville

Gently sloping to strongly sloping, somewhat poorly drained, well drained, and moderately well drained soils that have a clayey or loamy surface layer and a clayey, loamy, or loamy and clayey subsoil; formed in marine deposits

In this map unit, the landscape typically has varied relief. It is dominated by narrow to broad, gently sloping ridgetops and strongly sloping side slopes on uplands. Narrow flood plains border incised, meandering, mostly intermittent streams. The landscape is dissected by a well-defined, branching drainage system. Slopes range from 1 to 12 percent. Land use is mainly woodland of pines with intermingled hardwoods. Scattered, small open areas are pasture. Narrow corridors of open space are provided by rights-of-way for utilities. Scattered, small to large clearcuts for timber also create interesting open areas. The degree of visual variety is moderate.

This map unit makes up about 8 percent of the parish. It is about 69 percent Bellwood soils, 20 percent Natchitoches soils, 9 percent Keithville soils, and 2 percent soils of minor extent.

The Bellwood soils are somewhat poorly drained and are on gently sloping ridgetops and strongly sloping side slopes. The surface layer is reddish brown silty clay loam or brown very fine sandy loam. The subsoil is yellowish red clay in the upper part; gray and light brownish gray, mottled clay in the middle part; and pale brown, mottled clay in the lower part.

The Natchitoches soils are well drained and are on gently sloping ridgetops and strongly sloping side slopes. The surface layer is dark reddish brown sandy clay loam. The subsoil is reddish brown and red, mottled clay. The substratum is yellowish brown and light olive brown, mottled clay. Greenish glauconite sand and calcium carbonate accumulations are common in the substratum.

The Keithville soils are moderately well drained and are on broad, gently sloping ridgetops. The surface layer is dark brown loam. The upper part of the subsoil is strong brown and brownish yellow mottled loam, clay loam, and sandy clay loam. The lower part is reddish and grayish, mottled clay and clay loam.

Of minor extent are the Guyton, Ruston, Sacul, and Smithdale soils. The Guyton soils are in narrow drainageways and are poorly drained. The Ruston and Sacul soils are on high ridgetops, and the Smithdale soils are on side slopes. The Ruston and Smithdale soils are well drained, and the Sacul soils are moderately well drained.

The soils in this map unit are mainly used as woodland. Small acreages are used as pasture or homesites.

The soils in this map unit are moderately well suited to use as woodland. Potential productivity of loblolly pine is high. Logging operations during winter and early in spring are limited by wet soil conditions. Erosion is a hazard along logging roads and skid trails.

These soils are somewhat poorly suited to cultivated crops and moderately well suited to use as pasture. The main limitations are low fertility and the severe hazard of erosion. Conservation tillage, contour farming, and grassed waterways can minimize soil losses. Lime and fertilizer are needed for crops and pasture.

These soils are poorly suited to most urban uses. The main limitations are very slow permeability, wetness, and high shrink-swell potential. Slope is a limitation in some areas.

12. Sacul-Keithville

Gently sloping to strongly sloping, moderately well drained soils that have a loamy surface layer and a clayey and loamy subsoil; formed in old marine deposits

In this map unit, the landscape typically has varied relief. It is dominated by broad, gently sloping ridgetops and short to long, gently sloping to strongly sloping side slopes. The landscape is dissected by a well-defined, branching drainage system. Narrow flood plains border incised, meandering, mostly intermittent streams. Slopes range from 1 to 12 percent. Land use is mainly woodland. Small to large open areas are mainly pasture. A few farm structures are visible. Narrow corridors of open space are maintained as the rights-of-way for utilities. The degree of visual variety is moderate.

This map unit makes up about 22 percent of the parish. It is about 78 percent Sacul soils, 19 percent Keithville soils, and 3 percent soils of minor extent.

The Sacul soils are on gently sloping ridgetops and gently sloping and strongly sloping side slopes. The surface layer is dark brown or dark grayish brown fine sandy loam, and the subsurface layer is brown fine sandy loam. The subsoil is red, mottled clay in the upper and middle parts and red, mottled sandy clay loam and light gray, mottled silty clay loam in the lower part. The substratum is mottled light gray and yellowish red sandy clay loam.

The Keithville soils are on broad, gently sloping ridgetops. The surface layer is dark brown loam. The subsoil is brownish and yellowish, mottled loam, clay loam, and sandy clay loam in the upper part and reddish and grayish, mottled clay and clay loam in the lower part.

Of minor extent are the Briley, Ruston, Malbis, Bellwood, Natchitoches, and Guyton soils. Briley, Ruston, and Malbis soils are on ridgetops at high elevations, and Bellwood and Natchitoches soils are on ridgetops and side slopes at lower elevations than the Keithville soils. The Briley, Ruston, and Natchitoches soils are well drained. The Malbis soils are moderately well drained, and the Bellwood soils are somewhat poorly drained. The Guyton soils are in narrow drainageways and are poorly drained.

The soils in this map unit are mainly used as woodland. They are used as pasture or homesites in some areas.

The soils in this map unit are well suited to use as woodland. The potential productivity of loblolly pine is high. Logging operations during winter and early in spring are limited by wet soil conditions. Erosion is a hazard along logging roads and skid trails.

These soils are poorly suited to cultivated crops and somewhat poorly suited to use as pasture. The main limitations are low fertility and the severe hazard of erosion. Lime and fertilizer are needed for crops and pasture. Conservation tillage, contour farming, and grassed waterways can minimize soil losses.

These soils are poorly suited to most urban uses. The main limitations are wetness, slow and very slow permeability, and the high shrink-swell potential. Slope is a limitation in some areas.

13. Kisatchie-Oula

Gently sloping to steep, well drained and moderately well drained soils that have a loamy surface layer and a clayey and loamy or clayey subsoil; formed in old marine deposits

In this map unit, the landscape typically has prominent relief. It is part of the uplands and consists of hills and ridges that have narrow, gently sloping tops that break into steep side slopes. Ledges and boulders of sandstone and siltstone bedrock are prominent features. Gullies and other barren or sparsely vegetated areas of severely eroded soils add a rugged appearance to the landscape. Slopes range from 1 to 40 percent. The landscape is deeply incised by a well-defined, branching drainage system. Perennial and intermittent streams are in winding channels on narrow flood plains. Shallow rapids or shoals are common where bedrock forms the beds of perennial streams. Boulders and cobbles are also visible on the stream beds when water levels are low. Side slopes are entirely in forest of pine or a mixture of pine and hardwoods. Ridgetops are mainly in forest, but open areas of small pastures, roadways, gardens, and homesteads are common. Farm ponds, although not numerous, are highly visible where they occur. The degree of visual variety is high. A large area of this map unit in the Kisatchie Hills has been designated a National Wilderness Area because of the interesting landscape features.

This map unit makes up about 8 percent of the parish. It is about 48 percent Kisatchie soils, 28 percent Oula soils, and 24 percent soils of minor extent.

The Kisatchie soils are well drained and are on gently sloping ridgetops and strongly sloping to steep side slopes. These soils are moderately deep to siltstone bedrock. The surface layer is dark grayish brown silt loam, dark gray fine sandy loam, or very dark grayish brown silty clay loam. The subsoil is grayish brown silty clay in the upper part, pale olive silty clay loam in the middle part, and light olive gray clay loam in the lower part. The substratum is light gray siltstone.

The Oula soils are moderately well drained and are on strongly sloping to steep side slopes. The surface layer is brown fine sandy loam. The subsoil is light brownish gray, mottled sandy clay and clay. The substratum is light brownish gray, mottled silty clay.

Of minor extent are the Anacoco, Betis, Briley, Ruston, Malbis, and Guyton soils. The Anacoco soils are somewhat poorly drained and are on plane slopes on ridgetops. The Betis, Briley, and Ruston soils are in high positions on ridgetops and upper side slopes. The Betis soils are somewhat excessively drained, and the Briley and Ruston soils are well drained. The Malbis soils are moderately well drained and are on ridgetops, and the Guyton soils are poorly drained and are in narrow drainageways.

The soils in this map unit are mainly used as woodland. Small acreages are used as pasture or homesites.

The soils in this map unit are poorly suited to use as woodland. The potential productivity of loblolly pine is low to moderately high. The main concerns in producing and harvesting timber are the equipment use limitation, high seedling mortality, and low productivity. Steep slopes, rock outcrops, and gullies limit the use of equipment. Management that minimizes the risk of erosion is essential during planting and harvesting operations.

These soils are poorly suited to cultivated crops and pasture. The main limitations are steep slopes, low fertility, rock outcrops, and a severe hazard of erosion.

These soils are poorly suited to most urban uses. The main limitations are very slow permeability, high shrink-swell potential, depth to bedrock, and steep slopes.

14. Betis-Briley

Gently sloping to moderately steep, somewhat excessively drained and well drained soils that have a sandy surface layer and a sandy or loamy subsoil; formed in old marine deposits

In this map unit, the landscape typically has varied relief. It is on uplands and is mainly broad ridgetops and long, smooth side slopes in the northeastern part of the parish and short, complex slopes, narrow ridgetops, and deeply incised streams in the southwestern part. Slopes range from 1 to 20 percent. Land use is mainly woodland of pines with intermingled hardwoods. Small open areas are pasture or cropland. Other open areas are provided by the rights-of-way of roads, electrical power lines, and pipelines. The degree of visual variety is moderately high.

This map unit makes up about 4 percent of the parish. It is about 60 percent Betis soils, 38 percent Briley soils, and 2 percent soils of minor extent.

The Betis soils are somewhat excessively drained and are on gently sloping ridgetops and gently sloping and strongly sloping side slopes. The surface layer is dark grayish brown loamy fine sand, and the subsurface layer is brown loamy fine sand. The subsoil is yellowish red loamy fine sand.

The Briley soils are well drained and are on gently sloping ridgetops and strongly sloping and moderately steep side slopes. The surface layer is dark grayish brown loamy fine sand, and the subsurface layer is light yellowish brown loamy fine sand. The subsoil is yellowish red fine sandy loam in the upper part and red sandy clay loam in the lower part.

Of minor extent are the Guyton, Kisatchie, Ruston, and Smithdale soils. The Guyton soils are in narrow drainageways and are poorly drained. The Kisatchie soils are on side slopes at a lower elevation than the Betis and Briley soils, and the Ruston and Smithdale soils are in positions similar to those of the Betis and Briley soils. These soils are well drained.

The soils in this map unit are mainly used as woodland. Small acreages are used for pasture, cultivated crops, or homesites.

The soils in this map unit are moderately well suited to use as woodland. The potential productivity of loblolly pine is high. The sandy texture hinders use of wheeled equipment, especially when the soil is very dry or saturated. Soil droughtiness increases seedling mortality.

These soils are somewhat poorly suited to cultivated crops and moderately well suited to use as pasture. Droughtiness, low fertility, and the hazard of erosion are the main limitations. Lime and fertilizer are needed for crops and pasture plants. Conservation tillage, contour farming, and grassed waterways can minimize soil losses by erosion.

These soils are moderately well suited to most urban uses. The main limitations are moderate and rapid permeability and the sandy texture. Slope is a limitation in some areas.

15. Ruston-Malbis-Smithdale

Gently sloping to moderately steep, well drained and moderately well drained soils that are loamy throughout; formed in old stream deposits

In this map unit, the landscape typically has varied relief. It is on uplands and is dominated by narrow to broad, gently sloping ridgetops and strongly sloping and moderately steep side slopes. Narrow flood plains border incised, meandering, perennial and intermittent streams. The landscape is dissected by a well-defined, branching drainage system. Slopes range from 1 to 20 percent. Land use is mainly woodland. Open areas of pasture or cropland are limited to the gently sloping ridgetops. The degree of visual variety is moderately high. Clearcuts for timber are common. Other open areas are provided by cleared rights-of-way for roads and utilities.

This map unit makes up about 7 percent of the parish. It is about 41 percent Ruston soils, 21 percent Malbis soils, 20 percent Smithdale soils, and 18 percent soils of minor extent.

The Ruston soils are well drained and are on gently sloping, convex ridgetops. The surface layer is dark grayish brown fine sandy loam, and the subsurface layer is light yellowish brown fine sandy loam. The subsoil is yellowish red sandy clay loam, loam, and sandy loam.

The Malbis soils are moderately well drained and are on gently sloping, broad ridgetops and on side slopes. The surface layer is grayish brown fine sandy loam, and the subsurface layer is yellowish brown, mottled fine sandy loam. The subsoil is strong brown, yellowish brown, and reddish yellow loam and sandy clay loam in the upper part and mottled light gray and red sandy clay loam in the lower part.

The Smithdale soils are well drained and are on strongly sloping and moderately steep side slopes. The surface layer is dark grayish brown fine sandy loam, and the subsurface layer is brown fine sandy loam. The subsoil is red sandy clay loam and sandy loam.

Of minor extent are the Betis, Briley, Guyton, and Sacul soils. The Betis and Briley soils are on ridgetops. The Betis soils are somewhat excessively drained, and the Briley soils are well drained. The Guyton soils are in narrow drainageways and are poorly drained. The Sacul soils are in positions similar to those of the Ruston and Smithdale soils and are moderately well drained.

The soils in this map unit are mainly used as woodland. In many small areas, they are used as pasture or homesites.

The soils in this map unit are well suited to use as woodland. The potential productivity of loblolly pine is high. The soils have few limitations for this use; however, management that minimizes the risk of erosion is needed.

These soils are moderately well suited to cultivated crops and well suited to use as pasture. Slope and the hazard of erosion are limitations in most areas. Conservation tillage, contour farming, and grassed waterways can minimize soil losses from erosion. Lime and fertilizer are needed for crops and pasture. Areas of the Smithdale soils are poorly suited to cultivated crops and somewhat poorly suited to pasture because of strongly sloping and moderately steep slopes and the severe hazard of erosion.

These soils are well suited to most urban uses. The main limitations are moderate and moderately slow permeability and the steepness of slope. Wetness is a limitation in areas of the Malbis soils.

Detailed Soil Map Units

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

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

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

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

Soils of one series can differ in texture of the surface layer or of the underlying material. They also can differ in slope, stoniness, salinity, wetness, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Moreland clay is one of several phases in the Moreland series.

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

A *soil complex* consists of two or more soils in such an intricate pattern or in such small areas that they cannot be shown separately on the soil maps. The pattern and proportion of the soils are somewhat similar in all areas. Kisatchie-Anacoco complex, 1 to 5 percent slopes, is an example.

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

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

Table 5 gives the acreage and proportionate extent of each map unit. Other tables (see "Summary of Tables") give properties of the soils and the limitations, capabilities, and potentials for many uses. The Glossary defines many of the terms used in describing the soils.

The boundaries of map units in Natchitoches Parish were matched, where possible, with those of the previously completed surveys of Grant, Rapids, and Red River Parishes. In a few places, however, the lines do not join, and there are differences in the names of the map units. These differences result mainly from changes in soil series concepts, differences in map unit design, and changes in soil patterns near survey area boundaries.

The soils in Natchitoches Parish were mapped at the same level of detail, except for areas of frequently flooded bottom lands in the southern part of the parish. Frequent flooding limits the use and management of these soil areas, and separating all of the soils in these areas would be of little importance to the land user.

Ac—Acadia silt loam. This soil is nearly level and somewhat poorly drained. It is on broad, slightly convex ridgetops on uplands. The areas of this soil are irregular in shape and range from 25 to 350 acres. Slopes are generally long and smooth and range from 0 to 2 percent.

Typically, the surface layer is dark grayish brown, very strongly acid silt loam about 6 inches thick. The subsurface layer to a depth of about 8 inches is light yellowish brown, very strongly acid silt loam. The subsoil extends to a depth of about 50 inches. It is yellowish brown clay loam in the upper part, light brownish gray silty clay in the middle part, and light brownish gray clay in the lower part. The subsoil is very strongly acid and is mottled throughout. The substratum to a depth of about 65 inches is light brownish gray, mottled, very strongly acid clay.

Included with this soil in mapping are a few small areas of Gore and Wrightsville soils. Also included are small areas of soils similar to the Acadia soil except that they are loamy to a depth of 30 to 40 inches. Included in drainageways are small areas of soils that are loamy throughout the profile. The Gore soils are on side slopes and are moderately well drained. The Wrightsville soils are in flat positions or depressional areas and are poorly drained. The included soils make up about 20 percent of the map unit.

This Acadia soil has low fertility and high levels of exchangeable aluminum that are potentially toxic to most crops. Water and air move through this soil at a very slow rate, and water runs off the surface slowly. The soil is wet for long periods during winter and spring. A seasonal high water table is about 0.5 foot to 1.5 feet below the soil surface from December to April. This soil has high shrink-swell potential in the subsoil. Plants are damaged by a lack of water during dry periods in summer and fall of some years.

This soil is mainly used as woodland. Small acreages are used as pasture, cropland, or homesites.

This soil is well suited to use as woodland. It has high potential for the production of loblolly pine. Other common trees are shortleaf pine, sweetgum, southern red oak, and water oak. The main concern in producing and harvesting timber is a moderate equipment use limitation because of wetness. Standard-wheeled and tracked equipment cause rutting and compaction if the soil is wet. Using low-pressure ground equipment or harvesting during drier periods reduces compaction and helps to maintain productivity.

This soil is well suited to use as habitat for woodland wildlife. Habitat can be improved by planting appropriate vegetation, by maintaining existing plant cover, or by encouraging the propagation of desirable plants. Prescribed burning every three years, rotated among several small tracts of land, can increase the amount of palatable browse for deer and seed-producing plants for quail and turkey.

This Acadia soil is well suited to use as pasture. The main limitations are low fertility and wetness. Suitable pasture plants are common bermudagrass, Pensacola bahiagrass, ball clover, and crimson clover. Annual cool-season grasses, such as ryegrass or wheat, are suitable for winter forage. Grazing when the soil is wet results in compaction of the surface layer, poor tilth, and excessive runoff. Drainage is needed in some low places. Lime and fertilizer can overcome the low fertility and promote good growth of forage plants. Proper stocking, pasture rotation, and restricted grazing during wet periods help keep the pasture and the soil in good condition.

This soil is moderately well suited to cultivated crops. It is limited mainly by wetness and low fertility. Erosion can be a hazard in more sloping areas. Suitable crops are grain sorghum, soybeans, rice, and corn. Wetness can delay planting in some years. Drainage is needed in low areas. Surface crusting is common, and good soil tilth can be somewhat difficult to maintain. Using conservation tillage and returning all crop residue to the soil or regularly adding other organic matter improve fertility and help maintain soil tilth and content of organic matter. Runoff and erosion can be reduced by plowing in fall, fertilizing, and seeding a cover crop. Most crops respond well to lime and fertilizer, which help to overcome the low fertility and reduce the levels of exchangeable aluminum in the root zone.

This soil is poorly suited to most urban uses. It has severe limitations for building sites, local roads and streets, and most sanitary facilities. because of wetness, very slow permeability, and high shrink-swell potential. In addition, low strength is a severe limitation for roads. Drainage is needed where buildings are constructed, and roads and streets should be designed to offset the limited ability of the soil to support a load. Septic tank absorption fields do not function properly during rainy periods because of wetness and very slow permeability. Lagoons or self-contained sewage disposal units can be used to dispose of sewage properly.

This Acadia soil is in capability subclass IIIw. The woodland ordination symbol is 8W.

An—Anacoco loam, 1 to 5 percent slopes. This soil is gently sloping and somewhat poorly drained. It is on slightly convex slopes on ridgetops and side slopes on the uplands. The areas of this soil are irregular in shape and range from 25 to 350 acres.

Typically, the surface layer is dark gray, very strongly acid loam about 5 inches thick. The subsurface layer to a depth of about 10 inches is light brownish gray, mottled, very strongly acid loam. The subsoil extends to a depth of about 53 inches. It is light brownish gray and grayish brown, mottled, very strongly acid silty clay and clay. The substratum to a depth of about 60 inches is light olive gray clay that has common thin strata of siltstone. In places, sandstone or siltstone bedrock is at a depth of 40 to 60 inches.

Included with this soil in mapping are a few small areas of Kisatchie, Malbis, and Oula soils. Also included are a few outcroppings of sandstone and siltstone. Kisatchie and Oula soils are on lower or more steeply sloping side slopes than the Anacoco soil. Kisatchie soils are moderately deep to bedrock, and Oula soils do not have an abrupt textural change between the surface or subsurface layer and the subsoil. Malbis soils are in higher positions on ridgetops and are loamy throughout the profile. The included soils make up about 20 percent of the map unit.

This Anacoco soil has low fertility and moderately high levels of exchangeable aluminum that are potentially toxic to some plants. Water and air move through this soil at a very slow rate, and water runs off the surface at a medium rate. A seasonal high water table is within 1 foot of the soil surface from December to April in most years. This soil has high shrink-swell potential in the subsoil. Plants are damaged by a lack of water during dry periods in summer and fall of most years.

This soil is mainly used as woodland. Small acreages are used as pasture.

This soil is moderately well suited to use as woodland. It has moderate potential for the production of loblolly pine. Other common trees are longleaf pine, shortleaf pine, and sweetgum. The main concerns in producing and harvesting timber are the moderate equipment use limitation and seedling mortality because of wetness. Conventional methods of harvesting timber generally can be used, but their use can be limited during rainy periods, generally from December to April. Management that minimizes soil compaction should be used. Roads and landings can be protected from erosion by constructing diversions and by seeding cuts and fills.

This soil is moderately well suited to use as habitat for woodland wildlife. Habitat can be improved by planting appropriate vegetation, by maintaining existing plant cover, or by encouraging the propagation of desirable plants. Prescribed burning every three years, rotated among several small tracts of land, can increase the amount of palatable browse for deer and seed-producing plants for quail and turkey.

This Anacoco soil is moderately well suited to use as pasture. The main limitations are low fertility and wetness. Suitable pasture plants are common bermudagrass, improved bermudagrass, Pensacola bahiagrass, vetch, and crimson clover. Annual cool-season grasses, such as ryegrass and wheat, are suitable for winter forage. Lime and fertilizer can overcome the low fertility and promote good growth of forage plants. Proper stocking, pasture rotation, and restricted grazing during wet periods help keep the pasture and the soil in good condition.

This soil is somewhat poorly suited to cultivated crops. It is limited mainly by low fertility, wetness, and a severe hazard of erosion. Suitable crops are soybeans and grain sorghum. Most crops respond well to lime and fertilizer, which help to overcome the low fertility and potentially toxic levels of exchangeable aluminum in the root zone. Terraces, diversions, and grassed waterways help control erosion. Using conservation tillage and returning all crop residue to the soil or regularly adding other organic matter improve fertility and help maintain soil tilth and content of organic matter.

This soil is poorly suited to urban uses. It has severe limitations for building sites, local roads and streets, and most sanitary facilities because of wetness, very slow permeability, and high shrink-swell potential. In addition, low strength is a severe limitation for roads. A seasonal high water table is perched above the clay subsoil, and drainage should be provided if buildings are constructed. Roads and streets should be designed to offset the limited ability of the soil to support a load. Septic tank absorption fields do not function properly during rainy periods because of wetness and very slow permeability. Lagoons or self-contained disposal units can be used to dispose of sewage properly.

This Anacoco soil is in capability subclass IVe. The woodland ordination symbol is 6C.

Ar—Armistead clay. This soil is level and somewhat poorly drained. It is in intermediate positions on natural levees of old distributary channels of the Red River. The areas of this soil are long and narrow and range from 20 to 500 acres. Slopes are generally long and smooth. They are 0 to 1 percent.

Typically, the surface layer is dark reddish brown, slightly acid and neutral clay about 11 inches thick. The next layer to a depth of about 21 inches is very dark gray and dark reddish gray, slightly acid and neutral silty clay loam. The subsoil extends to a depth of about 43 inches. It is reddish brown, mottled, neutral silty clay loam and silt loam in the upper part and reddish brown, moderately alkaline silty clay loam in the lower part. The substratum to a depth of about 60 inches is reddish brown, moderately alkaline clay. In places, the soil is brownish throughout the profile, and in some higher areas, the clay surface layer is less than 10 inches thick.

Included with this soil in mapping are a few small areas of Caspiana, Gallion, Latanier, and Moreland soils. The Caspiana and Gallion soils are in slightly higher positions than the Armistead soil and do not have a clayey surface layer. The Latanier and Moreland soils are in slightly lower positions and are clayey to a depth of more than 20 inches. The included soils make up about 15 percent of the map unit.

This Armistead soil has high fertility. Water and air move through the clayey upper part of this soil at a slow rate and through the loamy lower part at a moderately slow rate. Water runs off the surface slowly and stands in low places for short periods after heavy rains. The surface layer is wet for long periods in winter and spring. A seasonal high water table is about 1.5 to 3 feet below the surface from December to April. This soil has high shrink-swell potential in the surface layer and low shrink-swell potential in subsoil. The surface layer cracks when dry and seals over when wet. Adequate water is available to plants in most years.

This soil is mainly used as cropland or pasture. Soybeans is the principal crop. In a few areas, this soil is used as woodland, homesites, or for pecan orchards.

This soil is well suited to use as cropland. It is limited mainly by wetness and poor tilth. Suitable crops are cotton, soybeans, corn, wheat, and grain sorghum. This soil is sticky when wet and hard when dry and becomes cloddy if farmed when too wet or too dry. It can be worked only within a narrow range of moisture content. Returning crop residue to the soil or regularly adding other organic matter improves fertility, helps to maintain tilth, and increases water intake. Proper row arrangement, field ditches, and vegetated outlets are needed to remove excess surface water. Land grading and smoothing improve surface drainage and permit more efficient use of farm equipment. Fertilizers are generally not needed for the production of legume crops. Nonlegume crops require nitrogen fertilizer. Lime is generally not needed.

This Armistead soil is well suited to use as pasture. The main limitations are wetness and the clay surface texture. Suitable pasture plants are common bermudagrass, improved bermudagrass, dallisgrass, tall fescue, white clover, vetch, and winter peas. Annual cool-season grasses, such as ryegrass and wheat, are suitable for winter forage. Grazing when the soil is wet results in compaction of the surface layer and poor tilth. Excessive water on the surface can be removed by shallow ditches. Proper stocking, pasture rotation, and restricted grazing during wet periods help keep the pasture and the soil in good condition. Nitrogen fertilizer is needed for maximum forage production. Lime and fertilizers are generally not needed.

This soil is well suited to use as woodland; however, only a few areas remain in native hardwoods. Common trees are pecan, sugarberry, green ash, cherrybark oak, sweetgum, and water oak. The main concern in producing and harvesting timber is a moderate equipment use limitation because of wetness and the clay surface texture. Trees suitable to plant are eastern cottonwood and American sycamore. Harvesting should be done during drier periods to reduce rutting and soil compaction.

This soil is well suited to use as habitat for woodland and openland wildlife. Habitat for whitetail deer, squirrels, and many species of nongame birds and animals can be improved by planting or encouraging the growth of existing oak trees and suitable understory plants. Fence lines, ditchbanks, and abandoned farmsteads can provide excellent habitat for birds and small animals.

This soil is moderately well suited to urban uses. It has moderate limitations for building sites and local roads and streets and severe limitations for most sanitary facilities. The main limitations are wetness, slow permeability, and low strength for roads. Excess water can be removed by using shallow ditches and providing the proper grade. Septic tank absorption fields do not function properly during rainy periods because of wetness and slow permeability. Lagoons or self-contained sewage disposal units can be used to dispose of sewage properly. Roads and streets should be designed to overcome the low strength of the subsoil.

This Armistead soil is in capability subclass IIw. The woodland ordination symbol is 3W.

Ba—Beauregard silt loam, 1 to 3 percent slopes. This soil is very gently sloping and moderately well drained. It is on broad, slightly convex ridgetops on the uplands. The areas of this soil are broad and range from 20 to 500 acres. Slopes are long and smooth.

Typically, the surface layer is very dark gray, medium acid silt loam about 5 inches thick. The subsurface layer to a depth of about 10 inches is dark grayish brown, strongly acid silt loam. The subsoil extends to a depth of about 60 inches. It is yellowish brown, mottled, strongly acid silt loam in the upper part; light brownish gray, mottled, strongly acid silty clay loam in the middle part; and light gray, mottled, strongly acid silty clay loam in the lower part. Red nodules of plinthite are common in the middle and lower parts of the subsoil. In places, the surface layer is fine sandy loam.

Included with this soil in mapping are a few small areas of Caddo, Guyton, and Malbis soils. The Caddo and Guyton soils are in lower, more nearly flat positions than the Beauregard soil and are grayish throughout the profile. Malbis soils are in slightly higher positions on convex ridgetops and side slopes and have more sand in the subsoil. The included soils make up about 15 percent of the map unit.

This Beauregard soil has low fertility and high levels of exchangeable aluminum that are potentially toxic to most crops. Water and air move through this soil slowly, and water runs off the surface at a slow to medium rate. The surface layer remains wet for relatively long periods in winter and spring. A seasonal high water table is about 1.5 to 3 feet below the surface from December to March. The shrink-swell potential is low. Plants generally are damaged by a lack of water during dry periods in summer and fall of most years.

This soil is mainly used as woodland or pasture. In a few areas, it is used as cropland or homesites.

This soil is well suited to use as woodland. It has high potential to produce loblolly, shortleaf, and longleaf pines. Other trees common in the area include sweetgum, white oak, southern red oak, and water oak. The main concern in producing and harvesting timber is a moderate equipment use limitation because of wetness. Standard-wheeled and tracked equipment cause rutting and compaction when the soil is wet. Using low-pressure ground equipment or harvesting during drier periods reduces damage to the soil and helps to maintain productivity. Reforestation after harvesting must be carefully managed to reduce competition from undesirable understory plants.

This soil is well suited to use as habitat for woodland wildlife. Habitat can be improved by planting appropriate vegetation, by maintaining existing plant cover, or by encouraging the propagation of desirable plants. Prescribed burning every three years, rotated among several small tracts of land, can increase the amount of palatable browse for deer and seed-producing plants for quail and turkey.

This Beauregard soil is well suited to use as pasture. The main limitations are wetness and low fertility. Suitable pasture plants are common bermudagrass, improved bermudagrass, Pensacola bahiagrass, white clover, and winter peas. Annual cool-season grasses, such as ryegrass or wheat, are suitable for winter forage. Grazing when the soil is wet results in puddling of the surface layer. Drainage is needed in low places. Lime and fertilizer can overcome the low fertility and promote good growth of forage plants. Proper stocking, pasture rotation, and restricted grazing during wet periods help keep the pasture and the soil in good condition.

This soil is well suited to most cultivated crops. The main soil limitations are wetness, low fertility, and the hazard of erosion. Suitable crops are corn, grain sorghum, wheat, cotton, and soybeans. This soil is friable and easy to keep in good tilth. Excessive cultivation can result in the formation of a tillage pan. This pan can be broken by subsoiling when the soil is dry. Wetness can delay planting in some areas. Drainage is needed in low areas. Crop residue on or near the surface helps to conserve moisture, maintain tilth, and control erosion. Runoff and erosion can be reduced by fertilizing and seeding a cover crop in the fall. Tillage should be on the contour or across the slope. Most crops respond well to lime and fertilizer, which help to overcome the low fertility and reduce the high levels of exchangeable aluminum in the root zone.

This soil is moderately well suited to urban uses. It has moderate limitations for building sites and local roads and streets and severe limitations for most sanitary facilities. The main limitations are wetness, slow permeability, and low strength for roads. Shallow ditches are needed to remove excess water in low areas. Septic tank absorption fields do not function properly during rainy periods because of wetness and slow permeability. Lagoons or self-contained sewage disposal units can be used to dispose of sewage properly. Roads and streets should be designed to overcome the limited ability of the soil to support a load.

This Beauregard soil is in capability subclass IIe. The woodland ordination symbol is 9W.

Bc—Bellwood clay, 1 to 5 percent slopes. This soil is gently sloping and somewhat poorly drained. It is on convex ridgetops and side slopes on the uplands. The areas of this soil are irregular in shape and range from 15 to 550 acres. Slopes are generally long and smooth, but some are short and complex.

Typically, the surface layer is reddish brown, very strongly acid silty clay loam about 1 inch thick. The subsoil to a depth of about 60 inches is yellowish red, extremely acid clay in the upper part; gray and light brownish gray, mottled, extremely acid clay in the middle part; and pale brown, mottled, extremely acid clay in the lower part. In places, the surface layer is silt loam, fine sandy loam, or very fine sandy loam.

Included with this soil in mapping are a few small areas of Keithville, Natchitoches, Sacul, and Ruston soils. Also included are small areas of soils similar to the Bellwood soil except that they are calcareous to the surface. These areas of calcareous soils are identified by a special symbol on the soil maps. Keithville and Ruston soils are in slightly higher positions than the Bellwood soil and are loamy in the upper part of the subsoil. The Natchitoches soils are well drained, and the Sacul soils are moderately well drained. These soils are in positions similar to those of the Bellwood soil and do not have intersecting slickensides in the subsoil. The included soils make up about 20 percent of the map unit.

This Bellwood soil has low fertility and high levels of exchangeable aluminum that are potentially toxic to most crops. Water runs off the surface at a medium rate, and water and air move through this soil very slowly. A seasonal high water table is about 2 to 4 feet below the soil surface from December to April. The soil has high shrink-swell potential in the subsoil. Plants generally are damaged by a lack of water during dry periods in summer and fall of most years.

This soil is mainly used as woodland. Small acreages are used as pasture or homesites.

This soil is moderately well suited to use as woodland. The site index for loblolly pine is about 78. Common trees are loblolly pine, shortleaf pine, white oak, and southern red oak. The main concerns in producing and harvesting timber are a severe equipment use limitation because of the clayey surface layer and a moderate erosion hazard because of the slope and slow water intake rate of the soil. Conventional methods of harvesting timber generally can be used, but their use may be limited during rainy periods, generally from December to April. Logging roads require suitable surfacing for year-round use. Roads and landings can be protected from erosion by constructing diversions and by seeding cuts and fills. Reforestation, after harvesting, must be carefully managed to reduce competition from undesirable understory plants. Competing vegetation can be controlled by proper site preparation and by spraying, cutting, or girdling to eliminate unwanted weeds, brush, or trees.

This soil is well suited to use as habitat for woodland wildlife. Habitat can be improved by planting appropriate vegetation, by maintaining existing plant cover, or by encouraging the propagation of desirable plants. Prescribed burning every three years, rotated among several small tracts of land, can increase the amount of palatable browse for deer and seed-producing plants for quail and turkey.

This Bellwood soil is moderately well suited to use as pasture. The main limitations are low fertility and a severe erosion hazard during establishment of pasture grasses. Suitable pasture plants are common bermudagrass, improved bermudagrass, Pensacola bahiagrass, and crimson clover. Annual cool-season grasses, such as ryegrass or wheat, are suitable for winter forage. Fertilizer and lime are needed for optimum growth of grasses and legumes. Seedbed preparation should be on the contour or across the slope where practical. Proper stocking, pasture rotation, and restricted grazing during wet periods help keep the pasture and the soil in good condition.

This soil is somewhat poorly suited to cultivated crops. It is limited mainly by low fertility, poor tilth, and a severe erosion hazard. Close-sown crops, such as small grains, are the most suitable to plant, but soybeans and grain sorghum are suitable crops if soil conserving practices are used. Early fall seeding, conservation tillage, terraces, diversions, and grassed waterways help control erosion. All tillage should be on the contour or across the slope. Most crops respond well to lime and fertilizer, which help to overcome the low fertility and reduce the high levels of exchangeable aluminum in the root zone.

This soil is poorly suited to use as homesites. It has severe limitations for building sites, local roads and streets, and most sanitary facilities because of very slow permeability, wetness, and high shrink-swell potential. In addition, low strength is a severe limitation for roads. If buildings are constructed on this soil, structural damage as a result of shrinking and swelling of the soil can be prevented by properly designing foundations and footings and by diverting runoff from buildings. Septic tank absorption fields do not function properly during rainy periods because of wetness and very slow permeability. Lagoons or self-contained sewage disposal units can be used to dispose of sewage properly. Roads and streets should be designed to overcome the limited load-supporting capacity of the subsoil.

This Bellwood soil is in capability subclass IVe. The woodland ordination symbol is 8C.

Bd—Bellwood clay, 5 to 12 percent slopes. This soil is strongly sloping and somewhat poorly drained. It is on side slopes on the uplands. Well-defined drainageways cross most areas. The areas of this soil are irregular in shape and range from 20 to 500 acres. Slopes are generally short and complex.

Typically, the surface layer is brown, very strongly acid very fine sandy loam about 2 inches thick. The subsoil to a depth of about 60 inches is red, extremely acid clay in the upper part and light brownish gray, mottled, extremely acid clay in the lower part. In places, the surface layer is silty clay loam, fine sandy loam, or silt loam, and it can be as much as 10 inches thick.

Included with this soil in mapping are a few small areas of Guyton, Keithville, Natchitoches, and Sacul soils. Also included are small areas of soils similar to the Bellwood soil except that they are calcareous to the surface. These areas of calcareous soils are identified by a special symbol on the soil map. The Guyton soils are poorly drained and are grayish and loamy throughout the profile. They are in drainageways. Keithville soils are on narrow ridgetops and are loamy in the upper part of the subsoil. The Natchitoches soils are well drained, and the Sacul soils are moderately well drained. These soils are in positions similar to those of the Bellwood soil and do not have intersecting slickensides in the subsoil. The included soils make up about 20 percent of the map unit.

This Bellwood soil has low fertility and high levels of exchangeable aluminum that are potentially toxic to most crops. Water runs off the surface at a rapid rate, and water and air move through this soil very slowly. A seasonal high water table is about 2 to 4 feet below the soil surface from December to April. This soil has high shrink-swell potential in the subsoil. Plants generally are damaged by a lack of water during dry periods in summer and fall of most years.

This soil is used mainly as woodland. Small acreages are used as pasture or homesites.

This soil is moderately well suited to use as woodland. The site index for loblolly pine is about 78. Common trees are loblolly pine, shortleaf pine, white oak, and southern red oak. The main concerns in producing and harvesting timber are a severe equipment use limitation because of the clayey surface layer and a moderate erosion hazard because of the slope. Management that minimizes the risk of erosion is essential in harvesting timber. Harvesting during dry seasons and locating skid trails, log landings, and haul roads properly and within limiting grades can reduce erosion. Roads and landings can be protected from erosion by constructing diversions and by seeding cuts and fills. Conventional methods of harvesting timber generally can be used, but their use may be limited during rainy periods, generally from December to April. Logging roads require suitable surfacing for year-round use. Reforestation, after harvesting, must be carefully managed to reduce competition from undesirable understory plants. Competing vegetation can be controlled by proper site preparation and by spraying, cutting, or girdling to eliminate unwanted weeds, brush, or trees.

This soil is well suited to use as habitat for woodland wildlife. Habitat can be improved by planting appropriate vegetation, by maintaining existing plant cover, or by encouraging the propagation of desirable plants. Prescribed burning every three years, rotated among several small tracts of land, can increase the amount of palatable browse for deer and seed-producing plants for quail and turkey.

This Bellwood soil is somewhat poorly suited to use as pasture. The main limitations are low fertility and a severe erosion hazard during the establishment of pasture grasses. Suitable pasture plants are common bermudagrass, Pensacola bahiagrass, and crimson clover. Annual cool-season grasses, such as ryegrass or wheat, are suitable for winter forage. Fertilizer and lime are needed for optimum growth of grasses and legumes. Seedbed preparation should be on the contour or across the slope where practical. Proper stocking, pasture rotation, and restricted grazing during wet periods help keep the pasture and the soil in good condition.

This soil is poorly suited to cultivated crops. It is limited mainly by a severe erosion hazard, low soil fertility, and short, irregular slopes. Close-sown crops, such as small grains, are suitable. The irregular slopes and drainageways limit the use of equipment. Conservation tillage, terraces, diversions, and grassed waterways help control erosion. Most crops respond well to lime and fertilizer, which help to overcome the low fertility and reduce the high levels of exchangeable aluminum in the root zone.

This soil is poorly suited to urban uses. It has severe limitations for building sites, local roads and streets, and most sanitary facilities because of slope, very slow permeability, wetness, and high shrink-swell potential. In addition, low strength is a severe limitation for roads, and erosion is a hazard in the steeper areas. Only the part of the site used for construction should be disturbed. Roads and streets can be designed to overcome the limited ability of the soil to support a load. Septic tank absorption fields do not function properly because of wetness and very slow permeability. Properly designed lagoons or self-contained sewage disposal units can be used to dispose of sewage properly.

This Bellwood soil is in capability subclass VIe. The woodland ordination symbol is 8C.

Be—Betis loamy fine sand, 1 to 5 percent slopes. This soil is gently sloping and somewhat excessively drained. It is on ridgetops and upper side slopes on the uplands. The areas of this soil are irregular in shape and range from 10 to several hundred acres.

Typically, the surface layer is dark grayish brown, strongly acid loamy fine sand about 9 inches thick. The subsurface layer to a depth of about 34 inches is brown, medium acid loamy fine sand. The subsoil to a depth of about 60 inches is yellowish red, strongly acid loamy fine sand.

Included with this soil in mapping are a few small areas of Briley and Ruston soils. Also included are small areas of Betis soils that have slopes of more than 5 percent. Briley and Ruston soils are in positions similar to those of the Betis soil, and they have a loamy subsoil. The included soils make up about 20 percent of the map unit.

This Betis soil has low fertility. Water and air move through this soil at a rapid rate, and water runs off the surface very slowly. The shrink-swell potential is low. Plants generally are damaged by a lack of water during dry periods in summer and fall of most years.

This soil is mainly used as woodland. In a few areas, it is used as pasture, cropland, or homesites.

This soil is moderately well suited to use as woodland. The site index for loblolly pine is about 80. Other common trees are shortleaf pine, longleaf pine, white oak, and southern red oak. The main concerns in producing and harvesting timber are a moderate equipment use limitation and seedling mortality because of the sandy surface layer and droughtiness. The sandy surface layer hinders the use of wheeled equipment, especially when the soil is saturated or very dry. The low available water capacity generally reduces seedling survival, especially in areas where understory plants are numerous. Proper site preparation controls initial plant competition, and spraying controls subsequent growth. Roads and landings can be protected from erosion by constructing diversions and by seeding cuts and fills.

This soil is moderately well suited to use as habitat for woodland wildlife. Habitat can be improved by planting appropriate vegetation, by maintaining existing plant cover, or by encouraging the propagation of desirable plants. Prescribed burning every three years, rotated among several small tracts of land, can increase the amount of palatable browse for deer and seed-producing plants for quail and turkey.

This Betis soil is moderately well suited to use as pasture. The main limitations are droughtiness and low soil fertility. Suitable pasture plants are improved bermudagrass, Pensacola bahiagrass, weeping lovegrass, and crimson clover. The low available water capacity of the soil limits the production of forage. Adding lime and fertilizer can overcome the low fertility and promote good growth of forage plants. Proper stocking and pasture rotation help keep the pasture in good condition.

This soil is somewhat poorly suited to most cultivated crops. It is limited mainly by low fertility, droughtiness, and poor trafficability. Soybeans, wheat, and grain sorghum are the main crops grown, but watermelons, peanuts, and other vegetables are also suitable crops. Crop residue on or near the surface helps to conserve moisture, maintain tilth, and control erosion. Tillage should be done when the soil is moist and should be on the contour or across the slope. Most crops respond well to fertilizer, and lime is generally needed.

This soil is moderately well suited to urban uses. It has slight limitations for building sites and roads and severe limitations for most sanitary facilities. The main limitations are rapid permeability and the sandy texture. Because this soil has rapid permeability, effluent from onsite sewage disposal systems may seep at points downslope. If the density of housing is moderate to high, community sewage systems are needed to prevent contamination of water supplies as a result of seepage. Selection of adapted vegetation is critical for the establishment of lawns, shrubs, trees, and vegetable gardens. Plants that tolerate droughtiness should be selected if irrigation is not provided.

This Betis soil is in capability subclass IIIs. The woodland ordination symbol is 7S.

Bf—Betis loamy fine sand, 5 to 12 percent slopes. This soil is strongly sloping and somewhat excessively drained. It is on side slopes on the uplands. Well-defined drainageways cross most areas of this soil. The areas of this soil are irregular in shape and range from 20 to 300 acres. Slopes are generally short and complex.

Typically, the surface layer is dark grayish brown, very strongly acid loamy fine sand about 7 inches thick. The subsurface layer is brown, very strongly acid loamy fine sand about 22 inches thick. The subsoil to a depth of about 60 inches is yellowish red, very strongly acid loamy fine sand.

Included with this soil in mapping are a few small areas of Briley, Guyton, Kisatchie, and Smithdale soils. Also included are small areas of Betis soils that have slopes of more than 12 percent. The Briley and Smithdale soils are in positions similar to those of the Betis soil and have a loamy subsoil. The Guyton soils are in drainageways. They are poorly drained and are loamy throughout the profile. The Kisatchie soils are on lower side slopes and have a clayey subsoil. The included soils make up about 20 percent of the map unit.

This Betis soil has low fertility. Water and air move through this soil at a rapid rate, and water runs off the surface very slowly. The shrink-swell potential is low. Plants generally are damaged by a lack of water for long periods in summer and fall of most years.

This soil is mainly used as woodland. In a few areas, it is used as pasture or homesites.

This soil is moderately well suited to use as woodland. The site index for loblolly pine is about 80. Other common trees are shortleaf pine, longleaf pine, white oak, and southern red oak. The main concerns in producing and harvesting timber are a moderate equipment use limitation and seedling mortality because of the sandy soil texture and droughtiness. The sandy surface layer hinders the use of wheeled equipment, especially when the soil is saturated or very dry. The low available water capacity generally reduces seedling survival, especially in areas where understory plants are numerous. Proper site preparation controls initial plant competition, and spraying controls subsequent growth. Skid trails and firebreaks are subject to rilling and gullying unless adequate water bars are constructed or the soil is protected by plant cover.

This soil is moderately well suited to use as habitat for woodland wildlife. Habitat can be improved by planting appropriate vegetation, by maintaining existing plant cover, or by encouraging the propagation of desirable plants. Prescribed burning every three years, rotated among several small tracts of land, can increase the amount of palatable browse for deer and seed-producing plants for quail and turkey.

This Betis soil is moderately well suited to use as pasture. The main limitations are droughtiness and low fertility. Suitable pasture plants are improved bermudagrass, crimson clover, Pensacola bahiagrass, and weeping lovegrass. The low available water capacity of the soil limits the production of forage. Lime and fertilizer can overcome the low fertility and promote growth of forage plants. Proper stocking and pasture rotation help keep the pasture in good condition.

This soil is poorly suited to most cultivated crops. It is limited mainly by droughtiness, low fertility, and a severe hazard of erosion. Suitable crops are soybeans, grain sorghum, watermelons, and peanuts. Conservation tillage, diversions, and grassed waterways help control erosion. In places, the short, irregular slopes can limit the use of equipment. Most crops respond well to fertilizer, and lime is generally needed.

This soil is somewhat poorly suited to urban uses. The main limitations are rapid permeability, slope, and the sandy texture. Because the soil is rapidly permeable, effluent from onsite sewage disposal systems can seep at points downslope. Lined sewage lagoons or community sewage disposal systems are needed to prevent contamination of water supplies as a result of seepage. Because erosion is a hazard in the steeper areas, only the part of the site that is used for construction should be disturbed. Cutbanks cave easily where shallow excavations are constructed.

This Betis soil is in capability subclass VIe. The woodland ordination symbol is 7S.

Bn—Bienville loamy fine sand, 1 to 5 percent slopes. This soil is gently sloping and somewhat excessively drained. It is on low stream terraces. The areas of this soil range from 15 to 600 acres.

Typically, the surface layer is dark brown, very strongly acid loamy fine sand about 12 inches thick. The subsurface layer is yellowish brown, extremely acid loamy fine sand to a depth of about 24 inches. The subsoil to a depth of 60 inches is strong brown, extremely acid loamy fine sand. In some places, the subsoil is grayish brown or light brownish gray. In other places, gravelly material is in the subsoil below a depth of 50 inches.

Included with this soil in mapping are a few small areas of Cahaba, Guyton, and Lotus soils. Also included are small areas of Bienville soils that are subject to rare flooding. Cahaba soils are in positions similar to those of Bienville soil, and they contain more clay in the subsoil. The Guyton soils are in lower positions. They are poorly drained and are loamy throughout the profile. Lotus soils are on natural levees of streams and have a seasonal high water table within 3 feet of the soil surface. The included soils make up about 20 percent of the map unit.

This Bienville soil has low fertility and a high level of exchangeable aluminum that is potentially toxic to most crops. Water runs off the surface slowly, and water and air move through this soil at a moderately rapid rate. A seasonal high water table is about 4 to 6 feet below the soil surface from December to April. The shrink-swell potential is low. Plants generally are damaged by a lack of water for long periods in summer and fall of most years.

This soil is mainly used as woodland. Small acreages are used as pasture, cropland, or homesites. A few very small areas are mined for sand and gravel.

This soil is well suited to use as woodland. It has high production potential for loblolly pine. The site index for loblolly pine is about 96. Other common trees are shortleaf pine, longleaf pine, white oak, water oak, and southern red oak. The main concerns in producing and harvesting timber are a moderate equipment use limitation and seedling mortality because of the sandy texture and soil droughtiness. The sandy surface layer hinders use of wheeled equipment, especially when the soil is saturated or very dry. The low available water capacity of the soil generally reduces seedling survival, especially in areas where understory plants are numerous. Proper site preparation controls initial plant competition, and spraying controls subsequent growth.

This soil is moderately well suited to use as habitat for woodland wildlife. Habitat can be improved by planting appropriate vegetation, by maintaining existing plant cover, or by encouraging the propagation of desirable plants. Prescribed burning every three years, rotated among several small tracts of land, can increase the amount of palatable browse for deer and seed-producing plants for quail and turkey.

This Bienville soil is moderately well suited to use as pasture. The main limitations are low fertility and droughtiness. Suitable pasture plants are improved bermudagrass, Pensacola bahiagrass, weeping lovegrass, and crimson clover. Fertilizer and lime are needed for optimum growth of grasses and legumes. Proper stocking and pasture rotation help keep the pasture in good condition.

This soil is moderately well suited to most cultivated crops. It is limited mainly by low fertility and droughtiness, and erosion is a hazard in the more sloping areas. Suitable crops are corn, grain sorghum, wheat, peanuts, watermelons, and soybeans. This soil is friable and easy to keep in good tilth. It can be worked throughout a wide range of moisture content. Crop residue on or near the surface helps to conserve moisture, maintain tilth, and control erosion. All tillage should be on the contour or across the slope. Most crops respond well to lime and fertilizer, which help to overcome the low fertility and reduce the levels of exchangeable aluminum in the root zone.

This soil is moderately well suited to urban uses. It has slight limitations for building sites and local roads and streets and moderate to severe limitations for most sanitary facilities. The main limitations are moderately rapid permeability and the sandy texture. During the rainy season, effluent from onsite sewage disposal systems may seep at points downslope. Lined sewage lagoons or community sewage systems may be needed to prevent contamination of water supplies as a result of seepage. Where shallow excavations are constructed, the cutbanks cave easily. Selection of adapted vegetation is critical for the establishment of lawns, shrubs, trees, and vegetable gardens. Plants that tolerate droughtiness should be selected if irrigation is not provided.

This Bienville soil is in capability subclass IIIs. The woodland ordination symbol is 10S.

Br—Briley loamy fine sand, 1 to 5 percent slopes. This soil is gently sloping and well drained. It is on convex ridgetops on the uplands. The areas of this soil are irregular in shape and range from 15 to 200 acres.

Typically, the surface layer is dark grayish brown, strongly acid loamy fine sand about 8 inches thick. The subsurface layer is light yellowish brown, strongly acid loamy fine sand to a depth of about 20 inches. The subsoil to a depth of about 60 inches is yellowish red, medium acid fine sandy loam in the upper part and red, strongly acid sandy clay loam in the lower part.

Included with this soil in mapping are a few small areas of Betis, Kisatchie, and Ruston soils. The Betis and Ruston soils are in positions similar to those of the Briley soil. The Betis soils are sandy throughout the profile, and the Ruston soils are loamy throughout. The Kisatchie soils are on ridgetops and side slopes at a lower elevation than the Briley soil, and they have a clayey subsoil. The included soils make up about 20 percent of the map unit.

This Briley soil has low fertility. Water runs off the surface slowly, and water and air move through this soil at a moderate rate. This soil dries out quickly and is droughty. The shrink-swell potential is low. Plants generally are damaged by a lack of water during dry periods in summer and fall of most years.

This soil is mainly used as woodland. Small acreages are used as cropland, pasture, or homesites.

This soil is well suited to use as woodland. The site index for loblolly pine is about 80. Other common trees are shortleaf pine, longleaf pine, hickory, white oak, and southern red oak. The main concerns in producing and harvesting timber are a moderate equipment use limitation because of the sandy soil texture and moderate seedling mortality because of soil droughtiness. The sandy texture of the surface layer hinders use of wheeled equipment, especially when the soil is saturated or very dry. The low available water capacity generally reduces seedling survival, especially in areas where understory plants are numerous. Proper site preparation can control initial plant competition, and spraying will control subsequent growth. Roads and landings can be protected from erosion by constructing diversions and by seeding cuts and fills.

This soil is well suited to use as habitat for woodland wildlife. Habitat can be improved by planting appropriate vegetation, by maintaining existing plant cover, or by encouraging propagation of desirable plants. Prescribed burning every three years, rotated among several small tracts of land, can increase the amount of palatable browse for deer and seed-producing plants for quail and turkey.

This Briley soil is moderately well suited to use as pasture. The main limitations are low fertility and soil droughtiness. Suitable pasture plants are improved bermudagrass, Pensacola bahiagrass, weeping lovegrass, and crimson clover. Fertilizer and lime are needed for optimum growth of grasses and legumes. Proper stocking and pasture rotation help keep the pasture in good condition.

This soil is moderately well suited to most cultivated crops. It is limited mainly by low fertility and soil droughtiness, and soil erosion is a hazard in the more sloping areas. Truck crops, such as peas, peanuts, and watermelons, are the most suitable crops, but cotton, corn, wheat, and soybeans are also suitable. This soil is friable and easy to keep in good tilth. Because trafficability is poor when this sandy soil is dry, all tillage should be done when the soil is moist and should be on the contour or across the slope. Crop residue on or near the surface helps to conserve moisture, maintain tilth, and control erosion. Most crops respond well to lime and fertilizer.

This soil is moderately well suited to urban development. It has slight limitations for buildings and local roads and streets and slight to severe limitations for sanitary facilities. The main limitation for sanitary facilities is seepage, especially where sewage lagoons are constructed. However, septic tank absorption fields can adequately dispose of sewage effluent. Sewage lagoons need to be lined with impervious material to prevent seepage. Selection of adapted vegetation is critical for the establishment of lawns, shrubs, trees, and vegetable gardens. Plants that can tolerate soil droughtiness should be selected if irrigation is not provided.

This Briley soil is in capability subclass IIIe. The woodland ordination symbol is 8S.

Bt—Briley loamy fine sand, 5 to 12 percent slopes. This soil is strongly sloping and well drained. It is on side slopes on the uplands. Well-defined drainageways cross most areas of this soil. The areas of this soil are irregular in shape and range from 20 to 160 acres. Slopes are generally short and complex.

Typically, the surface layer is dark grayish brown, strongly acid loamy fine sand about 9 inches thick. The subsurface layer is yellowish brown, strongly acid loamy fine sand to a depth of about 28 inches. The subsoil to a depth of about 60 inches is yellowish red, strongly acid fine sandy loam in the upper part and red, strongly acid sandy clay loam in the lower part.

Included with this soil in mapping are a few small areas of Betis, Guyton, Kisatchie, Sacul, and Smithdale soils. Also included are small areas of Briley soils that have slopes of more than 12 percent. The Betis, Sacul, and Smithdale soils are in positions similar to those of the Briley soil. The Betis soils are sandy throughout the profile. The Sacul soils have a clayey subsoil, and the Smithdale soils are loamy throughout. Guyton soils are in drainageways and are grayish and loamy throughout. The Kisatchie soils are on side slopes at a lower elevation than the Briley soil, and they have a clayey subsoil. The included soils make up about 20 percent of the map unit.

This Briley soil has low fertility. Water and air move through this soil at a moderate rate, and water runs off the surface slowly. This soil dries out quickly and is droughty. The shrink-swell potential is low. Plants generally are damaged by a lack of water during dry periods in summer and fall of most years.

This soil is mainly used as woodland. Small acreages are used as pasture or homesites.

This soil is well suited to use as woodland. It has moderately high production potential for loblolly pine. The site index for loblolly pine is about 80. Other common trees are shortleaf pine, longleaf pine, hickory, white oak, and southern red oak. The main concerns in producing and harvesting timber are a moderate equipment use limitation because of the sandy soil surface and moderate seedling mortality because of soil droughtiness. Soil erosion is also a concern. The sandy surface layer is loose when dry and hinders the use of most wheeled equipment. The low available water capacity reduces seedling survival in areas where understory plants are numerous. Proper site preparation can control initial plant competition, and spraying will control subsequent growth. Management that minimizes the risk of erosion is essential in harvesting timber. Skid trails and firebreaks are subject to rilling and gullying unless adequate water bars are constructed or the soil is protected by plant cover.

This soil is well suited to use as habitat for woodland wildlife. Habitat can be improved by planting appropriate vegetation, by maintaining existing plant cover, or by encouraging the propagation of desirable plants. Prescribed burning every three years, rotated among several small tracts of land, can increase the amount of palatable browse for deer and seed-producing plants for quail and turkey.

This Briley soil is moderately well suited to use as pasture. The main soil limitations are droughtiness and low fertility, and soil erosion is a hazard. Suitable pasture plants are improved bermudagrass, Pensacola bahiagrass, weeping lovegrass, and crimson clover. Low available water capacity limits the production of most plants suitable for pasture. Fertilizer and lime are needed for optimum growth of grasses and legumes. Proper stocking and pasture rotation help keep the pasture in good condition.

This soil is somewhat poorly suited to cultivated crops. It is limited mainly by low fertility, droughtiness, and a severe hazard of erosion. Truck crops, such as peas, peanuts, and watermelons, are the most suitable crops, but cotton, corn, wheat, grain sorghum, and soybeans can also be grown. Conservation tillage, terraces, diversions, and grassed waterways can control soil erosion. All tillage should be done when the soil is moist and should be on the contour or across the slope. Crop residue on or near the surface helps to conserve moisture, maintain tilth, and control erosion. Most crops respond well to lime and fertilizer.

This soil is moderately well suited to urban development. It has moderate limitations for buildings and local roads and streets, and moderate to severe limitations for most sanitary facilities. The main limitations are steepness of slope, moderate permeability, and the sandy texture. Septic tank absorption fields can adequately dispose of sewage effluent if absorption lines are placed on the contour. Seepage and slope are limitations to constructing sanitary facilities, such as sewage lagoons and sanitary land fills. Excavations for buildings and roads increase the hazard of erosion. Revegetating disturbed areas around construction sites as soon as possible helps to control soil erosion. Selection of adapted vegetation is critical for the establishment of lawns, shrubs, and trees. Plants that can tolerate droughtiness should be selected if irrigation is not provided.

This Briley soil is in capability subclass IVe. The woodland ordination symbol is 8S.

By—Briley loamy fine sand, 12 to 20 percent slopes. This soil is moderately steep and well drained. It is on side slopes on the uplands. Well-defined drainageways cross most areas of this soil. The areas of this soil are irregular in shape and range from 20 to 100 acres.

Typically, the surface layer is dark grayish brown, strongly acid loamy fine sand about 6 inches thick. The subsurface layer is brown, strongly acid loamy fine sand to a depth of about 22 inches. The subsoil to a depth of about 60 inches is yellowish red, strongly acid fine sandy loam in the upper part and yellowish red, strongly acid sandy clay loam in the lower part.

Included with this soil in mapping are a few small areas of Betis, Guyton, Kisatchie, Sacul, and Smithdale soils. Also included are small areas of Briley soils that have slopes of less than 12 percent or more than 20 percent. The Betis, Sacul, and Smithdale soils are in positions similar to those of the Briley soil. The Betis soils are sandy throughout the profile. Sacul soils have a clayey subsoil, and Smithdale soils are loamy throughout. Guyton soils are in drainageways and are grayish and loamy throughout. The Kisatchie soils are on side slopes at a lower elevation than the Briley soil, and they have a clayey subsoil. The included soils make up about 20 percent of the map unit.

This Briley soil has low fertility. Water and air move through the soil at a moderate rate, and water runs off the surface slowly. This soil dries quickly after rains and is droughty. The shrink-swell potential is low. Plants generally are damaged by a lack of water during dry periods in summer and fall of most years.

This soil is mainly used as woodland. Small acreages are used as pasture.

This soil is moderately well suited to use as woodland. It has moderately high production potential for loblolly pine. The site index for loblolly pine is about 80. Other common trees are shortleaf pine, longleaf pine, hickory, white oak, and southern red oak. The main concerns in producing and harvesting timber are moderately steep slopes, the sandy surface layer, droughtiness, and a severe hazard of erosion. Conventional methods of harvesting trees can be used in the more gently sloping areas but are difficult to use in the steeper areas. The sandy texture hinders the use of wheeled equipment, especially when the soil is saturated or very dry. Locating skid trails and haul roads on the contour or across the slopes can reduce erosion. The low available water capacity of the soil generally reduces seedling survival in areas where understory plants are numerous. Proper site preparation can control initial plant competition, and spraying will control subsequent growth.

This soil is well suited to use as habitat for woodland wildlife. Habitat can be improved by planting appropriate vegetation, by maintaining existing plant cover, or by encouraging the propagation of desirable plants. Prescribed burning every three years, rotated among several small tracts of land, can increase the amount of palatable browse for deer and seed-producing plants for quail and turkey.

This Briley soil is somewhat poorly suited to use as pasture. The main limitations are steepness of slope, low fertility, and droughtiness. Soil erosion is a hazard during establishment of pasture grasses. Suitable pasture plants are improved bermudagrass, Pensacola bahiagrass, weeping lovegrass, and crimson clover. The low available water capacity of the soil limits the production of most plants suitable for pasture. Fertilizer and lime are needed for optimum production of forage. Proper stocking and pasture rotation help keep the pasture in good condition.

This soil is generally not suited to cultivated crops because of the moderately steep slopes and the severe hazard of erosion. Other soil limitations are low fertility and droughtiness.

This soil is poorly suited to urban uses. It has severe limitations for buildings, local roads and streets, and most sanitary facilities because of the moderately steep slope and the severe hazard of erosion. The steepness of slope is a concern in installing septic tank absorption fields. Absorption lines should be installed on the contour to prevent seepage of effluent in downslope areas. To reduce soil losses from erosion, access roads should be designed to provide a minimum cut-slope grade. Revegetating disturbed areas around construction sites as soon as possible also helps to control soil erosion. Selection of adapted vegetation is critical for the establishment of lawns, shrubs, and trees. Plants that can tolerate droughtiness should be selected if irrigation is not provided.

This Briley soil is in capability subclass VIe. The woodland ordination symbol is 8S.

Ca—Caddo very fine sandy loam. This soil is level and poorly drained. It is on broad flats on the uplands. The areas of this soil are broad and range from 25 to 350 acres. Slopes are less than 1 percent.

Typically, the surface layer is grayish brown, strongly acid very fine sandy loam about 4 inches thick. The subsurface layer is light brownish gray, mottled, strongly acid very fine sandy loam to a depth of about 26 inches. The subsoil to a depth of about 60 inches is gray, mottled, medium acid and strongly acid silty clay loam.

Included with this soil in mapping are a few small areas of Beauregard, Guyton, and Malbis soils. Also included are small areas of moderately well drained, loamy soils on low, rounded mounds. Beauregard and Malbis soils are in higher, more convex positions than the Caddo soil and contain more than 5 percent plinthite in the subsoil. Guyton soils are in slightly concave positions and do not have red mottles or plinthite in the subsoil. The included soils make up about 20 percent of the map unit.

This Caddo soil has low fertility and high levels of exchangeable aluminum that are potentially toxic to most crops. Water runs off the surface slowly and stands in low places for short periods after heavy rains. Water and air move through this soil slowly. The soil remains wet for long periods during the winter and spring. A seasonal high water table is within 2 feet of the soil surface from December to April in most years. The shrink-swell potential is low. Plants are damaged by a lack of water during dry periods in summer and fall of most years.

This soil is mainly used as woodland. Small acreages are used as pasture, cropland, or homesites.

This soil is well suited to use as woodland. It has high production potential for loblolly pine and southern hardwoods. Common trees are loblolly pine, shortleaf pine, sweetgum, water oak, and willow oak. The main concern in producing and harvesting timber is wetness. Standard-wheeled and tracked equipment cause rutting and compaction if the soil is wet. Using low-pressure ground equipment or harvesting during drier periods reduces damage to the soil and helps to maintain productivity. Seedling mortality can be reduced by providing drainage or by planting seedlings on bedded rows.

This soil is well suited to use as habitat for woodland and wetland wildlife. Habitat for wetland wildlife can be improved by constructing shallow ponds to provide open water areas for waterfowl and furbearing animals, such as muskrat, nutria, and otter. Habitat for woodland wildlife can be improved by planting appropriate vegetation, by maintaining existing plant cover, or by encouraging propagation of desirable plants. Prescribed burning every three years, rotated among several small tracts of land, can increase the amount of palatable browse for deer and seed-producing plants for quail and turkey.

This Caddo soil is well suited to use as pasture. The main limitations are low fertility and wetness. Suitable pasture plants are common bermudagrass, Pensacola bahiagrass, white clover, vetch, and winter peas. Annual cool-season grasses, such as ryegrass and wheat, are suitable for winter forage. Grazing when the soil is wet results in puddling of the soil surface layer. Excessive water on the surface can be removed by shallow ditches. Lime and fertilizer can overcome the low fertility and promote good growth of forage plants. Proper stocking, pasture rotation, and restricted grazing during wet periods help keep the pasture and the soil in good condition.

This soil is moderately well suited to most cultivated crops. It is limited mainly by low fertility and wetness. Droughtiness late in summer is an additional problem. Suitable crops are grain sorghum, rice, corn, and soybeans. A surface crust may form in areas that are clean tilled. Returning crop residue to the soil or regularly adding other organic matter improves fertility, reduces crusting, and increases the water intake rate. A drainage system is needed for most cultivated crops and pasture plants. Most crops respond well to lime and fertilizer, which help to overcome the low fertility and reduce the level of exchangeable aluminum in the root zone.

This soil is poorly suited to urban uses. It has severe limitations for building sites, local roads and streets, and most sanitary facilities mainly because of wetness. Drainage is needed if roads and building foundations are constructed. Slow permeability and the high water table increase the possibility of failure of septic tank absorption fields. Lagoons or self-contained sewage disposal units can be used to dispose of sewage properly. Roads should be designed to offset the limited ability of the soil to support a load.

This Caddo soil is in capability subclass IIIw. The woodland ordination symbol is 9W.

Cb—Cahaba fine sandy loam, 1 to 5 percent slopes. This soil is gently sloping and well drained. It is on convex slopes on low stream terraces. The areas of this soil are broad and range from 15 to 300 acres.

Typically, the surface layer is dark brown, slightly acid fine sandy loam about 8 inches thick. The subsurface layer is yellowish brown and yellowish red, slightly acid sandy loam to a depth of about 16 inches. The subsoil to a depth of about 48 inches is red, slightly acid sandy clay loam in the upper part and yellowish red, very strongly acid loam in the lower part. The substratum to a depth of about 66 inches is strong brown, extremely acid fine sandy loam. In places, the substratum between depths of 50 and 60 inches is gravelly sand or gravelly sandy loam.

Included with this soil in mapping are a few small areas of Bienville and Guyton soils. Also included are small areas of Cahaba soils that are subject to rare flooding. Bienville soils are in positions similar to those of the Cahaba soil, and they are sandy throughout the profile. The Guyton soils are in low positions. They are poorly drained and are grayish throughout the profile. The included soils make up about 20 percent of the map unit.

This Cahaba soil has low fertility and moderately high levels of exchangeable aluminum that are potentially toxic to some plants. Water and air move through this soil at a moderate rate, and water runs off the surface at a medium rate. This soil dries quickly after rains. The shrink-swell potential is low. Plants are damaged by a lack of water during dry periods in summer and fall of some years.

This soil is mainly used as woodland. Small acreages are used as pasture, cropland, or homesites. A few small areas are used as sources of gravelly material for roadfill.

This soil is well suited to use as woodland. It has high production potential for pines and hardwoods. Common trees are longleaf pine, shortleaf pine, loblolly pine, sweetgum, southern red oak, hickory, and white oak. This soil has a few limitations for timber production. Reforestation, after harvesting, must be carefully managed to reduce competition from undesirable understory plants. If site preparation is not adequate, competition from undesirable plants can prevent or prolong natural or artificial reestablishment of trees. Competing vegetation can be controlled by proper site preparation and by spraying, cutting, or girdling to eliminate unwanted weeds, brush, or trees.

This soil is well suited to use as habitat for woodland wildlife. Habitat can be improved by planting appropriate vegetation, by maintaining existing plant cover, or by encouraging the propagation of desirable plants. Prescribed burning every three years, rotated among several small tracts of land, can increase the amount of palatable browse for deer and seed-producing plants for quail and turkey.

This Cahaba soil is well suited to use as pasture. The main limitation is low fertility. Suitable pasture plants are common bermudagrass, improved bermudagrass, Pensacola bahiagrass, and crimson clover. Annual cool-season grasses, such as ryegrass and wheat, are suitable for winter forage. Lime and fertilizer can overcome the low fertility and promote good growth of forage plants. Proper stocking, pasture rotation, and restricted grazing during wet periods help keep the pasture and the soil in good condition.

This soil is well suited to cultivated crops; however, it is limited by low fertility and a moderate hazard of erosion. The main crops are cotton, corn, and soybeans. Grain sorghum and wheat are also suitable crops. This soil is friable and easy to keep in good tilth. It can be worked throughout a wide range of moisture content. Crop residue management, stripcropping, contour farming, and terraces reduce soil loss by erosion. Most crops respond well to lime and fertilizer, which help to overcome the low fertility and reduce the level of exchangeable aluminum in the root zone.

This soil is well suited to urban development. It has few limitations for building sites. Seepage can be a problem with sanitary facilities, such as sewage lagoons and sanitary landfills. Where shallow excavations are constructed, the cutbanks are subject to caving.

This Cahaba soil is in capability subclass IIe. The woodland ordination symbol is 9A.

Cn—Caspiana silty clay loam. This soil is level and well drained. It is on old natural levees of former channels and distributaries of the Red River. The areas of this soil are long and narrow and range from 25 to 500 acres. Slope is generally less than 1 percent.

Typically, the surface layer is dark brown and very dark gray, neutral silty clay loam about 12 inches thick. The subsoil to a depth of about 48 inches is very dark gray, mottled, neutral silty clay loam in the upper part; reddish brown, mildly alkaline silty clay loam in the middle part; and yellowish red, moderately alkaline silt loam in the lower part. The substratum to a depth of about 60 inches is yellowish red, moderately alkaline silt loam. In places, the surface layer is silt loam.

Included with this soil in mapping are a few small areas of Armistead, Gallion, and Moreland soils. Armistead soils are in slightly lower positions than the Caspiana soil and have a clayey surface layer about 10 to 20 inches thick. Gallion soils are in high positions on the natural levees and do not have a dark color surface layer. Moreland soils are in lower positions and are clayey throughout the profile. The included soils make up about 20 percent of the map unit.

This Caspiana soil has high fertility. Water runs off the surface slowly, and water and air move through this soil at a moderate rate. A seasonal high water table is about 4 to 6 feet below the surface from December to April. The surface layer is sticky when wet and dries slowly once wetted. The shrink-swell potential is moderate. Adequate water is available to plants in most years.

This soil is mainly used as cropland or pasture. In a few areas, it is used as homesites.

This soil is well suited to cultivated crops. The level slopes and high fertility are favorable features. Suitable crops are cotton, soybeans, corn, wheat, and grain sorghum. This soil is somewhat difficult to keep in good tilth because of the silty clay loam surface texture. Proper row arrangement, field ditches, and vegetated outlets are needed to remove excess surface water. Traffic pans develop easily, but these can be broken up by deep plowing or chiseling. Maintaining crop residue on or near the surface reduces runoff and helps to maintain soil tilth and organic matter content. Most crops respond well to fertilizer. Lime is generally not needed.

This soil is well suited to use as pasture and has few limitations for this use. Suitable pasture plants are common bermudagrass, improved bermudagrass, Pensacola bahiagrass, tall fescue, and white clover. Annual cool-season grasses, such as ryegrass and wheat, are suitable for winter forage. Shallow ditches can be used to drain low areas. Proper stocking, pasture rotation, and restricted grazing during wet periods help keep the pasture and the soil in good condition. Nitrogen fertilizer is needed for maximum forage production. Lime and other fertilizers are generally not needed.

This Caspiana soil is well suited to use as woodland; however, only a few small areas remain in native hardwoods. Native trees on this soil include pecan, sweetgum, eastern cottonwood, sugarberry, and water oak. This soil has few limitations for commercial timber production. Suitable trees to plant are eastern cottonwood, sweetgum, and American sycamore.

This soil is well suited to use as habitat for woodland and openland wildlife. Habitat for whitetail deer, squirrels, and many species of nongame birds and animals can be improved by planting or encouraging the growth of existing oak trees and suitable understory plants. Fence lines, ditchbanks, and abandoned building sites provide excellent cover and nesting areas for birds and small animals if the vegetation in these areas is allowed to grow naturally.

This soil is well suited to urban development; however, it has moderate limitations for building sites, local roads and streets, and most sanitary facilities. The main limitations are wetness, moderate permeability, low strength for roads, and moderate shrink-swell potential. Excess water on the surface can be removed by using shallow ditches and by providing the proper grade. Septic tank absorption fields do not function properly during rainy periods because of wetness and the moderate soil permeability. These limitations can be overcome by increasing the length of the absorption lines. The effects of shrinking and swelling can be minimized by using proper engineering designs. Roads should be designed to offset the limited ability of this soil to support a load.

This Caspiana soil is in capability subclass IIw. The woodland ordination symbol is 10A.

Ga—Gallion silt loam. This soil is level and well drained. It is in high positions on natural levees of former channels and distributaries of the Red River. The areas of this soil are long and narrow and range from 5 to 800 acres. Slopes are generally less than 1 percent.

Typically, the surface layer is brown, strongly acid silt loam about 8 inches thick. The subsoil to a depth of about 53 inches is yellowish red, slightly acid silt loam and loam. The substratum to a depth of 71 inches is yellowish red and strong brown, slightly acid and neutral very fine sandy loam. In places, the surface layer is calcareous.

Included with this soil in mapping are a few small areas of Armistead, Caspiana, and Latanier soils. Also included are small areas of Gallion soils that have a silty clay loam surface layer and Gallion soils that have slopes of more than 1 percent. Armistead and Latanier soils are in lower positions than the Gallion soil and are clayey in the upper part of the profile. Caspiana soils are in slightly lower positions and have a dark color surface layer. The included soils make up about 15 percent of the map unit.

This Gallion soil has medium fertility. Water runs off the surface slowly, and water and air move through this soil at a moderate rate. This soil dries quickly after rains. The shrink-swell potential is moderate. Adequate water is available to plants in most years.

This soil is mainly used as cropland (fig. 1). In a few areas, it is used as pasture or homesites.

This soil is well suited to most cultivated crops. The level slopes and medium fertility are favorable features for this use. The main crops are cotton, soybeans, corn, wheat, and grain sorghum. This soil is friable and easy to keep in good tilth. It can be worked throughout a wide range of moisture content; however, excessive cultivation can result in the formation of a tillage pan. This pan can be broken by subsoiling when the soil is dry. Grading and smoothing the land and aligning crop rows with the slope can remove excess water. Returning crop residue to the soil or regularly adding other organic matter improves fertility, reduces crusting, and increases the water intake rate. Most crops respond well to fertilizer. Lime is generally not needed.

This soil is well suited to use as pasture. The level slopes and medium fertility are favorable soil features. Suitable pasture plants are common bermudagrass, improved bermudagrass, Pensacola bahiagrass, tall fescue, white clover, and winter peas. Annual cool-season grasses, such as ryegrass and wheat, are suitable for winter forage. Proper stocking, pasture rotation, and restricted grazing during wet periods help keep the pasture and soil in good condition. Fertilizer is needed for optimum growth of grasses and legumes. Lime is generally not needed.

The soil is well suited to use as woodland; however, only a few small areas remain in native hardwoods. Native trees include pecan, sweetgum, American sycamore, eastern cottonwood, and sugarberry. The soil has few limitations for commercial timber production. Trees that are suitable for planting include eastern cottonwood and American sycamore.

This soil is well suited to use as habitat for woodland and openland wildlife. Habitat for whitetail deer, squirrels, and many species of nongame birds and animals can be improved by planting or encouraging the growth of existing oak trees and suitable understory plants. Fence

Figure 1.—Gallion silt loam is used mainly for cultivated crops. The soil in the background is Bellwood clay, 5 to 12 percent slopes. It is used as pasture.

lines, ditchbanks, and abandoned building sites provide excellent cover and nesting areas for birds and small animals if the vegetation in these areas is allowed to grow naturally.

This soil is moderately well suited to urban uses. It has moderate limitations for building sites and most sanitary facilities because of moderate permeability and moderate shrink-swell potential. Low soil strength is a limitation for local roads and streets. Septic tank absorption fields may not function properly during rainy periods because of the moderate permeability. This limitation can be overcome by increasing the length of the absorption lines. The effects of shrinking and swelling can be minimized by using proper engineering designs. Roads should be designed to offset the limited ability of this soil to support a load.

This Gallion soil is in capability class I. The woodland ordination symbol is 9A.

Gn—Gallion silty clay loam. This soil is level and well drained. It is in intermediate positions on natural levees of former channels and distributaries of the Red River. The areas of this soil are long and narrow and range from 5 to 500 acres. Slopes are generally less than 1 percent.

Typically, the surface layer is reddish brown, medium acid silty clay loam about 7 inches thick. The subsoil to a depth of about 44 inches is yellowish red, medium acid silt loam in the upper part and yellowish red, slightly acid silt loam in the lower part. The substratum to a depth of about 60 inches is yellowish red, neutral silt loam. In some low areas, the surface layer is clay or silty clay. In other areas, the surface layer and upper part of the subsoil are calcareous.

Included with this soil in mapping are a few small areas of Armistead, Caspiana, and Latanier soils. Also included are a few small areas of Gallion silt loam. The Armistead and Latanier soils are in slightly lower positions than the Gallion soil, and they are clayey in the upper part of the profile. Caspiana soils are in slightly lower positions and have a dark color surface layer. The included soils make up about 15 percent of the map unit.

This Gallion soil has medium fertility. Water runs off the surface slowly, and water and air move through the soil at a moderate rate. The surface layer is sticky when wet and dries slowly once wetted. The shrink-swell potential is moderate. Adequate water is available to plants in most years.

This soil is mainly used as cropland or pasture. In a few areas, it is used as homesites.

This soil is well suited to cultivated crops; however, it is limited by wetness. Suitable crops are cotton, soybeans, corn, wheat, and grain sorghum. The silty clay loam surface layer is somewhat difficult to keep in good tilth. It becomes cloddy if worked when it is too wet or too dry. Grading and smoothing the land and aligning crop rows with the slope can remove excess water that accumulates after heavy rains. Shallow field ditches are needed to drain low areas. Traffic pans develop easily, but these can be broken up by deep plowing. Maintaining crop residue on or near the surface reduces runoff and helps to maintain soil tilth and organic matter content. Most crops respond well to fertilizer. Lime is generally not needed.

This soil is well suited to use as pasture and has few limitations for this use. Suitable pasture plants are common bermudagrass, improved bermudagrass, tall fescue, Pensacola bahiagrass, white clover, and winter peas. Annual grasses, such as ryegrass or wheat, are suitable for winter forage. Shallow ditches are needed to drain low areas. Proper stocking, pasture rotation, and restricted grazing during wet periods help keep the pasture and the soil in good condition. Fertilizer is needed for optimum growth of grasses and legumes. Lime is generally not needed.

This Gallion soil is well suited to use as woodland; however, only a few small areas remain in native hardwoods. Native trees include pecan, sweetgum, eastern cottonwood, sugarberry, and water oak. This soil has few limitations for commercial timber production. Trees that are suitable for planting include eastern cottonwood and American sycamore.

This soil is well suited to use as habitat for woodland and openland wildlife. Habitat for whitetail deer, squirrels, and many species of nongame birds and animals can be improved by planting or encouraging the growth of existing oak trees and suitable understory plants. Fence lines, ditchbanks, and abandoned homesites provide excellent cover and nesting areas for birds and small animals if the vegetation in these areas is allowed to grow naturally.

This soil is moderately well suited to urban uses. It has moderate limitations for building sites and most sanitary facilities because of moderate permeability and moderate shrink-swell potential. Low strength is a limitation for roads. Excess water on the surface can be removed by using shallow ditches and by providing the proper grade. Septic tank absorption fields may not function properly during rainy periods because of the moderate permeability. This limitation can be overcome by increasing the length of the absorption lines. The effects of shrinking and swelling can be minimized by using proper engineering designs. Roads should be designed to offset the limited ability of this soil to support a load.

This Gallion soil is in capability subclass IIw. The woodland ordination symbol is 9A.

Gr—Gore silt loam, 1 to 5 percent slopes. This soil is gently sloping and moderately well drained. It is on convex ridgetops and side slopes on the uplands. The areas of this soil are irregular in shape and range from about 10 to 350 acres. Slopes are generally short and smooth. Well-defined drainageways cross most areas of this soil.

Typically, the surface layer is dark brown, strongly acid silt loam about 4 inches thick. The next layer is reddish yellow, mottled, strongly acid silt loam to a depth of about 8 inches. The subsoil to a depth of 45 inches is yellowish red, strongly acid clay in the upper part; light brownish gray, mottled, very strongly acid clay in the middle part; and red, mottled, very strongly acid clay in the lower part. The substratum to a depth of about 60 inches is yellowish red, mottled, medium acid clay.

Included with this soil in mapping are a few small areas of Acadia and Morse soils. Also included are small areas of loamy soils in high positions on ridgetops. Acadia soils are in higher positions than the Gore soil and are brownish and grayish throughout the profile. Morse soils are on lower and more steeply sloping side slopes and are calcareous to the surface. The included soils make up about 20 percent of the map unit.

This Gore soil has low fertility and moderately high levels of exchangeable aluminum that are potentially toxic to some crops. Water and air move through this soil very slowly, and water runs off the surface at a medium rate. The surface layer is friable, but it becomes somewhat difficult to keep in good tilth where cultivation has mixed some of the clayey subsoil into the plow layer. This soil has high shrink-swell potential. Plants generally are damaged by a lack of water during dry periods in summer and fall of most years.

This soil is mainly used as woodland or pasture. Small acreages are used as homesites or for cultivated crops.

This soil is moderately well suited to use as woodland. It has moderately high production potential for hardwoods and pines. Common trees are loblolly pine, shortleaf pine, sweetgum, white oak, post oak, and southern red oak. The site index for loblolly pine is about 76. The main concern in producing and harvesting timber is the moderate equipment use limitation caused by the clayey subsoil. Because the subsoil is sticky when wet, most planting and harvesting equipment should be used only during dry periods. Using low pressure ground equipment during rainy periods reduces rutting and compaction of the soil and helps to maintain productivity. Roads and landings can be protected from erosion by constructing diversions and by seeding cuts and fills. Reforestation, after harvesting, must be carefully managed to reduce competition from undesirable understory plants. Competing vegetation can be controlled by proper site preparation and by spraying, cutting, or girdling to eliminate unwanted weeds, brush, or trees.

The soil is moderately well suited to use as habitat for woodland wildlife. Habitat can be improved by planting appropriate vegetation, by maintaining existing plant cover, or by promoting the natural establishment of desirable plants. Prescribed burning every three years, rotated among several small tracts of land, can increase the amount of palatable browse for deer and seed-producing plants for quail and turkey.

This Gore soil is moderately well suited to to use as pasture. The main limitations are the hazard of erosion and low fertility. Suitable pasture plants are common bermudagrass, improved bermudagrass, Pensacola bahiagrass, and crimson clover. Annual grasses, such as ryegrass and wheat, are suitable for winter forage. Lime and fertilizer can overcome the low fertility and promote good growth of forage plants. Proper stocking and pasture rotation help keep the pasture in good condition.

This soil is somewhat poorly suited to most cultivated crops because of the severe hazard of erosion and low fertility. Suitable crops are grain sorghum and soybeans. Crop residue management, contour farming, grassed waterways, and terraces reduce runoff and soil erosion. Most crops respond well to lime and fertilizer, which help to overcome the low fertility and reduce the level of exchangeable aluminum in the root zone.

This soil is poorly suited to urban development. It has severe limitations for building sites, local roads and streets, and most sanitary facilities. The main limitations are the very slow permeability, high shrink-swell potential, and low strength for roads. Septic tank absorption fields do not function properly during rainy periods because of the very slow permeability. Lagoons or self-contained sewage disposal units can be used to dispose of sewage properly. If buildings are constructed on this soil, structural damage as a result of shrinking and swelling can be prevented by properly designing foundations and footings and by diverting runoff from buildings. Roads and streets should be designed to compensate for the poor load-supporting capacity and instability of the subsoil.

This Gore soil is in capability subclass IVe. The woodland ordination symbol is 7C.

Gt—Guyton silt loam. This soil is level and poorly drained. It is on broad flats on low stream terraces. The areas of this soil are broad and range from 30 to 350 acres. Slopes are less than 1 percent.

Typically, the surface layer is dark grayish brown, very strongly acid silt loam about 6 inches thick. The subsurface layer is light brownish gray, mottled, strongly acid silt loam to a depth of about 18 inches. The subsoil to a depth of about 60 inches is light brownish gray, mottled, very strongly acid silt loam in the upper part; gray, mottled, strongly acid silty clay loam in the middle part; and grayish brown, mottled, very strongly acid silty clay loam in the lower part.

Included with this soil in mapping are a few small areas of Beauregard, Caddo, and Cahaba soils. Also included are small areas of moderately well drained, loamy soils on low, rounded mounds. The Beauregard and Cahaba soils are in slightly higher and more convex positions than the Guyton soil. Beauregard soils are moderately well drained and have a brownish subsoil, and Cahaba soils are well drained and have a reddish subsoil. Caddo soils have slightly more convex slopes than the Guyton soil and have red mottles and plinthite in the subsoil. The included soils make up about 15 percent of the map unit.

This Guyton soil has low fertility and moderately high levels of exchangeable aluminum that are potentially toxic to some crops. Water and air move through this soil at a slow rate. Water runs off the surface slowly and stands in low places for long periods after heavy rains. The soil is subject to rare flooding during unusually wet conditions. Flooding occurs about one time each 10 years during anytime of the year. A seasonal high water table is within 1.5 feet of the soil surface from December to May in most years. The shrink-swell potential is low. Plants generally are damaged by lack of water during the summer and fall of most years.

This soil is mainly used as woodland. Small acreages are used as cropland or pasture.

This soil is well suited to use as woodland. It has high production potential for hardwood and pine trees. Common trees are loblolly pine, shortleaf pine, water oak, sweetgum, willow oak, and swamp chestnut oak. The main concerns in producing and harvesting timber are a severe equipment use limitation and moderate seedling mortality because of wetness. Standard-wheeled and tracked equipment cause rutting and compaction when the soil is wet. Using low-pressured ground equipment or harvesting during drier periods reduces damage to the soil and helps to maintain productivity. Seedling mortality can be reduced by providing drainage or by planting seedlings on bedded rows. Reforestation, after harvesting, must be carefully managed to reduce competition from undesirable understory plants. Competing vegetation can be controlled by proper site preparation and by spraying, cutting, or girdling to eliminate unwanted weeds, brush, or trees.

This soil is moderately well suited to use as habitat for woodland wildlife and well suited as habitat for wetland wildlife. Habitat for wetland wildlife can be improved by constructing shallow ponds to provide open water areas for waterfowl and furbearing animals, such as muskrat, nutria, and otter. Habitat for other wildlife can be improved by planting appropriate vegetation, by maintaining existing plant cover, or by encouraging the propagation of desirable plants.

This Guyton soil is well suited to use as pasture; however, wetness and low fertility are limitations. Suitable pasture plants are common bermudagrass, Pensacola bahiagrass, white clover, vetch, and winter peas. Surface drainage can remove excess surface water from low areas. Wetness limits the choice of plants and the period of grazing. Proper stocking, pasture rotation, and restricted grazing during wet periods help keep the pasture and the soil in good condition. Lime and fertilizer can improve soil fertility and promote good growth of forage plants.

The soil is moderately well suited to cultivated crops. It is limited mainly by low fertility, wetness in spring, and droughtiness in summer. Suitable crops are grain sorghum, corn, rice, and soybeans. A drainage system is needed for most cultivated crops. A surface crust forms easily after tillage. Returning crop residue to the soil or regularly adding other organic matter improves fertility, reduces crusting, and increases the water intake rate. Most crops respond well to lime and fertilizer, which help to overcome the low fertility and reduce the levels of exchangeable aluminum in the root zone. Where water of suitable quality is available, supplemental irrigation can prevent damage to crops that results during dry periods of most years.

This soil is poorly suited to urban development. It has severe limitations for building sites, local roads and streets, and most sanitary facilities because of wetness and the hazard of flooding. Drainage is needed if roads and building foundations are constructed. Buildings can be placed on pilings or mounds to elevate them above the expected flood level. Slow permeability and the high water table increase the possibility of failure of septic tank absorption fields. Properly designed lagoons or self-contained sewage disposal units can be used to dispose of sewage properly.

This Guyton soil is in capability subclass IIIw. The woodland ordination symbol is 9W.

Gy—Guyton silt loam, frequently flooded. This soil is level and poorly drained. It is on flood plains of streams that drain the uplands. It is subject to frequent flooding. The areas of this soil are long and narrow and range from 10 to 1,000 acres. Slopes are less than 1 percent.

Typically, the surface layer is dark grayish brown, very strongly acid silt loam about 4 inches thick. The subsurface layer is grayish brown and light brownish gray, mottled, very strongly acid silt loam to a depth of about 19 inches. The subsoil to a depth of about 60 inches is gray, mottled, very strongly acid silty clay loam in the upper part; grayish brown, mottled, very strongly acid silty clay loam in the middle part; and light brownish gray, mottled, very strongly acid clay loam in the lower part. In places, the surface layer is fine sandy loam.

Included with this soil in mapping are a few small areas of Bienville, Cahaba, and Lotus soils. Also included are moderately well drained, loamy soils on natural levees of streams. The Bienville and Cahaba soils are on low terraces adjacent to and within the flood plain. Bienville soils are somewhat excessively drained, and Cahaba soils are well drained. The Lotus soils are on natural levees adjacent to stream channels and are sandy throughout the profile. The included soils make up about 20 percent of the map unit.

This Guyton soil has low fertility and moderately high levels of exchangeable aluminum that are potentially toxic to some crops. Water and air move through this soil at a slow rate, and water runs off the surface slowly. A seasonal high water table is within 1.5 feet of the soil surface from December to May in most years. This soil is flooded for very brief to long periods. Flooding occurs more often than twice in 5 years during anytime of the year. Floodwaters typically are 2 to 5 feet deep, but the depth exceeds 10 feet in places. The shrink-swell potential is low. Plants are damaged by a lack of water during dry periods in summer and fall of some years.

This soil is mainly used as woodland. In a few areas, it is used as pasture or cropland.

This soil is moderately well suited to use as woodland. Common trees in areas of this soil are loblolly pine, shortleaf pine, water oak, sweetgum, willow oak, and swamp chestnut oak. The potential production of loblolly pine is high. The main concerns in producing and harvesting timber are a severe equipment use limitation and high seedling mortality because of wetness and frequent flooding. Trafficability is poor when the soil is wet. Using low-pressure ground equipment or harvesting during drier periods reduces rutting and soil compaction and helps to maintain productivity. Seedling mortality can be reduced by providing drainage or by planting seedlings on bedded rows. Trees should be water-tolerant, and they should be planted or harvested during dry periods. Reforestation, after harvesting, must be carefully managed to reduce competition from undesirable understory plants.

This soil is moderately well suited to use as habitat for woodland wildlife and well suited as habitat for wetland wildlife. Habitat can be improved by planting appropriate vegetation, by maintaining existing plant cover, or by encouraging the propagation of desirable plants. Habitat for wetland wildlife can be improved by constructing shallow ponds to provide open water areas for waterfowl and furbearing animals, such as muskrat, nutria, and otter.

This Guyton soil is poorly suited to use as pasture because of frequent flooding, low fertility, and wetness. The main suitable pasture plant is common bermudagrass. Frequent flooding and wetness limit the choice of pasture plants and the period of grazing. Proper stocking, pasture rotation, and restricted grazing during wet periods help keep the pasture and the soil in good condition. It is generally not practical to apply high rates of fertilizer or lime because of the hazard of frequent overflow.

This soil is poorly suited to cultivated crops because of low fertility, wetness, and frequent flooding. Planting dates are delayed and crops are damaged by floods in most years. If this soil is protected from flooding and if drainage is provided, most climatically adapted crops can be grown.

This soil is poorly suited to most urban uses and is generally not suited to use as homesites. The soil has severe limitations for building sites, local roads and streets, and most sanitary facilities because of frequent flooding and wetness. Ring levees, pumps, and other water control systems can control flooding and remove excess water. Buildings can be placed on pilings or mounds to elevate them above the expected flood level.

This Guyton soil is in capability subclass Vw. The woodland ordination symbol is 9W.

GZ—Guyton-Lotus association, frequently flooded. The Guyton and Lotus soils are on flood plains of streams that drain the uplands. Guyton soils are poorly drained, and the Lotus soils are moderately well drained to somewhat poorly drained. These soils are subject to frequent flooding. This map unit is entirely in one long and narrow delineation of several thousand acres. It is crossed by several perennial streams and many intermittent drainageways. Slopes are generally less than 1 percent but range to 3 percent along drainageways.

The composition of this association varies somewhat between the upstream and downstream end of the mapped area. Most areas contain about 50 percent Guyton soil and 30 percent Lotus soil. The soils are in a regular and repeating pattern on the flood plain. The Guyton soil is in low, flat areas, and the Lotus soil is on convex natural levees adjacent to stream channels.

Fewer observations were made in this map unit than in other areas because the hazard of frequent flooding is a major limitation to the use and management of these soils. For this reason, separation of the soils would be of little value to the land user. The detail in mapping, however, is adequate for the expected use of the soils.

The soils in this association are subject to very brief to long periods of flooding. Floodwaters typically are 2 to 5 feet deep, but the depth can exceed 10 feet in places. Flooding is generally by fast-flowing water and lasts from a few hours to several days. It occurs more often than twice in 5 years and at anytime during the year.

Typically, the Guyton soil has a dark grayish brown, strongly acid silt loam surface layer about 4 inches thick. The subsurface layer is light brownish gray, mottled, very strongly acid silt loam about 14 inches thick. The subsoil to a depth of about 60 inches is gray, mottled, very strongly acid silty clay loam in the upper and middle parts and grayish brown, mottled, very strongly acid silty clay loam in the lower part. Tongues of light brownish gray silt loam extend through the upper part of the subsoil. In places, the surface layer is fine sandy loam or loamy fine sand.

This Guyton soil has low fertility and moderately high levels of exchangeable aluminum that are potentially toxic to some crops. Water and air move through this soil slowly. Water runs off the surface at a slow rate and stands in low areas for long periods after heavy rains. A seasonal high water table is within 1.5 feet of the soil surface from December to May in most years. The shrink-swell potential is low. Plants are damaged by a lack of water during dry periods in summer and fall of some years.

Typically, the Lotus soil has a grayish brown, slightly acid sand surface layer about 2 inches thick. The next layer is light brownish gray, medium acid sand to a depth of about 10 inches. Below that to a depth of about 65 inches are buried soil horizons of grayish brown, strongly acid sand; light brownish gray, mottled, strongly acid loamy sand; and light gray, mottled, very strongly acid loamy sand.

The Lotus soil has low fertility. Water and air move through this soil at a rapid rate, and water runs off the surface slowly. A seasonal high water table is 1.5 to 3 feet below the soil surface from December to April. The soil dries quickly after rains. The shrink-swell potential is low. Plants generally are damaged by a lack of water during dry periods in summer and fall of most years.

Included with these soils in mapping are a few small areas of Bienville and Cahaba soils. Also included are moderately well drained, loamy soils on natural levees. The Bienville and Cahaba soils are on low terraces adjacent to and within the flood plain. Bienville soils are somewhat excessively drained, and Cahaba soils are well drained. The included soils make up about 20 percent of the map unit.

The Guyton and Lotus soils are mainly used as woodland. A few acres are used as pasture.

The soils in this association are moderately well suited to the production of hardwood and pine trees. Common trees include loblolly pine, shortleaf pine, water oak, sweetgum, willow oak, and swamp chestnut oak. The potential production of loblolly pine and water oak is high. The main concerns in producing and harvesting timber are equipment use limitations and high seedling mortality because of wetness and frequent flooding. Conventional methods of harvesting timber generally can be used, but their use may be limited during rainy periods, generally from December through April. Standard-wheeled and tracked vehicles cause rutting and soil compaction, especially in areas of the Guyton soil. Using low-pressure ground equipment reduces damage to the soil and helps to maintain productivity. Trafficability is poor on the Lotus soil when it is saturated or very dry. Logging roads require suitable surfacing for year-round use. Tree seedlings have a low rate of survival because of frequent flooding and wetness in spring and soil droughtiness in summer. Seedling survival can be improved on the Guyton soil by planting on bedded rows. Reforestation, after harvesting, must be carefully managed to reduce competition from undesirable understory plants. Site preparation, such as chopping, burning, herbicide application, and bedding, should reduce debris and immediate plant competition and facilitate mechanical planting.

These soils are moderately well suited to use as habitat for woodland wildlife. The Guyton soil is well suited to use as habitat for wetland wildlife, and the Lotus soil is poorly suited. Habitat can be improved by planting appropriate vegetation, by maintaining existing plant cover, or by encouraging the propagation of desirable plants. Habitat for wetland wildlife can be improved by constructing shallow ponds in the Guyton soil to provide open water areas for waterfowl and furbearing animals, such as muskrat, nutria, and otter.

The Guyton and Lotus soils are poorly suited to use as pasture because of frequent flooding, low fertility, wetness in spring, and droughtiness in summer. The main suitable pasture plant is common bermudagrass. Frequent flooding and wetness limit the choice of suitable plants and the period of grazing.

These soils are poorly suited to cultivated crops because of frequent flooding, wetness, and low fertility. Planting dates are delayed and crops are damaged by floods in most years. If these soils are protected from flooding and drainage is provided, most climatically adapted crops can be grown.

The soils in this association are poorly suited to urban uses and are generally not suited to use as homesites. The soils have severe limitations for building sites, local roads and streets, and most sanitary facilities because of frequent flooding and wetness. Ring levees, pumps, and other water control systems can control flooding and remove excess water. Buildings can be placed on pilings or mounds to elevate them above the expected flood level.

Guyton and Lotus soils are in capability subclass Vw. The woodland ordination symbol is 9W for the Guyton soil and 5W for the Lotus soil.

Ke—Keithville loam, 1 to 5 percent slopes. This soil is gently sloping and moderately well drained. It is on broad ridgetops on uplands. The areas of this soil are broad and range from 15 to 650 acres. Slopes are long, smooth, and slightly convex.

Typically, the surface layer is dark brown, very strongly acid loam about 7 inches thick. The subsoil to a depth of about 60 inches is brown, mottled, very strongly acid loam and clay loam in the upper part; brownish yellow, mottled, strongly acid clay loam in the middle part; and red and light brownish gray, mottled, very strongly acid clay and clay loam in the lower part.

Included with this soil in mapping are a few small areas of Bellwood, Malbis, and Sacul soils. Also included are small areas of Keithville soils that have slopes of more than 5 percent. Bellwood and Sacul soils are on slopes at a lower elevation than that of the Keithville soil and do not have a subsoil that is loamy in the upper part. Malbis soils are in slightly higher positions and are loamy throughout the profile. The included soils make up about 20 percent of the map unit.

This Keithville soil has low fertility and high levels of exchangeable aluminum that are potentially toxic to most crops. Water and air move through this soil very slowly, and water runs off the surface at a medium rate. A seasonal high water table is about 2 to 3 feet below the soil surface from December to April. The soil has high shrink-swell potential in the lower part of the subsoil. Plants are damaged by a lack of water during dry periods in summer and fall of some years.

This soil is mainly used as woodland. Small acreages are used as pasture, cropland, or homesites.

This soil is well suited to use as woodland. The production potential for loblolly pine and shortleaf pine is high. The site index for loblolly pine is about 90. Common trees are loblolly pine, shortleaf pine, longleaf pine, white oak, and southern red oak. The main concern in producing and harvesting timber is a moderate equipment use limitation because of wetness. Standard-wheeled and tracked equipment cause rutting and soil compaction when the soil is wet (fig. 2). Using low-pressure ground equipment or harvesting during drier periods reduces damage to the soil and helps to maintain productivity. Roads and landings can be protected from erosion by constructing diversions and by seeding cuts and fills.

This soil is well suited to use as habitat for woodland wildlife. Habitat can be improved by planting appropriate vegetation, by maintaining existing plant cover, or by encouraging the propagation of desirable plants. Prescribed burning every three years, rotated among several small tracts of land, can increase the amount of palatable browse for deer and seed-producing plants for quail and turkey.

This Keithville soil is well suited to use as pasture; however, low fertility and a severe hazard of erosion are limitations. Suitable pasture plants are common bermudagrass, improved bermudagrass, Pensacola bahiagrass, and crimson clover. Annual cool-season

Figure 2.—Deep ruts are made if trees on Keithville loam, 1 to 5 percent slopes, are logged when the soil is wet. Rutting and soil compaction are major concerns in many soils in Natchitoches Parish.

grasses, such as ryegrass and wheat, are suitable for winter forage. Seedbed preparation should be on the contour or across the slope where practical. Proper stocking, pasture rotation, and restricted grazing during wet periods help keep the pasture and the soil in good condition. Fertilizer and lime are needed for optimum growth of grasses and legumes.

This soil is moderately well suited to cultivated crops. It is limited mainly by a severe erosion hazard and low fertility. The main suitable crops are cotton, corn, grain sorghum, wheat, and soybeans. This soil is friable and easy to keep in good tilth. It can be worked throughout a wide range of moisture content. Traffic pans develop easily, but these can be broken up by deep plowing or chiseling. Crop residue on the soil surface, contour farming, grassed waterways, and terraces help control runoff and erosion. Most crops respond well to lime and fertilizer, which help to overcome the low fertility and reduce the levels of exchangeable aluminum in the root zone.

This soil is moderately well suited to urban development. It has moderate limitations for building sites and local roads and streets and severe limitations for most sanitary facilities. The main limitations are wetness, very slow permeability, and low strength for roads. Septic tank absorption fields do not function properly during rainy periods because of wetness and very slow permeability. Lagoons or self-contained sewage disposal systems can be used to dispose of sewage properly. A seasonal high water table is perched above the clayey subsoil, and drainage should be provided if buildings are constructed. Roads and streets should be designed to compensate for the moderate load-supporting capacity and instability of the subsoil.

This Keithville soil is in capability subclass IIIe. The woodland ordination symbol is 9W.

Kt—Kisatchie clay, 1 to 15 percent slopes, severely eroded. This soil is gently sloping to moderately steep and well drained. It is on ridgetops and side slopes on the uplands. The areas are severely eroded, crossed by many deep gullies, and contain many small outcroppings of siltstone or sandstone (fig. 3). Vegetation is sparse throughout most areas. The areas of this soil are irregular in shape and range from 5 to 150 acres. Slopes are generally short and complex.

Typically, the upper inch of this soil is very dark grayish brown, very strongly acid silty clay loam. The subsoil is pale olive, very strongly acid clay to a depth of about 35 inches. The substratum to a depth of about 60 inches is olive siltstone. In some places, the surface layer is fine sandy loam, silt loam, or clay. In other places, the surface and subsurface layers have been eroded away and the subsoil is exposed at the surface.

Figure 3.—Kisatchie clay, 1 to 15 percent slopes, severely eroded, produces little vegetation and is poorly suited to most uses.

The surface layer of this soil is considered to be clay because the silty clay loam is too thin to significantly affect the use of the soil.

Included with this soil in mapping are a few small areas of Anacoco and Oula soils. Also included are small areas of soils similar to the Kisatchie soil except that they have a calcareous subsoil and a few small areas of shallow to moderately deep, loamy soils. The Anacoco soils typically are on flats on the ridgetops. The Oula soils are in positions similar to those of the Kisatchie soil. Neither the Anacoco nor the Oula soils have bedrock within a depth of 40 inches. The included soils make up about 20 percent of the map unit.

This Kisatchie soil has low fertility. Runoff is medium to rapid, and the hazard of erosion is severe. Water and air move through this soil very slowly. Plant roots penetrate the upper part of the soil with difficulty, and rooting depth is limited by siltstone or sandstone bedrock within 20 to 40 inches of the surface. This soil has high shrink-swell potential in its subsoil. Plants generally are damaged by a lack of water during dry periods in summer and fall of most years.

This soil is mainly used as habitat for wildlife. The soil produces little vegetation and no commercial timber. The areas of this soil are primary sources of sediment to local streams.

This soil is poorly suited to use as habitat for woodland wildlife; however, it does provide areas utilized by quail, dove, turkey, and nongame birds for dusting and grit-gathering. Habitat can be improved by planting appropriate vegetation, by maintaining existing plant cover, or by encouraging the propagation of desirable plants.

This soil is poorly suited to the production of commercial timber. Common trees are loblolly pine, longleaf pine, and shortleaf pine. Trees are scattered and are typically stunted. Potential productivity of pine and hardwoods is low. The main concerns in producing and harvesting timber are a moderate equipment use limitation, severe seedling mortality, and the severe hazard of erosion. Deep gullies, the clayey texture, and rock outcrops limit the use of most equipment. Establishment of seedlings is difficult because of the low fertility and soil droughtiness. Hand planting hardy nursery stock and adding phosphorus fertilizer to the soil can improve seedling survival. Locating haul roads, skid trails, and log landings on the contour or where slopes are gentle can reduce erosion. Harvesting should be done during dry periods. Roads, landings, skid trails, and firebreaks can be protected from erosion by constructing diversions and by seeding cuts and fills.

This Kisatchie soil is poorly suited to use as pasture. It is limited mainly by low fertility, soil droughtiness, deep gullies, and depth to bedrock. Because of these severe limitations, reclaiming most soil areas is difficult and expensive. Native drought-resistant grasses are the most suitable pasture plants; however, common bermudagrass and Pensacola bahiagrass can be grown. Lime and fertilizer can encourage faster growth. Diversions and terraces should be built to control runoff during the establishment period.

This soil is generally not suited to cultivated crops. The limitations of low fertility, deep gullies, rock outcrops, droughtiness, and steep slopes are too severe for this use.

This soil is poorly suited to urban use. The main limitations are steep slopes, deep gullies, rock outcrops, very slow permeability, high shrink-swell potential, and low strength for roads. Erosion is the main hazard. Areas that have gentle slopes should be selected as homesites. Only the part of the site that is used for construction should be disturbed. Mulching, fertilizing, and irrigation are needed to establish lawn grasses and other small seeded plants. Buildings and roads can be designed to offset the effects of shrinking and swelling of the soil. Septic tank absorption fields do not function properly because of the very slow permeability of the soil. Lagoons or self contained sewage disposal units can be used to dispose of sewage properly.

This Kisatchie soil is in capability subclass VIe. The woodland ordination symbol is 5D.

Kw—Kisatchie-Anacoco complex, 1 to 5 percent slopes. These soils are on gently sloping ridgetops on the uplands. Areas of these soils are too intermingled to be mapped separately at the selected scale. This complex is about 45 percent Kisatchie soil, 35 percent Anacoco soil, and about 20 percent other soils. Kisatchie soil is well drained and is on the more convex slopes. The Anacoco soil is somewhat poorly drained and is on plane slopes. The areas of these soils range from about 10 to 400 acres. Slopes are generally short, but some are long and smooth.

Typically, the Kisatchie soil has a dark grayish brown, strongly acid silt loam surface layer about 6 inches thick. The subsoil extends to a depth of 36 inches. It is grayish brown, very strongly acid silty clay in the upper part; pale olive, very strongly acid silty clay loam in the middle part; and light olive gray, strongly acid clay loam in the lower part. The substratum to a depth of about 60 inches is light gray siltstone. In places, the surface layer is fine sandy loam.

The Kisatchie soil has low fertility. Water and air move through this soil very slowly, and water runs off the surface at a medium rate. Effective rooting depth is about 20 to 40 inches and is limited by the underlying siltstone bedrock. This soil has high shrink-swell potential. Plants generally are damaged by a lack of water during dry periods in summer and fall of most years.

The Anacoco soil has a dark gray, very strongly acid very fine sandy loam surface layer about 3 inches thick. The subsurface layer to a depth of about 8 inches is light brownish gray, mottled, very strongly acid very fine sandy loam. The subsoil extends to a depth of about 43 inches. It is grayish brown and strong brown, mottled, very strongly acid clay in the upper part; grayish brown, mottled, very strongly acid clay in the middle part; and light brownish gray, mottled, very strongly acid silty clay in the lower part. The substratum is light olive brown stratified silty clay loam and loam to a depth of about 60 inches. In some places, the surface layer is silt loam or fine sandy loam. In other places, the substratum between depths of 40 and 60 inches is siltstone or sandstone bedrock.

The Anacoco soil has low fertility and moderately high levels of exchangeable aluminum that are potentially toxic to some crops. Water and air move through this soil very slowly, and water runs off the surface at a medium rate. A seasonal high water table is within 1 foot of the soil surface from December to April in most years. This soil has high shrink-swell potential. Plants are damaged by lack of water during dry periods in summer and fall of most years.

Included with this complex in mapping are a few small areas of Betis, Briley, and Oula soils and outcroppings of sandstone and siltstone bedrock. Soils similar to the Anacoco soil except that they have a calcareous subsoil and soils that are loamy throughout and are shallow to moderately deep to siltstone are also included. Betis and Briley soils are in high positions on ridgetops and have thick sandy surface and subsurface layers. The Oula soils are in positions similar to those of the Kisatchie soil. They are moderately well drained and do not have bedrock within 40 inches of the soil surface. Outcroppings of bedrock are scattered throughout the area but typically are on ridgetops and the shoulders of slopes.

The Kisatchie and Anacoco soils are mainly used as woodland. In a few areas, these soils are used as homesites or pasture.

The soils in this complex are poorly suited to use as woodland. The production potential for loblolly pine is moderately low. The main concerns in producing and harvesting timber are a moderate equipment use limitation and moderate seedling mortality. Soil erosion is also a hazard during and after harvesting operations. The seedling mortality rate is higher in summer because of a shortage of moisture during this period. Hand planting hardy nursery stock can increase seedling survival. Conventional methods of harvesting timber generally can be used but their use can be limited during rainy periods, generally from December to April. Logging roads require suitable surfacing for year-round use. Rock outcrops and boulders also limit the use of equipment. Mechanical planting of trees on the contour helps to control erosion. Roads and landings can be protected from erosion by constructing diversions and by seeding cuts and fills. Adequate water bars on skid trails and firebreaks also help to control soil loss.

These soils are moderately well suited to use as habitat for woodland wildlife. Habitat can be improved by planting appropriate vegetation, by maintaining existing plant cover, or by encouraging the propagation of desirable plants. Prescribed burning every three years, rotated among several small tracts of land, can increase the amount of palatable browse for deer and seed-producing plants for quail and turkey.

The Kisatchie and Anacoco soils are somewhat poorly suited to use as pasture because of low fertility and droughtiness. Wetness is an additional limitation to use of the Anacoco soil. In places, rock outcrops limit the use of equipment. The main suitable pasture grasses are common bermudagrass, Pensacola bahiagrass, ball clover, and crimson clover. Adding lime and fertilizer to the soil can overcome the low fertility and increase forage production.

These soils are somewhat poorly suited to cultivated crops because of steepness of slope, low fertility, and a severe hazard of erosion. In places, stoniness limits the use of equipment. The main suitable crops are soybeans and grain sorghum. Using conservation tillage and returning all crop residue to the soil or regularly adding other organic matter improve fertility and help to maintain soil tilth and content of organic matter. Early fall seeding, conservation tillage, terraces, diversions, and grassed waterways help control erosion. Most crops respond well to lime and fertilizer, which help to overcome the low fertility and reduce the levels of exchangeable aluminum in the root zone.

These soils are poorly suited to urban development. They have severe limitations for building sites, local roads and streets, and most sanitary facilities because of very slow permeability, high shrink-swell potential, and low strength. Wetness of the Anacoco soil and moderate depth to bedrock in the Kisatchie soil are additional limitations. Septic tank absorption fields do not function properly during rainy periods because of wetness and very slow permeability. In areas of the Anacoco soil, lagoons or self-contained disposal units can be used to dispose of sewage properly. Roads should be designed to overcome the low load-supporting capacity of the soils. If buildings are constructed on these soils, structural damage as a result of shrinkage and swelling can be prevented by properly designing foundations and footings and by diverting runoff from buildings.

This complex is in capability subclass IVe. The woodland ordination symbol is 6D for the Kisatchie soil and 7C for the Anacoco soil.

Kz—Kisatchie-Oula fine sandy loams, 5 to 40 percent slopes. These soils are on strongly sloping to steep side slopes on the uplands. Areas of the Kisatchie soil are too intricately intermingled with areas of the Oula soil to be mapped separately at the selected scale. The Kisatchie soil is well drained and is on convex slopes. The Oula soil is moderately well drained and is on plane slopes. The areas of these soils are irregular in shape and range from 10 to 350 acres. They are about 40 percent Kisatchie soil and 40 percent Oula soil. Slopes are typically short and complex, but some are long and smooth. Well-defined drainageways and gullies cross most areas of these soils.

Typically, the Kisatchie soil has a dark gray, very strongly acid fine sandy loam surface layer about 6 inches thick. The subsurface layer is dark gray, very strongly acid fine sandy loam to a depth of about 9 inches. The subsoil to a depth of about 35 inches is grayish brown and light olive gray, very strongly acid silty clay. The substratum to a depth of about 60 inches is light brownish gray siltstone. In places, the surface layer is stony or bouldery.

This Kisatchie soil has low fertility. Water and air move through this soil at a very slow rate. Runoff is rapid, and the hazard of water erosion is severe. Effective rooting depth is 20 to 40 inches, and it is limited by the underlying sandstone or siltstone bedrock. This soil has high shrink-swell potential. Plants generally are damaged by a lack of water during dry periods in summer and fall of most years.

Typically, the Oula soil has a brown, extremely acid fine sandy loam surface layer about 6 inches thick. The subsoil to a depth of about 50 inches is light brownish gray, mottled, extremely acid sandy clay and clay. The substratum to a depth of about 63 inches is light brownish gray, mottled, extremely acid silty clay.

This Oula soil has low fertility and moderately high levels of exchangeable aluminum that are potentially toxic to some crops. Water and air move through this soil at a very slow rate. Runoff is rapid, and the hazard of water erosion is severe. This soil has high shrink-swell potential. Plants generally suffer from a lack of water during dry periods in summer and fall of most years.

Included with these soils in mapping are a few small areas of Betis, Guyton, and Smithdale soils and outcroppings of sandstone and siltstone bedrock. Also included are small areas of eroded soils on side slopes and small areas of Kisatchie and Oula soils on narrow ridgetops. Betis soils are at a higher elevation than the Oula and Kisatchie soils and are sandy throughout the profile. The Guyton soils are in drainageways. They are poorly drained and are loamy throughout. The Smithdale soils are in positions similar to those of the Kisatchie and Oula soils and are loamy throughout. Sandstone and siltstone outcrops and boulders are scattered throughout the landscape. The included soils make up about 20 percent of the map unit.

The Kisatchie and Oula soils are mainly used as woodland. In a few areas, they are used as pasture.

These soils are poorly suited to use as woodland. The Kisatchie soil has moderately low production potential for loblolly pine, and the Oula soil has moderately high potential. The main concerns in producing and harvesting timber are limitations to the use of equipment and difficulty in establishing seedlings because of steep slopes and the clayey subsoil. Soil erosion is also a hazard during and after harvesting operations. The seedling mortality rate is moderate because of a moisture shortage in the Kisatchie soil. Hand planting hardy nursery stock can increase seedling survival. Conventional methods of harvesting trees can be used in the more gently sloping areas but are difficult to use in the steeper areas. Steep slopes, rock outcrops, and gullies limit the use of equipment (fig. 4). Management that minimizes the risk of erosion is essential in harvesting timber. Harvesting during dry periods and locating skid trails, log landings, and haul roads across the slope, where practical, can reduce erosion. Roads and landings can be protected from erosion by constructing diversions and by seeding cuts and fills. Water bars on skid trails and firebreaks can also reduce soil loss.

These soils are moderately well suited to use as habitat for woodland wildlife. Habitat can be improved by planting appropriate vegetation, by maintaining existing plant cover, or by encouraging the propagation of desirable plants.

The Kisatchie and Oula soils are poorly suited to use as pasture because of low fertility, steep slopes, and a severe hazard of erosion. In places, rock outcrops limit the use of equipment. Suitable pasture plants are common bermudagrass, Pensacola bahiagrass, ball clover, and crimson clover. The steeply sloping and stony areas of these soils are better suited to native grasses because seedbed preparation is difficult. Lime and fertilizer increase growth of forage plants. Proper stocking and pasture rotation help keep the pasture in good condition.

These soils are poorly suited to cultivated crops because of the steep complex slopes, low fertility, rock outcrops, and severe hazard of erosion. Tillage equipment can be used only in gently sloping areas.

These soils are poorly suited to urban uses. They have severe limitations for building sites, local roads and streets, and most sanitary facilities. The main limitations are steep slopes, high shrink-swell potential, very slow permeability, and low strength for roads. Moderate depth to bedrock is an additional limitation in the Kisatchie soil. Because erosion is a severe hazard, only the part of the site that is used for construction should be disturbed. Access roads need to be designed to provide a minimum cut-slope grade, and diversions and grassed waterways should be constructed to control surface runoff. Steep slopes, moderate depth to bedrock, and very slow permeability adversely affect the installation and performance of septic tank absorption fields and sewage lagoons. Self-contained sewage disposal units can be used to dispose of sewage properly. The effects of shrinking and swelling and low strength can be minimized by using proper engineering designs and by

Figure 4.—Cobbles and boulders of sandstone or siltstone restrict the use of equipment in woodland areas of Kisatchie-Oula fine sandy loams, 5 to 40 percent slopes.

backfilling with material that has low shrink-swell potential.

The Kisatchie and Oula soils are in capability subclass VIe. The woodland ordination symbol is 6D for the Kisatchie soil and 8C for the Oula soil.

La—Latanier clay. This soil is level and somewhat poorly drained. It is in intermediate positions on natural levees on the Red River alluvial plain. The areas of this soil are long and narrow and range from 20 to several hundred acres. Slopes are long and smooth and are 0 to 1 percent.

Typically, the surface layer is dark brown, neutral clay about 6 inches thick. The upper part of the subsoil is dark reddish brown, neutral clay, and the lower part is reddish brown, neutral clay. The substratum to a depth of about 60 inches is yellowish red, neutral and mildly alkaline silt loam.

Included with this soil in mapping are a few small areas of Armistead, Gallion, Moreland, and Roxana soils. Also included are small areas of Latanier soils that have gently undulating slopes. The Armistead soils are on the natural levees of former channels and distributaries of the Red River. They are clayey to a depth of less than 20 inches and loamy below that. Gallion and Roxana soils are in higher positions than the Latanier soil and are loamy throughout the profile. Moreland soils are in lower positions and are clayey throughout. The included soils make up about 20 percent of the map unit.

This Latanier soil has high fertility. Water and air move through this soil at a very slow rate. Water runs off the surface slowly and stands in low places for long periods after heavy rains. The surface layer is wet for long periods in winter and spring. A seasonal high water table is 1 foot to 3 feet below the soil surface from December to April. Flooding is rare, but it can occur under abnormal or catastrophic conditions. It generally occurs less often than once in 10 years and at anytime during the year. This soil develops cracks when it is dry and seals over when wet. It has high shrink-swell potential. Plants are damaged by lack of water during dry periods in summer and fall of some years.

This soil is mainly used as cropland or pasture. Small acreages are used as woodland or homesites.

This soil is moderately well suited to most cultivated crops. It is limited mainly by wetness and poor tilth. Suitable crops are cotton, grain sorghum, rice, oats, wheat, and soybeans. This soil can be worked only within a narrow range of moisture content. The surface layer is sticky when wet, hard when dry, and becomes cloddy if farmed when too wet or too dry. Returning crop residue to the soil or regularly adding other organic matter improves tilth and increases the water intake rate. A drainage system is needed for most cultivated crops. Land grading and smoothing improve surface drainage and permit more efficient use of farm equipment. Fertilizers are generally not needed for the production of legume crops. Nonlegume crops require nitrogen fertilizer. Lime is generally not needed.

This soil is well suited to use as pasture. The main limitations are wetness and the clayey surface texture. Suitable pasture plants are common bermudagrass, improved bermudagrass, tall fescue, dallisgrass, and white clover. Annual cool-season grasses, such as ryegrass and wheat, are suitable for winter forage. Grazing when the soil is wet results in compaction of the surface layer. Excessive water on the surface can be removed by shallow ditches. Proper stocking, pasture rotation, and restricted grazing during wet periods help keep the pasture and the soil in good condition. Nitrogen fertilizer is needed for maximum forage production. Lime and other fertilizers are generally not needed.

This Latanier soil is well suited to use as woodland; however, only a few areas remain in native hardwoods. Common trees are cherrybark oak, Nuttall oak, water oak, pecan, sweetgum, eastern cottonwood, and American sycamore. The main concerns in producing and harvesting timber are moderate equipment use limitations and seedling mortality because of soil wetness and the clayey surface layer. Trees suitable for planting include eastern cottonwood and American sycamore.

This soil is well suited to use as habitat for woodland and openland wildlife. Habitat for whitetail deer, squirrels, and many species of nongame birds and animals can be improved by planting or encouraging the growth of existing oak trees and suitable understory plants. Fence lines, ditchbanks, and abandoned farmsteads provide habitat for birds and small animals if the vegetation is allowed to grow naturally.

This soil is poorly suited to urban development. It has severe limitations for building sites, local roads and streets, and most sanitary facilities. The main limitations are wetness, low strength for roads, very high shrink-swell potential, and rare flooding. Buildings can be placed on pilings or mounds to elevate them above expected flood levels. Excess water can be removed by using shallow ditches and providing the proper grade. Septic tank absorption fields do not function properly during rainy periods because of wetness and very slow permeability. Lagoons or self-contained sewage disposal units can be used to dispose of sewage properly. Roads and streets should be designed to compensate for the low strength and instability of the soil. If buildings are constructed on this soil, structural damage as a result of shrinking and swelling can be prevented by properly designing foundations and footings and by diverting runoff from buildings.

This Latanier soil is in capability subclass IIIw. The woodland ordination symbol is 8W.

Ma—Malbis fine sandy loam, 1 to 5 percent slopes. This soil is gently sloping and moderately well drained. It is on broad ridgetops and side slopes on the uplands. The areas of this soil are irregular in shape and range from 20 to 800 acres. Slopes are generally long and smooth.

Typically, the surface layer is grayish brown, very strongly acid fine sandy loam about 6 inches thick. The subsurface layer is yellowish brown, mottled, strongly acid fine sandy loam to a depth of about 10 inches. The subsoil to a depth of about 35 inches is strong brown and yellowish brown, very strongly acid loam in the upper part and strong brown and reddish yellow, very strongly acid sandy clay loam in the lower part. To a depth of 75 inches, the subsoil is mottled, very strongly acid sandy clay loam. It is yellowish brown in the upper part, brownish yellow and strong brown in the middle part, and light gray and red in the lower part. Red mottles and plinthite are common in the middle and lower parts of the subsoil.

Included with this soil in mapping are a few small areas of Beauregard, Guyton, Keithville, and Ruston soils. Beauregard soils are on less convex slopes and have less sand in the subsoil than the Malbis soil. The

Guyton soils are in depressional areas and drainageways. They are poorly drained and are grayish throughout the profile. Keithville soils are at a lower elevation than the Malbis soil and have a subsoil that is clayey in the lower part. Ruston soils are on more convex ridgetops and do not have plinthite in the subsoil. The included soils make up about 20 percent of the map unit.

This Malbis soil has low fertility and high levels of exchangeable aluminum that are potentially toxic to most crops. Water and air move through this soil at a moderately slow rate, and water runs off the surface at a medium rate. This soil dries quickly after rains. A seasonal high water table is about 2.5 to 4 feet below the soil surface from December to March. The shrink-swell potential is low. Plants generally are damaged by a lack of water during dry periods in summer and fall of most years.

This soil is mainly used as woodland or pasture. In a few areas, it is used as homesites or for crops.

This soil is well suited to use as woodland (fig. 5). The production potential for loblolly pine and shortleaf pine is high, and the site index for loblolly pine is about 90. Common trees include loblolly pine, shortleaf pine, longleaf pine, white oak, and southern red oak. The soil has few limitations for woodland use and management. Roads and landings should be protected from erosion by constructing diversions and by seeding cuts and fills. Skid trails and firebreaks are subject to rilling and gullying unless runoff is controlled. Undesirable plants can reduce adequate natural or artificial reforestation; however, intensive site preparation and maintenance are generally not needed.

This soil is well suited to use as habitat for woodland wildlife. Habitat can be improved by planting appropriate vegetation, by maintaining existing plant cover, or by encouraging the propagation of desirable plants. Prescribed burning every three years, rotated among several small tracts of land, can increase the amount of palatable browse for deer and seed-producing plants for quail and turkey.

This Malbis soil is well suited to use as pasture; however, low fertility is a limitation and soil erosion is a hazard during establishment of pasture grasses. Suitable pasture plants are common bermudagrass, improved bermudagrass, Pensacola bahiagrass, and crimson clover. Annual cool-season grasses, such as ryegrass or wheat, are suitable for winter forage. Lime and fertilizer can overcome the low fertility and promote good growth of forage plants. Proper stocking, pasture rotation, and restricted grazing during wet periods help keep the pasture and the soil in good condition.

This soil is well suited to cultivated crops. It is limited mainly by low fertility and a severe hazard of erosion. Suitable crops are corn, wheat, soybeans, grain sorghum, and cotton. This soil is friable and easy to keep in good tilth. It can be worked throughout a wide range of moisture content. Using conservation tillage and returning all crop residue to the soil or regularly adding other organic matter improve fertility and help maintain soil tilth and content of organic matter. Sheet and rill erosion can be reduced by constructing gradient terraces and farming on the contour. Most crops respond to lime and fertilizer, which help to overcome the low fertility and reduce the levels of exchangeable aluminum in the root zone.

This soil is moderately well suited to urban development. It has slight to moderate limitations for building sites and local roads and moderate to severe limitations for most sanitary facilities. The main limitations are wetness and moderately slow permeability. Septic tank absorption fields do not function properly during rainy periods because of wetness and moderately slow permeability. Lagoons or self-contained sewage disposal units can be used to dispose of sewage properly. Roads and streets should be designed to overcome the limited ability of this soil to support a load.

This Malbis soil is in capability subclass IIe. The woodland ordination symbol is 9A.

Md—Moreland silt loam. This soil is level and somewhat poorly drained. It is in low positions on natural levees on the Red River alluvial plain. The areas of this soil are long and narrow and are 10 to 300 acres. Slopes are generally less than 1 percent.

Typically, the surface layer is reddish brown, mildly alkaline silt loam about 8 inches thick. The next layer to a depth of 17 inches is dark reddish brown, mildly alkaline clay. The subsoil to a depth of about 60 inches is reddish brown, mottled, mildly alkaline and moderately alkaline clay. In low areas of this soil, the surface layer is silty clay loam.

Included with this soil in mapping are a few small areas of Gallion and Latanier soils. Also included in low positions are small areas of Moreland clay. Gallion soils are in higher positions than the Moreland soil and are loamy throughout the profile. Latanier soils are in slightly higher positions and have a loamy substratum. The included soils make up about 15 percent of the map unit.

This Moreland soil has high fertility. Water and air move through this soil at a very slow rate, and water runs off the surface slowly. A seasonal high water table is within 1.5 feet of the soil surface from December to April. Flooding is rare, but it can occur under abnormal or catastrophic conditions. It generally occurs less often than once in 10 years and at anytime during the year. The surface layer remains wet for long periods after heavy rains. The soil has very high shrink-swell potential. It cracks when dry and seals over when wet. Plants are damaged by lack of water during dry periods in summer and fall of some years.

This soil is used mainly as cropland or pasture. In a few areas, it is used as woodland or homesites.

Figure 5.—This well-managed area of loblolly pine is on Malbis fine sandy loam, 1 to 5 percent slopes.

This soil is moderately well suited to most cultivated crops. The level slopes and high fertility are favorable features for cultivated crops. The main limitation is wetness, which can delay planting and harvesting in some years. Suitable crops are soybeans, cotton, rice, wheat, and grain sorghum. The surface layer of this soil is friable, but it becomes somewhat difficult to keep in good tilth where cultivation has mixed some of the clayey subsoil into the plow layer. A drainage system is needed for most cultivated crops. Land grading and smoothing improve surface drainage and permit more efficient use of farm equipment. Returning crop residue to the soil or regularly adding other organic matter improves fertility, reduces crusting, and increases the water intake rate. Nonlegume crops respond well to nitrogen fertilizer. Lime or other fertilizer is generally not needed.

This soil is well suited to use as pasture. The level slopes and high fertility are favorable soil features for this use. The main limitation is wetness. Suitable pasture plants are common bermudagrass, tall fescue, dallisgrass, improved bermudagrass, white clover, and winter peas. Annual cool-season grasses, such as ryegrass or wheat, are suitable for winter forage. Grazing when the soil is wet results in compaction of the surface layer. Shallow ditches can remove excessive water that accumulates on the surface. Proper stocking, pasture rotation, and restricted grazing during wet periods help keep the pasture and the soil in good condition. Nitrogen fertilizer is needed if grasses are grown alone, but lime and other fertilizer is generally not needed.

This Moreland soil is well suited to use as woodland; but most areas are used as cropland or pasture. Common trees are sugarberry, sweetgum, Nuttall oak, water oak, and green ash. The main concern in producing and harvesting timber is wetness, which severely limits the use of equipment and increases seedling mortality. Suitable trees to plant are eastern cottonwood and American sycamore. Planting trees on bedded rows lowers the effective depth of the water table and reduces seedling mortality. Rutting and soil compaction can be reduced by using suitable logging systems, laying out skid trails in advance, and harvesting timber when the soil is least susceptible to compaction.

This soil is well suited to use as habitat for woodland and wetland wildlife. Habitat for whitetail deer, squirrels, and many species of nongame birds and animals can be improved by planting or encouraging the growth of existing oak trees and suitable understory plants. Fence lines, ditchbanks, and abandoned building sites provide habitat for birds and small animals if vegetation is allowed to grow naturally. Habitat for wetland wildlife can be improved by constructing shallow ponds to provide open water areas for waterfowl and furbearing animals, such as muskrat, nutria, and otter.

This soil is poorly suited to urban uses. It has severe limitations for building sites, local roads and streets, and most sanitary facilities. The main limitations are wetness, very slow permeability, very high shrink-swell potential, low strength for roads, and the hazard of flooding. Buildings can be placed on pilings or mounds to elevate them above expected flood levels. Excess surface water can be removed by using shallow ditches and providing the proper grade. Septic tank absorption fields do not function properly during rainy periods because of wetness and very slow permeability. Lagoons or self-contained sewage disposal units can be used to dispose of sewage properly. If buildings are constructed on this soil, structural damage as a result of shrinking and swelling can be prevented by properly designing foundations and footings, and diverting runoff from buildings. Roads and streets should be designed to compensate for the low strength and instability of the subsoil.

This Moreland soil is in capability subclass IIIw. The woodland ordination symbol is 7W.

Mn—Moreland clay. This soil is level and somewhat poorly drained. It is in low positions on natural levees on the Red River alluvial plain. The areas of this soil are broad and are 50 to several hundred acres. Slopes are generally less than 1 percent.

Typically, the surface layer is dark reddish brown, neutral clay about 16 inches thick. The subsoil to a depth of about 63 inches is dark reddish brown, neutral clay in the upper part and reddish brown, mildly alkaline clay in the middle and lower parts. In places, the lower part of the subsoil is gray or grayish brown silt loam, silty clay loam, or clay.

Included with this soil in mapping are a few small areas of Gallion, Latanier, and Perry soils. Also included in low positions are small areas of Moreland soils that are subject to occasional or frequent flooding. Gallion soils are in higher positions than the Moreland soil and are loamy throughout the profile. Latanier soils are in slightly higher positions and have loamy underlying material. Perry soils are in slightly lower positions and do not have a dark reddish brown surface layer. The included soils make up about 15 percent of the map unit.

This Moreland soil has high fertility. Wetness causes poor aeration and restricts root development of many plants. Water and air move through this soil at a very slow rate. Water runs off the surface slowly and stands in low places for long periods after heavy rains. A seasonal high water table is within 1.5 feet of the soil surface from December to April. Flooding is rare, but it can occur under abnormal or catastrophic conditions. It generally occurs less often than once in 10 years and at anytime during the year. This soil has very high shrink-swell potential. Plants are damaged by lack of water during dry periods in summer and fall of some years.

This soil is mainly used as cropland or pasture. In a few areas, it is used as woodland or homesites.

This soil is moderately well suited to most cultivated crops. The level slopes and high fertility are favorable soil features for cultivated crops, but wetness and a clayey surface layer are less favorable features. The main suitable crops are cotton, soybeans, grain sorghum, wheat, and rice (fig. 6). This soil is difficult to keep in good tilth and can be worked only within a narrow range of moisture content. The surface layer is sticky when wet and hard when dry and becomes cloddy if farmed when too wet or too dry. A drainage system is needed for most cultivated crops. Land grading and smoothing improve surface drainage and permit more efficient use of farm equipment. Crop residue on or near the surface helps to maintain tilth and improves water intake. Nonlegume crops respond well to nitrogen fertilizer. Lime or other fertilizer is generally not needed.

This soil is well suited to use as pasture; however, wetness and the clayey surface layer are limitations. Suitable pasture plants are common bermudagrass, tall fescue, improved bermudagrass, dallisgrass, white clover, and winter peas. Annual cool-season grasses, such as ryegrass or wheat, are suitable for winter forage. Grazing when the soil is wet results in compaction of the surface layer. Shallow ditches can remove excess surface water. Proper stocking, pasture rotation, and restricted grazing during wet periods help keep the

Figure 6.—Winter wheat is a common crop on Moreland clay in Natchitoches Parish. Wheat can be successfully double cropped with soybeans in some years.

pasture and the soil in good condition. Nitrogen fertilizer is needed if grasses are grown alone, but lime and other fertilizers generally are not needed.

This Moreland soil is well suited to use as woodland, but most areas have been cleared and are used as cropland or pasture. Common trees are sugarberry, Nuttall oak, sweetgum, water oak, and green ash. The main concerns in producing and harvesting timber are wetness and the clayey surface layer, which severely limit the use of equipment and increase seedling mortality. Suitable trees to plant are eastern cottonwood and American sycamore. Planting and harvesting should be done during the drier periods to prevent rutting and soil compaction. Planting trees on bedded rows lowers the effective depth of the water table and reduces seedling mortality.

This soil is well suited to use as habitat for woodland and wetland wildlife. Habitat for whitetail deer, squirrels, and many species of nongame birds and animals can be improved by planting or encouraging the growth of existing oak trees and suitable understory plants. Fence lines, ditchbanks, and abandoned building sites provide habitat for birds and small animals if vegetation is allowed to grow naturally. Habitat for wetland wildlife can be improved by constructing shallow ponds to provide open water areas for waterfowl and furbearing animals, such as muskrat, nutria, and otter.

This soil is poorly suited to urban uses. It has severe limitations for building sites, local roads and streets, and most sanitary facilities. The main limitations are wetness, very slow permeability, very high shrink-swell potential, low strength for roads, and the hazard of flooding. Buildings can be placed on pilings or mounds to elevate them above expected flood levels. Excess surface water can be removed by using shallow ditches and providing the proper grade. Septic tank absorption fields do not function properly during rainy periods because of wetness and very slow permeability. Lagoons or self-contained sewage disposal units can be used to dispose of sewage properly. If buildings are constructed on this soil, structural damage as a result of shrinking and swelling can be prevented by properly designing foundations and footings, and by diverting runoff from buildings. Roads and streets should be designed to compensate for the low strength and instability of the subsoil.

This Moreland soil is in capability subclass IIIw. The woodland ordination symbol is 7W.

Mo—Moreland clay, gently undulating. This soil is somewhat poorly drained. It is on low, parallel ridges and swales on the Red River alluvial plain. The ridges are 1 to 3 feet high and are 100 to 250 feet wide. The swales are about 75 to 150 feet wide. The areas of this soil are broad and are 20 to 300 acres. Slopes are short and range from 0 to 3 percent.

Typically, the surface layer is dark reddish brown, slightly acid clay about 10 inches thick. The subsoil to a depth of about 60 inches is reddish brown, neutral and mildly alkaline clay.

Included with this soil in mapping are a few small areas of Gallion, Latanier, Perry, and Yorktown soils. Also included are a few small areas of Moreland soils that have slopes of more than 3 percent. Gallion soils are in higher positions on ridges and are loamy throughout the profile. Latanier soils are in higher positions on ridges and have loamy underlying material. Perry soils are in low positions in swales and do not have a dark reddish brown surface layer. Yorktown soils are in depressional areas within swales. They generally are wet and do not crack during dry periods. The included soils make up about 15 percent of the map unit.

This Moreland soil has high fertility. Wetness causes poor aeration and restricts root development of many plants. Water and air move through this soil at a very slow rate. Water runs off the ridges at a medium rate and ponds in the swales for long periods after heavy rains. A seasonal high water table is within 1.5 feet of the soil surface from December to April. Flooding is rare, but it can occur under abnormal or catastrophic conditions. It generally occurs less often than once in 10 years and at anytime during the year. This soil dries out more slowly in the swales than adjoining soils that are at a higher elevation. This soil has very high shrink-swell potential. Plants are damaged by lack of water during dry periods in summer and fall of some years.

This soil is mainly used as cropland or pasture. In a few areas, it is used as woodland or homesites.

This soil is moderately well suited to most cultivated crops. The main limitations are wetness, the clayey surface layer, and short choppy slopes. Suitable crops are soybeans, cotton, grain sorghum, and wheat. This soil is sticky when wet and hard when dry, and it becomes cloddy if farmed when too wet or too dry. It is difficult to keep in good tilth and can be worked only within a narrow range of moisture content. Wetness delays the planting and harvesting of crops in most years. A drainage system is needed for most cultivated crops. Land grading and smoothing improve surface drainage and permit more efficient use of farm equipment, but large amounts of earth need to be moved. Returning crop residue to the soil or regularly adding other organic matter improves fertility, reduces crusting, and increases the water intake rate. Nonlegume crops respond well to nitrogen fertilizer. Lime or other fertilizer is generally not needed.

This soil is well suited to use as pasture; however, wetness and the clayey surface layer are limitations. Suitable pasture plants are common bermudagrass, tall fescue, improved bermudagrass, dallisgrass, white clover, and winter peas. Annual cool-season grasses, such as ryegrass and wheat, are suitable for winter forage. Grazing when the soil is wet results in compaction of the surface layer. Shallow ditches can remove excessive surface water that accumulates in the swales. Proper stocking, pasture rotation, and restricted grazing during wet periods help keep the pasture and the soil in good condition. Nitrogen fertilizer is needed if grasses are grown alone, but lime or other fertilizer is generally not needed.

This Moreland soil is well suited to use as woodland; but most areas have been cleared and are used as cropland or pasture. Common trees are sugarberry, Nuttall oak, sweetgum, water oak, and green ash. The main concerns in producing and harvesting timber are wetness and the clayey surface layer, which severely limit the use of equipment and increase seedling mortality. Suitable trees to plant are eastern cottonwood and American sycamore. Rutting and soil compaction can be prevented by planting and harvesting during the drier periods. Seedling mortality can be reduced by planting trees on bedded rows.

This soil is well suited to use as habitat for woodland and wetland wildlife. Habitat for whitetail deer, squirrels, and many species of nongame birds and animals can be improved by planting or encouraging the growth of existing oak trees and suitable understory plants. Fence lines, ditchbanks, and abandoned building sites provide habitat for birds and small animals if vegetation is allowed to grow naturally. Habitat for wetland wildlife can be improved by constructing shallow ponds to provide open water areas for waterfowl and furbearing animals, such as muskrat, nutria, and otter.

This soil is poorly suited to urban development. It has severe limitations for building sites, local roads and streets, and most sanitary facilities. The main limitations are wetness, very slow permeability, very high shrink-swell potential, low strength for roads, and the hazard of flooding. Buildings can be placed on pilings or mounds to elevate them above expected flood levels. Excess surface water can be removed by using shallow ditches and providing the proper grade. Septic tank absorption fields do not function properly during rainy periods because of wetness and very slow permeability. Lagoons or self-contained sewage disposal units can be used to dispose of sewage properly. If buildings are constructed on this soil, structural damage as a result of shrinking and swelling can be prevented by properly designing foundations and footings and by diverting runoff from buildings. Roads and streets should be designed to compensate for the low strength and instability of the subsoil.

This Moreland soil is in capability subclass IIIw. The woodland ordination symbol is 7W.

Mp—Moreland clay, occasionally flooded. This soil is level and somewhat poorly drained. It is in low positions on natural levees on the Red River alluvial plain. The areas of this soil are irregular in shape and range from 15 to several hundred acres. Slopes are generally less than 1 percent.

Typically, the surface layer is dark reddish brown, neutral and mildly alkaline clay about 15 inches thick. The subsoil is dark reddish brown, mildly alkaline clay to a depth of about 42 inches. The next layer to a depth of about 60 inches is a buried surface layer of dark gray, mottled, moderately alkaline clay.

Included with this soil in mapping are a few small areas of Gallion, Latanier, and Perry soils. Also included are small areas of Moreland soils that do not flood and a few areas that flood frequently. Gallion soils are in higher positions than the Moreland soil and are loamy throughout. Latanier soils are in slightly higher positions and have a loamy substratum. Perry soils are in slightly lower positions and do not have a dark reddish brown surface layer. The included soils make up about 15 percent of the map unit.

This Moreland soil has high fertility. Wetness causes poor aeration and restricts root development of many plants. Water and air move through this soil at a very slow rate. Water runs off the surface very slowly and stands in low places for long periods after heavy rains. This soil is subject to brief to long periods of flooding in winter, spring, and early in summer of some years. Flood waters typically are 1 foot to 3 feet deep, but the depth exceeds 5 feet in places. Flooding occurs less often than twice in 5 years during anytime of the year. A seasonal high water table is within 1.5 feet of the soil surface from December to April. The surface layer of this soil is sticky when wet and cracks when dry. This soil has very high shrink-swell potential. Plants are damaged by lack of water during dry periods in summer and fall of some years.

This soil is mainly used as cropland or pasture. In a few areas, it is used as woodland or homesites.

This soil is somewhat poorly suited to most cultivated crops. The level slopes and high fertility are favorable features for cultivated crops, but flooding, wetness, and the clayey texture are less favorable features for this use. Short-season crops, such as soybeans and grain sorghum, are suitable. This soil is sticky when wet and hard when dry and becomes cloddy if farmed when too wet or too dry. Wetness delays planting and harvesting in most years, and flooding delays or prevents planting in some years. Levees and a well-designed drainage system are needed to protect this soil from flooding. Crop residue on or near the surface helps to maintain tilth and improves the rate of water intake. Nonlegume crops respond well to nitrogen fertilizer. Lime and other fertilizers are generally not needed.

This Moreland soil is moderately well suited to use as pasture. The main limitations are wetness, the clayey surface layer, and the hazard of flooding. A suitable pasture plant is common bermudagrass. Wetness and flooding limit the choice of plants and the period of grazing (fig. 7). Grazing when the soil is wet results in compaction of the surface layer. Excessive water on the surface can be removed by shallow ditches where suitable outlets are available. Proper stocking, pasture rotation, and restricted grazing during wet periods help keep the pasture and the soil in good condition.

This soil is moderately well suited to use as woodland. Common trees in areas of this soil are Nuttall oak, overcup oak, green ash, sugarberry, water hickory, and baldcypress. The main concerns in producing and harvesting timber are the severe equipment use limitation and seedling mortality caused by wetness, the clayey surface layer, and occasional flooding. When wet, the soil is sticky and plastic and has poor trafficability. Wheeled and tracked timber harvesting equipment can be used, but their use is limited during rainy periods, generally from December to May. Tree seedlings have a low survival rate because of wetness and flooding. Only trees that can tolerate seasonal wetness should be planted. Among the trees suitable for planting are eastern cottonwood and American sycamore.

This soil is well suited to use as habitat for woodland and wetland wildlife. Habitat for whitetail deer, squirrels, and many species of nongame birds and animals can be improved by encouraging the growth of existing oak trees and suitable understory plants. Fence lines, ditchbanks, and abandoned building sites provide habitat for birds and small animals if vegetation is allowed to grow naturally. Habitat for wetland wildlife can be improved by constructing shallow ponds to provide open water areas for waterfowl and furbearing animals, such as muskrat, nutria, and otter.

This soil is poorly suited to urban uses and is generally not suited to use as homesites because of flooding, wetness, very slow permeability, very high shrink-swell potential, and low strength for roads. Major flood control structures, along with extensive local drainage systems, are needed to protect this soil from flooding. Roads and streets should be located above the expected flood level. The effects of shrinking and swelling can be minimized by using proper engineering designs and by backfilling with material that has low shrink-swell potential. Septic tank absorption fields do not function properly during rainy periods because of wetness and very slow permeability. Properly designed sewage

Figure 7.—Flooding is a concern in managing livestock operations on Moreland clay, occasionally flooded.

lagoons or self-contained sewage disposal units can be used to dispose of sewage properly.

This Moreland soil is in capability subclass IVw. The woodland ordination symbol is 6W.

Mr—Moreland clay, frequently flooded. This soil is level and somewhat poorly drained. It is in backswamps and in low positions on natural levees on the Red River alluvial plain. The areas of this soil are generally broad and range from 30 to several hundred acres. Slopes are generally less than 1 percent.

Typically, the surface layer is dark reddish brown, mildly alkaline and neutral clay about 11 inches thick. The subsoil to a depth of about 48 inches is dark reddish brown, neutral clay in the upper part and reddish brown, moderately alkaline clay in the lower part. The substratum to a depth of about 60 inches is dark grayish brown and reddish brown, moderately alkaline clay.

Included with this soil in mapping are a few small areas of Latanier, Perry, and Yorktown soils. Also included are small areas of Moreland soils that flood rarely or occasionally. Latanier soils are in slightly higher positions than the Moreland soil and have a loamy substratum. Perry soils are in slightly lower positions and do not have a dark reddish brown surface layer. Yorktown soils are in depressional areas and are wet throughout the profile most of the time. The included soils make up about 20 percent of the map unit.

This Moreland soil has high fertility. Wetness causes poor aeration and restricts root development of many plants. Water and air move through this soil at a very slow rate. Water runs off the surface very slowly and ponds in low places for long periods after heavy rains.

This soil is subject to one or more brief to long periods of flooding from December to June of most years. Flooding occurs more often than twice in 5 years and at any time during the year. Depth of flood water can exceed 10 feet at the lower elevations, but it is typically 1 to 3 feet. During nonflood periods, a seasonal high water table is within 1.5 feet of the soil surface from December to April. This soil has very high shrink-swell potential. The surface layer is sticky when wet and cracks when dry. Adequate water is available to plants in most years.

This soil is mainly used as woodland or native pasture. In a few areas, it is used for short-season crops.

This soil is moderately well suited to use as woodland. Common trees are overcup oak, water hickory, baldcypress, black willow, water locust, and green ash. Management is difficult because of frequent, long periods of flooding and wetness. Wheeled and tracked timber harvesting equipment can be used, but their use is limited during rainy periods, generally from December to April. Tree seedlings have a low survival rate because of the long periods of flooding. Only trees that can tolerate seasonal wetness should be planted. Suitable trees to plant are baldcypress, eastern cottonwood, and green ash.

This soil is well suited to use as habitat for wetland and woodland wildlife. Habitat for wetland wildlife can be improved by constructing shallow ponds to provide open water areas for waterfowl and furbearing animals, such as muskrat, nutria, and otter. Habitat for whitetail deer, squirrels, and many species of nongame birds and animals can be improved by planting or encouraging the growth of existing oak trees and suitable understory plants.

This Moreland soil is poorly suited to use as pasture. Flooding and a seasonal high water table limit the choice of plants and period of grazing. A suitable pasture plant is common bermudagrass. Native grasses and forbs also produce temporary grazing. It is generally not practical to apply high rates of nitrogen to pastures because of the hazard of frequent overflow.

This soil is poorly suited to most cultivated crops because of frequent flooding, wetness, and poor tilth. Only late-planted crops, such as soybeans or grain sorghum, can be grown. Planting dates are delayed in most years by wetness. Flooding prevents planting in some years and damages crops in most years. Levees and a surface drainage system are needed to protect this soil from flooding.

This soil is poorly suited to most urban uses, and it is not suited to use as homesites. Unless flood protection is provided, wetness and flooding are generally too severe for most urban uses. Flooding can be overcome only by major flood control structures and surface drainage systems.

This Moreland soil is in capability subclass Vw. The woodland ordination symbol is 6W.

Ms—Morse clay, 5 to 12 percent slopes. This soil is strongly sloping and well drained. It is on side slopes on the uplands. Well-defined drainageways cross most areas. The areas of this soil are irregular in shape and range from 15 to 100 acres. Slopes are generally short and complex.

Typically, the surface layer is dark reddish brown, mildly alkaline clay about 4 inches thick. The next layer is reddish brown, moderately alkaline clay to a depth of about 16 inches. The underlying material to a depth of about 60 inches is reddish brown, mildly alkaline clay in the upper part and red, mottled, mildly alkaline clay in the lower part. Concretions and masses of soft calcium carbonate are common in the underlying material.

Included with this soil in mapping are a few small areas of Acadia, Gore, and Guyton soils. Also included are small areas of Morse soils that have slopes of less than 5 percent and areas that have slopes of more than than 12 percent. The Acadia and Gore soils are on upper side slopes and narrow ridgetops and do not have intersecting slickensides. Guyton soils are in drainageways and are grayish and loamy throughout the profile. The included soils make up about 20 percent of the map unit.

This Morse soil has low fertility. Water and air move through the soil at a very slow rate. Runoff is rapid, and the hazard of water erosion is severe. The soil has very high shrink-swell potential. It shrinks markedly upon drying, and cracks can form to a depth of 20 inches or more (fig. 8). Plants generally are damaged by a lack of water during dry periods in summer and fall of most years.

This soil is used mainly as woodland or pasture. It is also used for homesites or cultivated crops.

This soil is somewhat poorly suited to use as woodland. It has low production potential for loblolly pine and eastern redcedar. The main concerns in producing and harvesting timber are a moderate equipment use limitation and moderate seedling mortality. Harvesting during dry seasons and locating skid trails, log landings, and haul roads properly and within limiting grades reduce erosion. Roads and landings can be protected from erosion by constructing diversions and by seeding cuts and fills. Conventional methods of harvesting timber generally can be used, but their use may be limited during rainy periods, generally from December to April. Logging roads require suitable surfacing for year-round use. Tree seedlings have a low rate of survival because the clayey surface layer contains little available water in the summer. Eastern redcedar is a suitable tree to plant because it is adapted to alkaline soils.

This soil is moderately well suited to use as habitat for woodland wildlife. Habitat can be improved by planting appropriate vegetation, by maintaining existing plant cover, or by encouraging the propagation of desirable plants. In many areas, this soil is also suitable for small ponds that can provide valuable habitat for fish,

Figure 8.—During dry periods, deep, wide cracks form in the surface layer and subsoil of Morse clay, 5 to 12 percent slopes.

waterfowl, and furbearing animals, such as nutria, muskrat, mink, and otter.

This Morse soil is somewhat poorly suited to use as pasture. The main limitations are complex slopes, a severe hazard of erosion during seedbed preparation, and low fertility. Suitable pasture plants are King Ranch bluestem, johnsongrass, and Pensacola bahiagrass. Annual grasses, such as ryegrass or wheat, are suitable for winter forage. Fertilizer is needed for optimum growth of grasses and legumes. Erosion can be controlled by maintaining a good plant cover. Seedbed preparation should be on the contour or across the slope where practical. Proper stocking and pasture rotation help keep the pasture in good condition.

This soil is poorly suited to most cultivated crops. It is limited mainly by low fertility, a severe hazard of erosion, and short, complex slopes. Suitable crops are cotton, grain sorghum, and soybeans. Irregular slopes can hinder tillage operations. Crop residue on or near the surface helps to conserve moisture, maintain tilth, and control erosion. Conservation tillage, terraces, diversions, and grassed waterways help control erosion. Most crops respond well to fertilizer.

This soil is poorly suited to urban development. It has severe limitations for building sites, local roads and streets, and most sanitary facilities. The main limitations are very slow permeability, low strength for roads, and very high shrink-swell potential. Because erosion is a hazard. Only the part of the site that is used for construction should be disturbed. Roads and streets should be designed to overcome the limited ability of the soil to support a load. Septic tank absorption fields do not function properly because of the very slow permeability. Properly designed lagoons or self-contained sewage disposal units can be used to dispose of sewage properly.

This Morse soil is in capability subclass VIe. The woodland ordination symbol is 6C.

Na—Natchitoches sandy clay loam, 1 to 5 percent slopes. This soil is gently sloping and well drained. It is on broad ridgetops on the uplands. The areas of this soil are irregular in shape and range from 10 to 300 acres. Slopes are generally long and smooth, but some are short and complex.

Typically, the surface layer is dark reddish brown, strongly acid sandy clay loam about 4 inches thick. The subsoil to a depth of about 38 inches is reddish brown, mottled, very strongly acid clay in the upper part and red, mottled, very strongly acid clay in the lower part. The substratum to a depth of about 60 inches is yellowish brown and light olive brown, mottled, slightly acid clay in the upper part and light yellowish brown, mottled, neutral clay in the lower part. Greenish sand-sized grains of glauconite and soft accumulations and concretions of calcium carbonate are common in the subsoil and substratum.

Included with this soil in mapping are a few small areas of Bellwood, Keithville, and Sacul soils. Also included are small areas of Natchitoches soils that have slopes of more than 5 percent. The Bellwood and Sacul soils are in positions similar to those of the Natchitoches soil and do not contain glauconite in the subsoil. Keithville soils are at a slightly higher elevation and are loamy in the upper part of the subsoil. The included soils make up about 20 percent of the map unit.

This Natchitoches soil has low fertility and moderately high levels of exchangeable aluminum that are potentially toxic to some plants. Water and air move through this soil very slowly, and water runs off the surface at a medium rate. This soil has high shrink-swell potential. Plants generally are damaged by a lack of water during dry periods in summer and fall of most years.

This soil is mainly used as woodland. In a few areas, it is used as pasture or homesites.

This soil is moderately well suited to use as woodland. The site index for loblolly pine is about 80. Other common trees are shortleaf pine, longleaf pine, white oak, and southern red oak. The main concerns in producing and harvesting timber are moderate equipment use limitations and seedling mortality. Erosion is also a hazard in the steeper areas. Because the clayey subsoil is sticky when wet, most planting and harvesting equipment should be used only during dry periods. Using low pressure ground equipment during rainy periods reduces rutting and compaction of the soil. Roads and landings can be protected from erosion by constructing diversions and by seeding cuts and fills. Tree seedlings have a moderately low rate of survival because of the long dry periods in the summer. Ripping skid trails and landings when the soil is dry breaks up compacted layers, helps to maintain soil tilth, and increases seedling survival.

This soil is well suited to use as habitat for woodland wildlife. Habitat can be improved by planting appropriate vegetation, by maintaining existing plant cover, or by encouraging the propagation of desirable plants. Prescribed burning every three years, rotated among several small tracts of land, can increase the amount of palatable browse for deer and seed-producing plants for use by quail and turkey.

This Natchitoches soil is moderately well suited to use as pasture. The main limitations are low fertility and a severe hazard of erosion during establishment of pasture grasses. Suitable pasture plants are common bermudagrass, improved bermudagrass, Pensacola bahiagrass, and crimson clover. Annual cool-season grasses, such as ryegrass and wheat, are suitable for winter forage. Erosion can be controlled by maintaining a good plant cover. Seedbed preparation should be on the contour or across the slope where practical. Proper stocking and pasture rotation help keep the pasture and the soil in good condition. Fertilizer and lime are needed for optimum growth of grasses and legumes.

This soil is somewhat poorly suited to cultivated crops. It is limited mainly by low fertility and a severe hazard of erosion. Suitable crops are cotton, soybeans, and grain sorghum. Crop residue on or near the surface helps to conserve moisture, maintain tilth, and control erosion. Conservation tillage, terraces, diversions, and grassed waterways help control erosion. Most crops respond well to lime and fertilizer.

This soil is poorly suited to urban uses. It has severe limitations for building sites, local roads and streets, and most sanitary facilities. The main limitations are very slow permeability, high shrink-swell potential, and low strength for roads. Septic tank absorption fields do not function properly during rainy periods because of very slow permeability. Lagoons or self-contained sewage disposal units can be used to dispose of sewage properly. If buildings are constructed on this soil, structural damage as a result of shrinking and swelling can be prevented by properly designing foundations and footings and by diverting runoff from buildings. Roads and streets should be designed to compensate for the poor load-supporting capacity and instability of the subsoil.

This Natchitoches soil is in capability subclass IVe. The woodland ordination symbol is 8C.

Nh—Natchitoches sandy clay loam, 5 to 12 percent slopes. This soil is strongly sloping and well drained. It is on side slopes on the uplands. Well-defined drainageways cross most soil areas. The areas of this soil are irregular in shape and range from 10 to 150 acres.

Typically, the surface layer is dark reddish brown, strongly acid sandy clay loam about 6 inches thick. The subsoil to a depth of about 46 inches is red, mottled, strongly acid clay. The substratum to a depth of about 60 inches is yellowish brown, mottled, slightly acid clay and neutral sandy clay. Greenish sand-sized grains of glauconite are common in the subsoil and substratum.

Included with this soil in mapping are a few small areas of Bellwood, Guyton, Keithville, and Sacul soils. Also included are small areas of Natchitoches soils that have slopes of less than 5 percent and areas that have slopes of more than 12 percent. The Bellwood and Sacul soils are in positions similar to those of the Natchitoches soil and do not have glauconite in the subsoil. The Guyton soils are in drainageways. They are poorly drained and are grayish and loamy throughout the profile. Keithville soils are on upper side slopes at a slightly higher elevation than the Natchitoches soil and are loamy in the upper part of the subsoil. The included soils make up about 20 percent of the map unit.

This Natchitoches soil has low fertility. Water and air move through this soil at a very slow rate, and water runs off the surface rapidly. This soil has high shrink-swell potential in the subsoil. Plants generally are damaged by a lack of water during dry periods in summer and fall of most years.

This soil is mainly used as woodland. In a few areas, it is used as pasture or homesites.

This soil is moderately well suited to use as woodland. The site index for loblolly pine is about 80. Other common trees are shortleaf pine, longleaf pine, white oak, and southern red oak. The main concerns in producing and harvesting timber are moderate equipment use limitations and seedling mortality. Erosion is the main hazard. Because the clayey subsoil is sticky when wet, most planting and harvesting equipment should be used only during dry periods. During wet periods, using low pressure ground equipment can reduce rutting and soil compaction. Logging roads require suitable surfacing for year-round use. Harvesting during dry seasons and locating skid trails, log landings, and haul roads properly and within limiting grades can reduce erosion. Roads and landings can be protected from erosion by constructing diversions and by seeding cuts and fills. Tree seedlings have a moderately low rate of survival because of long dry periods in the summer. Ripping skid trails and landings when the soil is dry breaks up compacted layers, helps to maintain soil tilth, and increases seedling survival.

This soil is well suited to use as habitat for woodland wildlife. Habitat can be improved by planting appropriate vegetation, by maintaining existing plant cover, or by encouraging the propagation of desirable plants. Prescribed burning every three years, rotated among several small tracts of land, can increase the amount of palatable browse for deer and seed-producing plants for quail and turkey.

This Natchitoches soil is somewhat poorly suited to use as pasture. The main limitations are low fertility and a severe hazard of erosion during establishment of pasture grasses. Suitable pasture plants are common bermudagrass, improved bermudagrass, Pensacola bahiagrass, and crimson clover. Annual cool-season grasses, such as ryegrass or wheat, are suitable for winter forage. Proper stocking and pasture rotation help keep the pasture in good condition. Erosion can be controlled by maintaining a good plant cover. Seedbed preparation should be on the contour or across the slope where practical. Fertilizer and lime are needed for optimum growth of grasses and legumes.

This soil is poorly suited to cultivated crops. It is limited mainly by a severe erosion hazard, low fertility, and short irregular slopes. Close-sown crops, such as small grains, are the most suitable crops. Early fall seeding, conservation tillage, terraces, diversions, and grassed waterways help control erosion. The short, irregular slopes and the drainageways limit the use of some equipment. Most crops respond well to lime and fertilizer, which help to overcome the low soil fertility and reduce the level of exchangeable aluminum in the root zone.

This soil is poorly suited to urban uses. It has severe limitations for building sites, local roads and streets, and most sanitary facilities. The main limitations are slope, very slow permeability, high shrink-swell potential, and low strength for roads. Because erosion is a hazard, only the part of the site that is used for construction should be disturbed. Septic tank absorption fields do not function properly during rainy periods because of the very slow permeability. Properly designed lagoons or self-contained sewage disposal units can be used to dispose of sewage properly. If buildings are constructed on this soil, structural damage as a result of shrinking and swelling can by prevented by properly designing foundations and footings and by diverting runoff away from buildings. Roads and streets should be designed to compensate for the poor load-supporting capacity and instability of the subsoil.

This Natchitoches soil in capability subclass VIe. The woodland ordination symbol is 8C.

Pe—Perry clay, occasionally flooded. This soil is level and poorly drained. It is in low positions on natural levees on the Red River alluvial plain. The areas of this soil are irregular in shape and range from 5 to 400 acres. Slopes are generally less than 1 percent.

Typically, the surface layer is gray, medium acid clay about 6 inches thick. The subsoil to a depth of about 35 inches is gray, mottled, medium acid and neutral clay in the upper part and reddish brown, mildly alkaline clay in the lower part. The substratum to a depth of about 61 inches is reddish brown, moderately alkaline clay.

Included with this soil in mapping are a few small areas of Latanier, Moreland, and Yorktown soils. Also included are small areas of Perry soils that are frequently flooded. Latanier and Moreland soils are in slightly higher positions than the Perry soil and have a dark reddish brown surface layer. Yorktown soils are in depressional areas. They generally are wet throughout the profile and do not crack. The included soils make up about 20 percent of the map unit.

This Perry soil has medium fertility. Water and air move through this soil very slowly. Water runs off the surface at a very slow rate and stands in low places for long periods after heavy rains. This soil is subject to brief to very long periods of flooding in winter, spring, and early in summer of some years. Flooding occurs less often than twice in 5 years and at anytime during the year. Flood waters typically are 1 foot to 3 feet deep, but the depth exceeds 5 feet in places. Flood duration can exceed 1 month. A seasonal high water table is within 2 feet of the soil surface from December to June in most years. The surface layer of this soil is sticky when wet and hard when dry. The soil has very high shrink-swell potential. Plants are damaged by a lack of moisture during dry periods in summer and fall of some years.

This soil is mainly used as woodland. Small acreages are used as pasture or cropland.

This soil is well suited to use as woodland. Common trees in areas of this soil are sweetgum, Nuttall oak, overcup oak, green ash, sugarberry, water hickory, and baldcypress. The main concerns in producing and harvesting timber are seedling mortality and equipment use limitations because of wetness, the clayey surface layer, and occasional flooding. The soil is sticky and plastic when wet and has poor trafficability. Wheeled and tracked timber harvesting equipment can be used, but their use is limited during rainy periods, generally from December to May. Tree seedlings have a low rate of survival because of wetness and flooding. Only trees that can tolerate seasonal wetness should be planted. Trees suitable to plant are eastern cottonwood and sweetgum.

This soil is moderately well suited to use as habitat for woodland and wetland wildlife. Habitat for whitetail deer, squirrels, and many species of nongame birds and animals can be improved by planting or encouraging the growth of existing oak trees and suitable understory plants. Fence lines, ditchbanks, and abandoned building sites provide habitat for birds and small animals if vegetation is allowed to grow naturally. Habitat for wetland wildlife can be improved by constructing shallow ponds to provide open water areas for waterfowl and furbearing animals, such as muskrat, nutria, and otter.

This Perry soil is moderately well suited to use as pasture. The main limitations are the hazard of flooding, the clayey surface layer, and wetness. Wetness and flooding limit the choice of plants and the period of grazing. Common bermudagrass is a suitable pasture plant. Grazing when the soil is wet results in compaction of the surface layer and damage to the plant community. Excessive water on the surface can be removed by shallow ditches where suitable outlets are available. Proper stocking, pasture rotation, and restricted grazing during wet periods help keep the pasture and the soil in good condition.

This soil is somewhat poorly suited to most cultivated crops. It is limited mainly by flooding, poor tilth, and wetness. Late planted crops, such as soybeans and grain sorghum, are the most suitable crops to plant. This soil is sticky when wet, hard when dry, and becomes cloddy if farmed when too wet or too dry. Wetness delays planting and harvesting in most years, and flood waters can delay or prevent planting in some years. Levees and a well designed drainage system are needed to protect this soil from flooding. Most crops respond well to fertilizer, and lime may be needed.

This soil is poorly suited to urban development and is generally not suited to use as homesites. It has severe limitations for building sites, local roads and streets, and most sanitary facilities. The main limitations are very high shrink-swell potential, very slow permeability, wetness, and low strength for roads. Flooding is a hazard. Major flood control structures, along with extensive local drainage systems, are needed to protect this soil from flooding. Roads and streets should be located above the expected flood level. The effects of shrinking and swelling can be minimized by using proper engineering designs and by backfilling with material that has low shrink-swell potential. Septic tank absorption fields do not function properly during rainy periods because of wetness and very slow permeability. Properly designed sewage lagoons or self-contained sewage disposal units can be used to dispose of sewage properly.

This Perry soil is in capability subclass IVw. The woodland ordination symbol is 8W.

Ro—Roxana very fine sandy loam. This soil is level and well drained. It is in high positions on natural levees of the Red River. The areas of this soil range from 30 to several hundred acres. Slopes are typically less than 1 percent.

Typically, the surface layer is yellowish red, neutral very fine sandy loam about 6 inches thick. The underlying material to a depth of about 42 inches is yellowish red, neutral and moderately alkaline silt loam and very fine sandy loam. The next layer to a depth of about 66 inches is mildly alkaline, dark brown silt loam and strong brown fine sandy loam. In places, the soil is calcareous in the surface layer.

Included with this soil in mapping are a few small areas of Gallion and Severn soils. Also included are small areas of soils similar to the Roxana soil except that they contain more clay in the underlying material. Gallion soils are on natural levees of old, abandoned distributary channels and have a well-developed subsoil.

Severn soils are in positions similar to those of the Roxana soil and are calcareous in all horizons below a depth of 10 inches. The included soils make up about 15 percent of the map unit.

This Roxana soil has high fertility. Water and air move through the soil at a moderate rate, and water runs off the surface slowly. Roots penetrate the soil easily. A seasonal high water table is at a depth of about 4 to 6 feet from December to April of most years. This soil has low shrink-swell potential. Adequate water is available to plants in most years.

This soil is mainly used for cultivated crops. Small acreages are used as pasture or homesites.

This soil is well suited to most cultivated crops and has few limitations for this use (fig. 9). Suitable crops are cotton, corn, grain sorghum, wheat, and soybeans. This soil is friable and easy to keep in good tilth. It can be worked throughout a wide range of moisture content. Traffic pans develop under continuous cultivation, but these can be broken easily by deep plowing or chiseling. Land smoothing and leveling and aligning crop rows with the slope can remove excess water that accumulates after heavy rains. Proper management of crop residue helps maintain organic matter content and tilth and reduces soil loss by erosion. Nonlegume crops respond well to nitrogen fertilizer. Lime and other fertilizers generally are not needed.

This soil is well suited to use as pasture and has few limitations for this use. Suitable pasture plants are common bermudagrass, improved bermudagrass, Pensacola bahiagrass, tall fescue, and white clover. Annual cool-season grasses, such as ryegrass or wheat,

Figure 9.—Cotton is a major crop in Natchitoches Parish. Roxana very fine sandy loam is well suited to this crop.

are suitable for winter forage. Proper stocking, pasture rotation, and restricted grazing during wet periods help keep the pasture and soil in good condition. Nitrogen fertilizer is needed where grasses are grown alone. Lime and other fertilizers are generally not needed.

This Roxana soil is well suited to use as woodland; however, only a few small areas remain in native hardwoods. Common trees are pecan, cherrybark oak, water oak, American sycamore, eastern cottonwood, and sweetgum. Trees suitable to plant are eastern cottonwood and American sycamore. The soil has few limitations for woodland use and management.

This soil is well suited to use as habitat for woodland and openland wildlife. Habitat for whitetail deer, squirrels, and many species of nongame birds and animals can be improved by planting or encouraging the growth of existing oak trees and suitable understory plants. Fence lines, ditchbanks, and abandoned building sites provide cover and nesting areas for birds and small animals if vegetation is allowed to grow naturally.

This soil is well suited to most urban uses. It has slight limitations for building sites and local roads and streets, and moderate limitations for most sanitary facilities. The main limitations are wetness and moderate permeability. Septic tank absorption fields may not function properly during rainy periods because of the moderate permeability and wetness. This can be overcome by increasing the length of the absorption lines.

This Roxana soil is in capability class I. The woodland ordination symbol is 12A.

Ru—Ruston fine sandy loam, 1 to 5 percent slopes. This soil is gently sloping and well drained. It is on convex ridgetops on the uplands. The areas of this soil are irregular in shape and range from 5 to 300 acres.

Typically, the surface layer is dark grayish brown, slightly acid fine sandy loam about 4 inches thick. The subsurface layer is light yellowish brown, slightly acid fine sandy loam to a depth of about 12 inches. The subsoil to a depth of about 62 inches is yellowish red, medium acid and strongly acid sandy clay loam in the upper part; yellowish red, very strongly acid loam and light yellowish brown sandy loam in the middle part; and yellowish red, very strongly acid sandy clay loam in the lower part.

Included with this soil in mapping are a few small areas of Briley, Malbis, Sacul, and Smithdale soils. Also included are small areas of Ruston soils that have slopes of more than 5 percent. Briley soils are in positions similar to those of the Ruston soil and have thick sandy surface and subsurface layers. Malbis soils are on slightly less convex slopes and have a brownish subsoil that contains more than 5 percent plinthite. Sacul soils are on side slopes and have a clayey subsoil. Smithdale soils are on side slopes and do not have a profile with a bisequum. The included soils make up about 20 percent of the map unit.

This Ruston soil has low fertility and moderately high levels of exchangeable aluminum that are potentially toxic to some crops. Water and air move through this soil at a moderate rate, and water runs off the surface at a medium rate. The shrink-swell potential is low. Plants suffer from lack of water during dry periods in summer and fall of some years.

This soil is mainly used as woodland or pasture. Small acreages are used as homesites or for cultivated crops.

This soil is well suited to use as woodland. Common trees include loblolly pine, shortleaf pine, longleaf pine, sweetgum, white oak, hickory, and southern red oak. The soil has few limitations for woodland use and management. The site index for loblolly pine is about 84. Roads and landings can be protected from erosion by constructing diversions and by seeding cuts and fills. Skid trails and firebreaks are subject to rilling and gullying unless provided with adequate water bars or protected by plant cover. Undesirable plants can reduce adequate natural or artificial reforestation; however, intensive site preparation and maintenance are generally not needed.

This soil is well suited to use as habitat for woodland wildlife. Habitat can be improved by planting appropriate vegetation, by maintaining existing plant cover, or by encouraging the propagation of desirable plants. Prescribed burning every three years, rotated among several small tracts of land, can increase the amount of palatable browse for deer and seed-producing plants for quail and turkey.

This Ruston soil is well suited to use as pasture. It has few limitations for this use; however, soil erosion is a hazard during establishment of pasture grasses. Suitable pasture plants are common bermudagrass, improved bermudagrass, Pensacola bahiagrass, and crimson clover. Annual cool-season grasses, such as ryegrass and wheat, are suitable for winter forage. Seedbed preparation should be on the contour or across the slope where practical. Lime and fertilizer can overcome the low fertility and promote good growth of forage plants. Proper stocking and pasture rotation help keep the pasture in good condition.

This soil is moderately well suited to cultivated crops. The main limitations are low fertility and a severe hazard of erosion. Suitable crops are cotton, corn, soybeans, wheat, grain sorghum, and vegetables. The soil is friable and easy to keep in good tilth. It can be worked throughout a wide range of moisture content. Crop residue on the surface, contour farming, and terraces can reduce soil loss by erosion. All tillage should be on the contour or across the slope. Most crops respond well to lime and fertilizer, which help to overcome the low soil fertility and reduce the levels of exchangeable aluminum in the root zone.

This soil is moderately well suited to urban development. It has slight limitations for building sites and moderate limitations for local roads and streets and most sanitary facilities. The main limitations are low strength for roads and streets and moderate permeability. Septic tank absorption fields may not function properly during rainy periods because of the moderate permeability. This can be overcome by increasing the length of the absorption lines. Roads and streets should be designed to overcome the moderate load-supporting capacity of the soil.

This Ruston soil is in capability subclass IIIe. The woodland ordination symbol is 8A.

Sa—Sacul fine sandy loam, 1 to 5 percent slopes. This soil is gently sloping and moderately well drained. It is on convex ridgetops and side slopes on the uplands. The areas of this soil are irregular in shape and range from 20 to 600 acres. Slopes are generally long and smooth, but some are short and complex.

Typically, the surface layer is dark brown, strongly acid fine sandy loam about 2 inches thick. The subsurface layer is brown, strongly acid fine sandy loam to a depth of about 10 inches. The subsoil to a depth of about 58 inches is red, strongly acid, mottled clay in the upper and middle parts. The lower part of the subsoil is red, strongly acid, mottled sandy clay loam and light gray, strongly acid, mottled silty clay loam. The substratum to a depth of about 60 inches is mottled light gray and yellowish red, strongly acid sandy clay loam.

Included with this soil in mapping are a few small areas of Bellwood, Keithville, and Ruston soils. Also included are small areas of Sacul soils that have slopes of more than 5 percent. Bellwood soils are in positions similar to those of the Sacul soil and have intersecting slickensides in the subsoil. Keithville and Ruston soils are on ridgetops at a slightly higher elevation. Keithville soils are loamy in the upper part of the subsoil, and Ruston soils are reddish and loamy throughout the profile. The included soils make up about 20 percent of the map unit.

This Sacul soil has low fertility and high levels of exchangeable aluminum that are potentially toxic to most crops. Water and air move through this soil slowly, and water runs off the surface at a medium rate. No seasonal high water table has been observed in this soil. The soil has high shrink-swell potential in the subsoil. Plants generally are damaged by lack of water during dry periods in summer and fall of most years.

This soil is mainly used as woodland. Small acreages are used as pasture or homesites.

This soil is moderately well suited to use as woodland. The site index for loblolly pine is about 80. The main concern in producing and harvesting timber is a moderate equipment use limitation. When the soil surface is wet or moist, roads and skid trails are slippery and may be impassable during rainy periods. Harvesting timber during the drier periods can reduce rutting and soil compaction. Roads and landings can be protected from erosion by constructing diversions and by seeding cuts and fills. Skid trails and firebreaks are subject to rilling and gullying unless provided with adequate water bars or protected by plant cover. Undesirable plants can reduce adequate natural or artificial reforestation; however, intensive site preparation and maintenance are generally not needed.

This soil is well suited to use as habitat for woodland wildlife. Habitat can be improved by planting appropriate vegetation, by maintaining existing plant cover, or by encouraging the propagation of desirable plants. Prescribed burning every three years, rotated among several small tracts of land, can increase the amount of palatable browse for deer and seed-producing plants for quail and turkey.

This Sacul soil is moderately well suited to use as pasture. The main limitation is low fertility, and soil erosion is a hazard during establishment of pasture grasses. Suitable pasture plants are common bermudagrass, improved bermudagrass, Pensacola bahiagrass, and crimson clover. Annual cool-season grasses, such as ryegrass or wheat, are suitable for winter forage. Fertilizer and lime are needed for optimum growth of grasses and legumes. Seedbed preparation should be on the contour or across the slope where practical. Proper stocking and pasture rotation help keep the pasture in good condition.

This soil is somewhat poorly suited to cultivated crops. It is limited mainly by low fertility and a severe hazard of erosion. The main suitable crops are cotton, grain sorghum, wheat, soybeans, and corn. This soil is friable and easy to keep in good tilth. The surface layer erodes easily if this soil is clean tilled. Early fall seeding, conservation tillage, terraces, diversions, and grassed waterways help control erosion. All tillage should be on the contour or across the slope. Most crops respond well to lime and fertilizer, which help to overcome the low soil fertility and reduce the level of exchangeable aluminum in the root zone.

This soil is poorly suited to most urban uses. It has severe limitations for building sites, local roads and streets, and most sanitary facilities. The main limitations are slow permeability, high shrink-swell potential, and low strength for roads. Septic tank absorption fields do not function properly during rainy periods because of slow permeability. Lagoons or self-contained sewage disposal units can be used to dispose of sewage properly. If buildings are constructed on this soil, structural damage as a result of shrinking and swelling can be prevented by properly designing foundations and footings and by diverting runoff away from buildings. Roads and streets should be designed to overcome the instability and low supporting capacity of the subsoil.

This Sacul soil is in capability subclass IVe. The woodland ordination symbol is 8C.

Sc—Sacul fine sandy loam, 5 to 12 percent slopes. This soil is strongly sloping and moderately well drained.

It is on side slopes on the uplands. Well-defined drainageways cross most areas of this soil. The areas of this soil are irregular in shape and range from 30 to 400 acres. Slopes are generally short and complex.

Typically, the surface layer is dark grayish brown, strongly acid fine sandy loam about 4 inches thick. The subsurface layer is brown, strongly acid fine sandy loam to a depth of about 8 inches. The subsoil to a depth of about 44 inches is red, very strongly acid clay in the upper part; mottled red and light gray, very strongly acid clay in the middle part; and mottled light gray and strong brown, very strongly acid silty clay loam in the lower part. The substratum to a depth of about 60 inches is stratified light brownish gray, very strongly acid clay loam and yellowish red sandy loam.

Included with this soil in mapping are a few small areas of Bellwood, Guyton, Keithville, and Smithdale soils. Also included are small areas of Sacul soils that have slopes of less than 5 percent and areas that have slopes of more than 12 percent. The Bellwood and Smithdale soil are in positions similar to those of the Sacul soil. Bellwood soils have intersecting slickensides in the subsoil, and Smithdale soils are reddish and loamy throughout the profile. Guyton soils are in drainageways and are loamy and grayish throughout the profile. Keithville soils are on narrow ridgetops and are loamy in the upper part of the subsoil. The included soils make up about 20 percent of the map unit.

This Sacul soil has low fertility and high levels of exchangeable aluminum that are potentially toxic to most crops. Water and air move through the soil at a slow rate, and water runs off the surface rapidly. A seasonal high water table has not been observed in this soil. This soil has high shrink-swell potential in the subsoil. Plants generally suffer from a lack of water during dry periods in summer and fall of most years.

This soil is mainly used as woodland. Small acreages are used as pasture or homesites.

This soil is moderately well suited to use as woodland. The site index for loblolly pine is about 80. The main concern in producing and harvesting timber is a moderate equipment use limitation. Roads and skid trails are slippery when the surface is wet or moist and may be impassable during rainy periods. Harvesting during dry seasons reduces rutting and soil compaction. Locating skid trails, log landings, and haul roads properly and within limiting grades reduces erosion. Roads and landings can be protected from erosion by constructing diversions and by seeding cuts and fills. Skid trails and firebreaks are subject to rilling and gullying unless provided with adequate water bars or protected by plant cover.

This soil is well suited to use as habitat for woodland wildlife. Habitat can be improved by planting appropriate vegetation, by maintaining existing plant cover, or by encouraging the propagation of desirable plants. Prescribed burning every three years, rotated among several small tracts of land, can increase the amount of palatable browse for deer and seed-producing plants for quail and turkey. Areas suitable for small ponds are available. These ponds can provide habitat for fish, waterfowl, and furbearing animals, such as nutria, muskrat, mink, and otter.

This Sacul soil is somewhat poorly suited to use as pasture. The main limitations are low fertility and a severe hazard of erosion. Suitable pasture plants are common bermudagrass, improved bermudagrass, Pensacola bahiagrass, and crimson clover. Annual cool-season grasses, such as ryegrass or wheat, are suitable for winter forage. Fertilizer and lime are needed for optimum growth of grasses and legumes. Seedbed preparation should be on the contour or across the slope where practical. Proper stocking and pasture rotation help keep the pasture in good condition.

This soil is poorly suited to cultivated crops because of low fertility, a severe hazard of erosion, and short irregular slopes. Close-sown crops, such as small grains, are the most suitable crops to plant. In most places, irregular slopes and drainageways limit the use of equipment. Conservation tillage, terraces, diversions, and grassed waterways help control erosion. Most crops respond well to lime and fertilizer, which help to overcome the low soil fertility and reduce the level of exchangeable aluminum in the root zone.

This soil is poorly suited to urban development. It has severe limitations for building sites, local roads and streets, and most sanitary facilities. The main limitations are slope, slow permeability, high shrink-swell potential, and low strength for roads. Because erosion is a hazard in the steeper areas, only the part of the site that is used for construction should be disturbed. Roads and streets should be designed to overcome the limited ability of the soil to support a load. Septic tank absorption fields do not function properly because of slow permeability. Properly designed lagoons or self-contained sewage disposal units can be used to dispose of sewage properly.

This Sacul soil is in capability subclass VIe. The woodland ordination symbol is 8C.

Se—Severn very fine sandy loam, occasionally flooded. This soil is nearly level and well drained. It is in high positions on natural levees of the Red River. This soil is subject to occasional flooding for very brief to long periods. The areas of this soil are oblong and range from 30 to more than 500 acres. Slopes are generally long and range from 0 to 2 percent.

Typically, the surface layer is brown, mildly alkaline, very fine sandy loam about 7 inches thick. The underlying material to a depth of about 60 inches is yellowish red and reddish yellow, moderately alkaline very fine sandy loam. The soil is calcareous throughout the profile. In places, the surface layer is loamy very fine sand.

Included with this soil in mapping are a few small areas of Latanier, Moreland, and Roxana soils. Also included are small areas of Severn soils that are rarely flooded and areas that are frequently flooded. The Latanier and Moreland soils are in lower positions than the Severn soil and have a clayey subsoil. Roxana soils are in positions similar to those of the Severn soil and are not calcareous in all horizons below a depth of 10 inches. The included soils make up about 15 percent of the map unit.

This Severn soil has high fertility. Water and air move through this soil at a moderate rate. Water runs off the surface slowly and stands in low places for short periods after heavy rains. This soil is subject to very brief to long periods of flooding. Flooding occurs less often than twice in 5 years and at anytime during the year. The shrink-swell potential is low. Adequate water is available to plants in most years.

This soil is mainly used as woodland or pasture. In a few areas, it is used for cultivated crops.

This soil is well suited to the production of southern hardwoods and has few limitations for woodland use and management. Common trees are eastern cottonwood, American sycamore, black willow, pecan, and sugarberry. Suitable trees to plant are eastern cottonwood, American sycamore, pecan, and sweetgum. Reforestation, after harvesting, must be carefully managed to reduce competition from undesirable understory plants. Proper site preparation controls initial plant competition, and spraying controls subsequent growth.

This soil is well suited to use as habitat for openland and woodland wildlife. Habitat for whitetail deer, squirrels, and many species of nongame birds and animals can be improved by planting or encouraging the growth of existing oak trees and suitable understory plants. Fence lines, ditchbanks, and abandoned building sites provide cover and nesting areas for birds and small animals if vegetation is allowed to grow naturally.

This Severn soil is well suited to use as pasture. The main limitation is occasional flooding. Suitable pasture plants are common bermudagrass, improved bermudagrass, tall fescue, johnsongrass, and white clover. Proper stocking, pasture rotation, and restricted grazing during wet periods help keep the pasture and soil in good condition. Nitrogen fertilizer is needed where grasses are grown alone. Lime and other fertilizers are generally not needed.

This soil is moderately well suited to cultivated crops. It is limited mainly by occasional flooding. Grain sorghum and soybeans are the main crops grown; however, cotton and corn are also suitable crops. Flood waters can delay or prevent planting in some years, but short-season crops can be grown in most years. This soil is friable and easy to keep in good tilth. It can be worked throughout a wide range of moisture content. Traffic pans develop under continuous cultivation, but these can be broken easily by deep plowing or chiseling. Land smoothing and aligning crop rows with the soil slope can remove excess water that accumulates after heavy rains. Proper management of crop residue helps to maintain organic matter content and tilth and reduces soil loss by erosion. Nonlegume crops respond well to nitrogen fertilizer. Lime and other fertilizers generally are not needed.

This soil is poorly suited to urban development and is generally not suited to use as homesites. The areas of this soil are in a designated flood plain on the unprotected side of the Red River levee system. Flood control measures are restricted or prohibited in this area; therefore, the area is not likely to be improved for urban development.

This Severn soil is in capability subclass IIw. The woodland ordination symbol is 9A.

Sf—Severn very fine sandy loam, frequently flooded. This soil is nearly level and well drained. It is on sand bars along the Red River and is subject to frequent flooding, scouring, and deposition. The areas of this soil are irregular in shape and range from 40 to several hundred acres. Slope is generally less than 2 percent.

Typically, the surface layer is reddish brown, moderately alkaline, very fine sandy loam about 5 inches thick. The underlying material to a depth of about 60 inches is yellowish red, neutral and mildly alkaline loamy very fine sand and very fine sandy loam. The soil is calcareous in all horizons below the surface layer. In places, the surface layer is loamy very fine sand or silt loam.

Included with this soil in mapping are a few small areas of Severn soils that have slopes of 3 to 5 percent and soils similar to the Severn soil except that they are more sandy throughout the profile. Also included are small areas of Severn soils that are flooded occasionally rather than frequently. The included soils make up about 15 percent of the map unit.

This Severn soil has high fertility. Water and air move through this soil at a moderate rate, and water runs off the surface slowly. This soil is subject to very brief to long periods of flooding throughout the year. Flooding by rapidly flowing water, which results in scouring and deposition, generally occurs more often than twice in 5 years and at anytime during the year. Depth of flood water may exceed 10 feet. Areas of this soil are sometimes destroyed by bank cutting as the Red River changes its course. The shrink-swell potential is low. Adequate water is available to plants in most years.

This soil is mainly used as native grass pasture or woodland.

This soil is poorly suited to use as pasture and cropland because of flooding. The main suitable pasture plant is common bermudagrass. Native grasses also can provide forage to grazing cattle. Late-planted crops, such as soybeans, can be grown in some years. In other years, crops are damaged by flooding in summer.

This Severn soil is moderately well suited to use as woodland. Trees, such as eastern cottonwood and American sycamore, grow quickly on this soil, but they are often uprooted by rapidly flowing flood waters. The use of equipment is also limited by flooding.

This soil is generally not suited to urban development. The frequent flooding, scouring, and deposition are too severe for this use.

This Severn soil is in capability subclass Vw. The woodland ordination symbol is 9A.

Sh—Shatta very fine sandy loam, 1 to 5 percent slopes. This soil is gently sloping and moderately well drained. It is on broad ridgetops and side slopes on the uplands. The areas of this soil are broad and range from about 20 to 1,500 acres. Slopes are generally long and smooth.

Typically, the surface layer is brown, slightly acid very fine sandy loam about 7 inches thick. The subsurface layer is pale brown, medium acid very fine sandy loam to a depth of about 12 inches. The subsoil to a depth of about 32 inches is strong brown, medium acid clay loam in the upper part and yellowish brown, mottled, strongly acid clay loam in the lower part. The next layer to a depth of about 70 inches is a fragipan. It is yellowish brown, strongly acid loam and clay loam.

Included with this soil in mapping are a few small areas of Acadia, Gore, Guyton, Malbis, and Ruston soils. Acadia and Gore soils are at a slightly lower elevation than the Shatta soil and have a clayey subsoil. The Guyton soils are in drainageways and depressional areas. They are poorly drained and are grayish and loamy throughout the profile. Malbis and Ruston soils are in slightly higher positions than the Shatta soil and do not have a fragipan. The included soils make up about 20 percent of the map unit.

This Shatta soil has low fertility and moderately high levels of exchangeable aluminum that are potentially toxic to some crops. Water runs off the surface at a medium rate. Water and air move through the upper part of this soil at a moderate rate and through the lower part slowly. This soil dries quickly after rains. A seasonal high water table is perched on the fragipan about 1.5 to 3 feet below the soil surface from December to June in most years. The shrink-swell potential is low. Plants are damaged by lack of water during dry periods in summer and fall of most years.

This soil is used about equally as pasture or woodland. Small acreages are used for crops or as homesites.

This soil is well suited to use as pasture. The main limitation is low fertility. Soil erosion is a hazard during establishment of pasture grasses. Suitable pasture plants are common bermudagrass, improved bermudagrass, Pensacola bahiagrass, and crimson clover. Annual cool-season grasses, such as ryegrass and wheat, are suitable for winter forage. Seedbed preparation should be on the contour or across the slope where practical. Lime and fertilizer can overcome the low fertility and promote good growth of forage plants. Proper stocking, pasture rotation, and restricted grazing during wet periods help keep the pasture and the soil in good condition.

This soil is moderately well suited to cultivated crops. It is limited mainly by low fertility and a severe hazard of erosion. Suitable crops are cotton, corn, wheat, grain sorghum, and soybeans. This soil is friable and easy to keep in good tilth. It can be worked throughout a wide range of moisture content. Using conservation tillage and returning all crop residue to the soil or regularly adding other organic matter improve fertility and help maintain soil tilth and content of organic matter. The risk of sheet and rill erosion can be reduced by constructing gradient terraces and farming on the contour. Most crops respond well to lime and fertilizer, which help to overcome the low soil fertility and reduce the levels of exchangeable aluminum in the root zone.

This Shatta soil is well suited to use as woodland and has few limitations for use and management. The site index for loblolly pine is about 83. Common trees are loblolly pine, shortleaf pine, longleaf pine, sweetgum, white oak, hickory, and southern red oak. Roads and landings can be protected from erosion by constructing diversions and by seeding cuts and fills. Skid trails and firebreaks are subject to rilling and gullying unless provided with adequate water bars or protected by plant cover. Undesirable plants can reduce adequate natural or artificial reforestation; however, intensive site preparation and maintenance are generally not needed.

This soil is well suited to use as habitat for woodland wildlife. Habitat can be improved by planting appropriate vegetation, by maintaining existing plant cover, or by encouraging the propagation of desirable plants. Prescribed burning every three years, rotated among several small tracts of land, can increase the amount of palatable browse for deer and seed-producing plants for quail and turkey.

This soil is moderately well suited to urban development. It has moderate limitations for building sites and severe limitations for local roads and streets and most sanitary facilities. The main limitations are wetness, slow permeability, and low strength for roads. A seasonal high water table is perched above the fragipan, so drainage should be provided if buildings are constructed. Slow permeability and the high water table increase the possibility of failure of septic tank absorption fields. Lagoons or self-contained sewage disposal units can be used to dispose of sewage properly. Roads should be designed to offset the limited ability of the soil to support a load.

This Shatta soil is in capability subclass IIIe. The woodland ordination symbol is 8A.

Sm—Smithdale fine sandy loam, 8 to 20 percent slopes. This soil is strongly sloping to moderately steep and well drained. It is on side slopes on the uplands. The areas of this soil are irregular in shape and range from 10 to 150 acres. Well-defined drainageways cross most areas. Slopes are generally short and complex, but some are long and smooth.

Typically, the surface layer is dark grayish brown, slightly acid fine sandy loam about 9 inches thick. The next layer is brown, medium acid fine sandy loam to a depth of about 16 inches. The subsoil to a depth of about 66 inches is red, very strongly acid sandy clay loam and sandy loam.

Included with this soil in mapping are a few small areas of Guyton, Kisatchie, Ruston, and Sacul soils. Also included are a few small areas of soils similar to the Smithdale soil except that they have more than 10 percent gravel in the subsoil. The Guyton soils are in drainageways. They are poorly drained and are grayish throughout the profile. Kisatchie and Sacul soils are in positions similar to those of the Smithdale soil and have a clayey subsoil. Ruston soils are on narrow ridgetops and upper side slopes and have a bisequum in the profile. The included soils make up about 20 percent of the map unit.

This Smithdale soil has low fertility and moderately high levels of exchangeable aluminum that are potentially toxic to some crops. Water and air move through this soil at a moderate rate, and water runs off the surface rapidly. The shrink-swell potential is low. Plants generally are damaged by a lack of water during dry periods in summer and fall of most years.

This soil is mainly used as woodland. Small acreages are used as pasture or homesites.

This soil is moderately well suited to use as woodland. The site index for loblolly pine is about 80. The main concerns in producing and harvesting timber are a moderate erosion hazard and moderately steep slopes, which can limit the use of some equipment. Management that minimizes the risk of erosion is essential in harvesting timber. Harvesting during dry periods and locating skid trails, log landings, and haul roads properly and within limiting grades reduce erosion. Roads and landings can be protected from erosion by constructing diversions and by seeding cuts and fills. Planting trees on the contour also helps to control erosion. Conventional methods of harvesting trees can be used in the more gently sloping areas of this soil but are difficult to use in the steeper areas.

This soil is well suited to use as habitat for woodland wildlife. Habitat can be improved by planting appropriate vegetation, by maintaining existing plant cover, or by encouraging the propagation of desirable plants. Prescribed burning every three years, rotated among several small tracts of land, can increase the amount of palatable browse for deer and seed-producing plants for quail and turkey.

This Smithdale soil is somewhat poorly suited to use as pasture. The main limitations are moderately steep slopes, low fertility, and a severe hazard of erosion. Suitable pasture plants are common bermudagrass, Pensacola bahiagrass, and crimson clover. The use of equipment is limited by moderately steep slopes and drainageways. Seedbed preparation should be on the contour or across the slope where practical. Lime and fertilizer can overcome the low fertility and promote good growth of forage plants. Proper stocking and pasture rotation help keep the pasture in good condition.

This soil is poorly suited to cultivated crops. It is limited mainly by moderately steep slopes, low fertility, and a severe hazard of erosion. Close-grown crops, such as small grains, are more suitable. Drainageways and the moderately steep, irregular slopes limit the use of most equipment. Conservation tillage, terraces, diversions, and grassed waterways help control erosion.

This soil is poorly suited to most urban uses. It has severe limitations for building sites, local roads and streets, and most sanitary facilities. The main limitations are slope and seepage. Because erosion is a severe hazard, only the part of the site that is used for construction should be disturbed. The steepness of slope is a concern in installing septic tank absorption fields. Absorption lines should be installed on the contour to prevent effluent from seeping to the surface in downslope areas. If the density of housing is moderate to high, community sewage systems are needed to prevent contamination of water supplies as a result of seepage. Access roads should be designed to provide adequate cut-slope grade, and drains are needed to control surface runoff. Topsoil can be stockpiled and used to reclaim areas disturbed by cutting and filling.

This Smithdale soil is in capability subclass VIe. The woodland ordination symbol is 8R.

Wr—Wrightsville silt loam. This soil is level and poorly drained. It is on broad flats and in slight depressional areas on the uplands. The areas of this soil are irregular and range from 10 to more than 100 acres. Slopes are less than 1 percent.

Typically, the surface layer is dark grayish brown, strongly acid silt loam about 2 inches thick. The subsurface layer is light grayish brown, mottled, extremely acid silt loam to a depth of about 15 inches. The subsoil to a depth of about 54 inches is light brownish gray, mottled, very strongly acid silty clay loam in the upper part and light brownish gray, mottled, very strongly acid clay in the lower part. The substratum to a depth of about 60 inches is reddish brown, very strongly acid clay. Tongues of silt loam extend through the upper part of the subsoil.

Included with this soil in mapping are a few small areas of Acadia and Gore soils. Also included are small areas of moderately well drained, loamy soils on small circular mounds and Wrightsville soils along drainageways. These Wrightsville soils are subject to flooding. Acadia and Gore soils are on more convex slopes than the Wrightsville soil. Acadia soils have a subsoil that is brownish and loamy in the upper part. Gore soils have a reddish clayey subsoil. The included soils make up about 20 percent of the map unit.

This Wrightsville soil has low fertility and moderately high levels of exchangeable aluminum that are potentially toxic to some crops. Water runs off the surface slowly and stands in low places for long periods after heavy rains. Water and air move very slowly through the soil. A seasonal high water table is 0.5 foot to 1.5 feet below the soil surface from December to April. Flooding is rare, but it can occur during unusually wet periods. It generally occurs less often than once in 10 years and at anytime during the year. The soil dries out more slowly than most surrounding soils. It has high shrink-swell potential in the subsoil. Plants are damaged by lack of moisture during summer and fall of most years.

This soil is mainly used as woodland. Small acreages are used as pasture or cropland.

This soil is moderately well suited to use as woodland. Common trees are loblolly pine, shortleaf pine, water oak, willow oak, sweetgum, and hickory. The potential productivity of loblolly pine and hardwoods is high. The main concerns in producing and harvesting timber are the severe equipment use limitation and moderate seedling mortality because of wetness. Conventional methods of harvesting timber generally can be used, but their use may be limited during rainy periods, generally from December to April. Standard-wheeled and tracked vehicles cause rutting and soil compaction when the soil is moist and puddling can occur when the soil is wet. Using low-pressure ground equipment reduces damage to the soil and helps to maintain productivity. Logging roads require suitable surfacing for year-round use. Tree seedlings have a low rate of survival because wetness in spring and droughtiness in summer restrict root development. Planting trees on bedded rows lowers the effective depth of the water table and increases root growth and seedling survival. Reforestation, after harvesting, must be carefully managed to reduce competition from undesirable understory plants. Site preparation, such as chopping, burning, herbicide application, and bedding, should reduce debris and immediate competition and facilitate mechanical planting.

This soil is moderately well suited to use as habitat for woodland wildlife and well suited to use as habitat for wetland wildlife. Habitat for wetland wildlife can be improved by constructing shallow ponds to provide open water areas for waterfowl and furbearing animals, such as muskrat, nutria, and otter. Habitat for other wildlife can be improved by planting appropriate vegetation, by maintaining existing plant cover, or by encouraging the propagation of desirable plants.

This Wrightsville soil is well suited to use as pasture; however, wetness and low fertility are limitations. Suitable pasture plants are common bermudagrass, Pensacola bahiagrass, white clover, and winter peas. Wetness limits the choice of plants and the period of grazing. Excessive water on the surface can be removed by shallow ditches. Proper stocking, pasture rotation, and restricted grazing during wet periods help keep the pasture and the soil in good condition. Lime and fertilizer can overcome the low fertility and promote good growth of forage plants.

This soil is moderately well suited to cultivated crops. The main limitations are low fertility, wetness in spring, and droughtiness in summer. Suitable crops are rice, grain sorghum, soybeans, and cotton. A drainage system is needed for most cultivated crops. Returning crop residue to the soil or regularly adding other organic matter improves fertility, reduces crusting, and increases the water intake rate. Most crops respond well to lime and fertilizer, which help to overcome the low fertility and reduce the moderately high levels of exchangeable aluminum in the root zone. Where water of suitable quality is available, supplemental irrigation can prevent damage to crops that results during dry periods of most years.

This soil is poorly suited to most urban uses. It has severe limitations for building sites, local roads and streets, and most sanitary facilities. The main limitations are wetness, very slow permeability, high shrink-swell potential, and low strength for roads. Excess surface water can be removed by using shallow ditches and by providing the proper grade. Very slow permeability and the seasonal high water table increase the possibility of failure of septic tank absorption fields. Properly designed sewage lagoons or self-contained sewage disposal units can be used to dispose of sewage properly. The effects of shrinking and swelling can be minimized by using proper engineering designs and by backfilling with material that has low shrink-swell potential. Roads should be designed to offset the limited ability of the soil to support a load.

The Wrightsville soil is in capability subclass IIIw. The woodland ordination symbol is 6W.

Yo—Yorktown clay, frequently flooded. This soil is level and very poorly drained. It is in old channel scars and depressional areas on the alluvial plain. This soil is subject to very long periods of ponding and frequent flooding. The areas of this soil are oblong to round and range from 5 to 400 acres. Slopes are less than 1 percent.

Typically, the surface layer is gray, mottled, strongly acid clay about 6 inches thick. The subsoil to a depth of about 65 inches is dark gray, mottled, neutral clay in the upper part and reddish brown and dark reddish brown, mottled, neutral clay in the lower part. In places, the surface layer is reddish brown clay or very dark gray or black muck.

Included with this soil in mapping are a few small areas of Moreland and Perry soils. Also included are small areas of open water. The Moreland and Perry soils are in slightly higher positions than the Yorktown soil. These soils dry and crack to about 20 inches below the surface during dry periods in most years. The included soils and water make up about 20 percent of the map unit.

This Yorktown soil has medium fertility. Water and air move through this soil very slowly. It is subject to very long periods of ponding and flooding during anytime of the year. This soil is generally flooded continuously from late in fall to early in summer of most years. Depth of flood waters is typically 1 foot to 3 feet, but it can exceed 10 feet in places. During nonflood periods, water is ponded on the surface or the water table is within 0.5 foot of the soil surface. This soil has very high shrink-swell potential, but it seldom dries out enough to crack. Adequate water is available to plants in most years.

This soil is mainly used as habitat for wildlife. In a few areas, it is used for timber production (fig. 10).

This soil is moderately well suited to use as habitat for wetland wildlife. It produces habitat for resident and migratory waterfowl, many species of songbirds and wading birds, raccoons, nutria, muskrat, otter, and crawfish. Habitat can be improved by planting appropriate vegetation, by maintaining existing plant cover, or by encouraging the propagation of desirable

Figure 10.—Baldcypress is dominant in this area of Yorktown clay, frequently flooded.

plants. Openings can be made in thickly wooded or brushy areas to encourage growth of seed-producing grasses and forbs favored by waterfowl.

This soil is poorly suited to the production of commercial timber. Common trees are baldcypress, water tupelo, water locust, water hickory, black willow, and green ash. The understory vegetation is mainly water elm and button bush. The major concern in management is wetness. The high water table is at or above the soil surface for most of the year. This results in severe seedling mortality and equipment use limitations. Trees can be harvested only by using specialized equipment. Only trees that can tolerate seasonal wetness should be planted. Suitable trees to plant are baldcypress, green ash, and water tupelo.

This Yorktown soil is poorly suited to use as pasture mainly because of wetness and the long periods of flooding and ponding. It is generally not practical to overcome these problems.

This soil generally is not suited to cultivated crops. If areas are drained and water control is maintained through a system of dikes, ditches, and pumps, this soil is suited to soybeans, rice, and grain sorghum.

This soil is generally not suited to urban uses. Flooding and ponding are too severe for these uses. Ring levees, pumps, and other water control systems are needed to control flooding and remove excess water.

This Yorktown soil is in capability subclass VIIw. The woodland ordination symbol is 3w.

Prime Farmland

In this section, prime farmland is defined and discussed, and the prime farmland soils in Natchitoches Parish are listed.

Prime farmland is one of several kinds of important farmland defined by the U.S. Department of Agriculture. It is of major importance in meeting the nation's short- and long-range needs for food and fiber. The acreage of high-quality farmland is limited, and the U.S. Department of Agriculture recognizes that government at local, state, and federal levels, as well as individuals, must encourage and facilitate the wise use of our nation's prime farmland (fig. 11).

Prime farmland soils, as defined by the U.S. Department of Agriculture, are soils that are best suited

Figure 11.—Urban encroachment of prime farmland is not a major problem in Natchitoches Parish, but it is a concern. A residential area is encroaching upon Roxana very fine sandy loam, a prime agricultural soil.

to producing food, feed, forage, fiber, and oilseed crops. Such soils have properties that are favorable for the economic production of sustained high yields of crops. The soils need only to be treated and managed using acceptable farming methods. The moisture supply, of course, must be adequate, and the growing season has to be sufficiently long. Prime farmland soils produce the highest yields with minimal inputs of energy and economic resources. Farming these soils results in the least damage to the environment.

Prime farmland soils may presently be in use as cropland, pasture, or woodland, or they may be in other uses. They either are used for producing food or fiber or are available for these uses. Urban or built-up land, public land, and water areas cannot be considered prime farmland. Urban or built-up land is any contiguous unit of land 10 acres or more in size that is used for such purposes as housing, industrial, and commercial sites, sites for institutions or public buildings, small parks, golf courses, cemeteries, railroad yards, airports, sanitary landfills, sewage treatment plants, and water control structures. Public land is land not available for farming in national forests, national parks, military reservations, and state parks.

Prime farmland soils usually get an adequate and dependable supply of moisture from precipitation or irrigation. The temperature and growing season are favorable. The acidity or alkalinity level of the soils is acceptable. The soils have few or no rocks and are permeable to water and air. They are not excessively erodible or saturated with water for long periods and are not subject to frequent flooding during the growing season. The slope ranges mainly from 0 to 5 percent.

The following map units, or soils, make up prime farmland in Natchitoches Parish. The location of each map unit is shown on the detailed soil maps at the back of this publication. The extent of each unit is given in table 5. The soil qualities that affect use and management are described in the section "Detailed Soil Map Units." This list does not constitute a recommendation for a particular land use.

Soils that have limitations, such as a high water table or flooding, may qualify as prime farmland if these limitations are overcome by such measures as drainage or flood control. Only those soils are listed, however, that have few limitations and need no additional improvements to qualify as prime farmland.

Ac	Acadia silt loam
Ar	Armistead clay
Ba	Beauregard silt loam, 1 to 3 percent slopes
Ca	Caddo very fine sandy loam
Cb	Cahaba fine sandy loam, 1 to 5 percent slopes
Cn	Caspiana silty clay loam
Ga	Gallion silt loam
Cn	Gallion silty clay loam
Gt	Guyton silt loam
Ke	Keithville loam, 1 to 5 percent slopes
La	Latanier clay
Ma	Malbis fine sandy loam, 1 to 5 percent slopes
Md	Moreland silt loam
Mn	Moreland clay
Mo	Moreland clay, gently undulating
Ro	Roxana very fine sandy loam
Ru	Ruston fine sandy loam, 1 to 5 percent slopes
Sa	Sacul fine sandy loam, 1 to 5 percent slopes
Se	Severn very fine sandy loam, occasionally flooded
Sh	Shatta very fine sandy loam, 1 to 5 percent slopes
Wr	Wrightsville silt loam

Use and Management of the Soils

This soil survey is an inventory and evaluation of the soils in the survey area. It can be used to adjust land uses to the limitations and potentials of natural resources and the environment. Also, it can help avoid soil-related failures in land uses.

In preparing a soil survey, soil scientists, conservationists, engineers, and others collect extensive field data about the nature and behavior characteristics of the soils. They collect data on erosion, droughtiness, flooding, and other factors that affect various soil uses and management. Field experience and collected data on soil properties and performance are used as a basis for predicting soil behavior.

Information in this section can be used to plan the use and management of soils for crops and pasture; as woodland; as sites for buildings, sanitary facilities, highways and other transportation systems, and parks and other recreation facilities; and for wildlife habitat. It can be used to identify the potentials and limitations of each soil for specific land uses and to help prevent construction failures caused by unfavorable soil properties.

Planners and others using soil survey information can evaluate the effect of specific land uses on productivity and on the environment in all or part of the survey area. The survey can help planners to maintain or create a land use pattern that is in harmony with nature.

Contractors can use this survey to locate sources of sand and gravel, roadfill, and topsoil. They can use it to identify areas where bedrock, wetness, or very firm soil layers can cause difficulty in excavation.

Health officials, highway officials, engineers, and others may also find this survey useful. The survey can help them plan the safe disposal of wastes and locate sites for pavements, sidewalks, campgrounds, playgrounds, lawns, and trees and shrubs.

Crops and Pasture

Paul Miletello, conservation agronomist, Soil Conservation Service, helped prepare this section.

General management needed for crops and pasture is suggested in this section. The crops or pasture plants best suited to the soils, including some not commonly grown in the survey area, are identified; the system of land capability classification used by the Soil Conservation Service is explained; and the estimated yields of the main crops and hay and pasture plants are listed for each soil.

Planners of management systems for individual fields or farms should consider the detailed information given in the description of each soil under "Detailed Soil Map Units." Specific information can be obtained from the local office of the Soil Conservation Service or the Cooperative Extension Service.

About 175,000 acres in Natchitoches Parish was used for crops and pasture in 1985. Of this, about 75,000 acres was used for crops, mainly soybeans (fig 12). More than 100,000 acres was used as pasture. The acreage used for crops has steadily increased as woodland and pasture have been converted to cropland.

Differences in crop suitability and management needs result from differences in soil characteristics, such as fertility levels, erodibility, organic matter content, availability of water for plant growth, drainage, and the hazard of flooding. Cropping systems and soil tillage are also an important part of management. Each farm has a unique soil pattern; therefore, each has unique management problems. Some principles of farm management, however, apply only to specific soils and certain crops. This section presents the general principles of management that can be applied widely to the soils of Natchitoches Parish.

Pasture and Hayland

Perennial grasses or legumes, or mixtures of these, are grown for pasture and hay. The mixtures generally consist of either a summer or a winter perennial grass and a suitable legume. In addition, many farmers seed small grains or ryegrass in the fall for winter and spring forage. Excess grass in summer is harvested as hay for winter.

Common and improved bermudagrass and Pensacola bahiagrass are the summer perennials most commonly grown. Improved bermudagrass and Pensacola bahiagrass produce good quality forage. Tall fescue, the chief winter perennial grass, grows well only on soils that have a favorable moisture content. All of these grasses respond well to fertilizers, particularly nitrogen.

White clover, crimson clover, vetch, and winter peas are the most commonly grown legumes. They respond well to lime, particularly on acid soils.

Proper grazing is essential for high quality forage, stand survival, and erosion control. Brush and weed

Figure 12.—Soybeans is one of the major crops grown on Roxana very fine sandy loam.

control, fertilizer, lime, and renovation of the pasture are also important.

Some farmers obtain additional forage by grazing the understory native plants in woodland. Forage volume varies with the woodland site, the condition of the native forage, and the density of the timber stand. Although most woodland is managed mainly for timber, substantial volumes of forage can be obtained from these areas if properly managed. Stocking rates and grazing periods need to be carefully managed for optimum forage production and to maintain an adequate cover of understory plants to control erosion.

Fertilization and liming. The soils of Natchitoches Parish range from strongly acid to moderately alkaline to a depth of 20 inches. Most soils used for crops are low in content of organic matter and in available nitrogen. Acid soils require lime. The amount of fertilizer needed depends on the kind of crop to be grown, on past cropping history, on the level of yield desired, and on the kind of soil. It should be determined on the basis of soil test results. Information and instructions on collecting and testing soil samples can be obtained from the Cooperative Extension Service.

Organic matter content. Organic matter is important as a source of nitrogen for crops. It also increases the rate of water intake, reduces surface crusting, and helps maintain tilth. In Natchitoches Parish, most soils used for crops are low in organic matter content. The level of organic matter can be maintained by leaving plant residue on the surface, by growing crops that produce an extensive root system and an abundance of foliage, by adding barnyard manure, and by growing perennial grasses and legumes in rotation with other crops.

Soil tillage. Because excessive tillage destroys soil structure, soils should be tilled only enough to prepare a seedbed and to control weeds. Conservation tillage and no-till practices help maintain soil tilth. The clayey soils in the parish become cloddy if they are cultivated when too wet or too dry.

A compacted layer, generally known as a traffic pan or plowpan, sometimes develops just below the plow layer in loamy soils. It can be avoided by not plowing when the soil is wet or by varying the plowing depth. It can be broken up by subsoiling or chiseling. The use of tillage implements that stir the surface and leave crop residue in place protects the soil from beating rains. This helps control erosion, reduces runoff and surface crusting, and increases infiltration.

Drainage. Many of the soils in the parish need surface drainage to make them more suitable for crops. Early drainage methods involved a complex pattern of main ditches, laterals, and surface field ditches. The more recent approach to drainage in this parish is a combination of land smoothing with a minimum of surface drainage. This approach creates larger and more uniformly shaped fields, which are more suited to the use of modern, multirow farm machinery.

The network of levees along the Red River protects most of the cropland and pasture from flooding; nevertheless, some of the soils at lower elevations are subject to flooding by runoff from higher areas.

Water for plant growth. The soils in the parish have an available water capacity ranging from low to high. In many years, sufficient water is not available at the critical time for optimum plant growth unless supplemental water is provided by irrigation. Rainfall is plentiful in winter and spring, and sufficient rain generally falls in summer and autumn of most years to sustain crop growth. During dry periods in summer and autumn, however, most of the soils do not supply sufficient water for optimum plant-growth. This rainfall pattern favors the growth of early maturing crops.

Cropping system. A good cropping system includes a legume for nitrogen, a cultivated crop to aid in weed control, a deep-rooted crop to utilize subsoil fertility and maintain subsoil permeability, and a close-growing crop to help maintain organic matter content. The sequence of crops should keep the soil covered as much of the year as possible.

A suitable cropping system varies with the needs of the farmer and the characteristics of the soil. Producers of livestock, for example, generally use cropping systems that have higher percentages of pasture than the cropping systems of cash-crop farms. A commonly used cropping system in this parish is one in which soybeans are grown continuously or in rotation with corn, cotton, or grain sorghum. Grass or legume cover crops are grown during the fall and winter. Double cropping of wheat and soybeans is common in some places.

Control of erosion. Erosion is a major hazard on many of the soils in Natchitoches Parish. It is an especially serious problem on soils on the terrace uplands. Erosion is generally not a serious hazard on soils on the alluvial plains because the topography is mainly level to gently undulating and slopes are short. Sloping soils, such as Bellwood and Smithdale soils, are highly susceptible to erosion if left without plant cover for extended periods. Sheet erosion is common in all fallow-plowed fields and in newly constructed drainage ditches. Gullies form easily in the strongly sloping to steep soils. Soil erosion results in sedimentation of systems and pollution of streams by sediment, nutrients, and pesticides. Cropping systems that maintain a plant cover on the soil for extended periods reduce soil erosion. Conservation tillage, contour farming, grass or close-growing crops in rotation with row crops, terraces, diversions, and grassed waterways help control erosion on cropland and pasture. New drainage ditches should be seeded immediately after construction. Installing water control structures in drainageways to drop water to different levels can prevent gullying.

Additional information on erosion control, cropping systems, and drainage practices can be obtained from the local office of the Soil Conservation Service, the Cooperative Extention Service, or the Louisiana Agricultural Experiment Station.

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.

The yields are based mainly on the experience and records of farmers, conservationists, and extension agents. Available yield data from nearby parishes and results of field trials and demonstrations are also considered.

The management needed to obtain the indicated yields of the various crops depends on the kind of soil and the crop. Management can include drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate and timely tillage; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium, and trace elements for each crop; effective use of crop residue, barnyard manure, and green manure crops; and harvesting that insures the smallest possible loss.

The estimated yields reflect the productive capacity of each soil for each of the principal crops. Yields are likely to increase as new production technology is developed.

The productivity of a given soil compared with that of other soils, however, is not likely to change.

Crops other than those shown in table 6 are grown in the survey area, but estimated yields are not listed because the acreage of such crops is small. The local office of the Soil Conservation Service or of the Cooperative Extension Service can provide information about the management and productivity of the soils for those crops.

Land Capability Classification

Land capability classification shows, in a general way, the suitability of soils for use as cropland. Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The criteria used in grouping the soils do not include major, and generally expensive, landforming that would change slope, depth, or other characteristics of the soils, nor do they include possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for rangeland, for woodland, and for engineering purposes.

In the capability system, soils are generally grouped at three levels: capability class, subclass, and unit. Only class and subclass are used in this survey. These levels are defined in the following paragraphs.

Capability classes, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class I soils have few limitations that restrict their use.

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

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

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

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

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

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

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

Capability subclasses are soil groups within one class. They are designated by adding a small letter, *e, w,* or *s,* to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless a close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); and *s* shows that the soil is limited mainly because it is shallow, droughty, or stony.

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

The acreage of soils in each capability class and subclass is shown in table 7. The capability classification of each map unit is given in the section "Detailed Soil Map Units."

Woodland Management and Productivity

Carl V. Thompson, Jr., forester, Soil Conservation Service, helped prepare this section.

This section provides information on the relation between trees and their environment, particularly trees and the soils in which they grow. Information is included on the kind, amount, and condition of woodland resources in Natchitoches Parish and soils interpretations that can be used in planning.

Soil directly influences the growth, management, harvesting, and multiple uses of forests. It is the medium in which a tree is anchored and from which it draws its nutrients and moisture. Soil characteristics, such as chemical composition, texture, structure, depth, and slope position, affect tree growth, seedling survival, species adaptability, and equipment limitations.

The ability of a soil to supply moisture and nutrients to trees is strongly related to its texture, structure, and depth. Generally, sandy soils, such as Betis soils, are less fertile and have lower available water capacity than clayey soils, such as Bellwood soils. Aeration, however, is often impeded in clayey soils, particularly under wet conditions. Slope position strongly influences species composition as well as growth within an individual tree.

These soil characteristics, in combination, largely determine the forest stand species composition and influence management and use decisions. Sweetgum, for example, is tolerant of many soils and sites, but grows best on the rich, moist, alluvial loamy soils of bottom lands. Use of heavy logging and site preparation equipment is more restricted on clayey soils than on better drained, sandy or loamy soils.

Woodland Resources

Natchitoches Parish is rich in history, and the parish's forests and forest industry have played a major role in shaping this history. The parish was once entirely wooded. Although most of the bottom land hardwoods have been cleared for agricultural crops, the bottom lands once supported vast forests of oak, gum, cypress, hickory, pecan, ash, elm, and cottonwood. Only remnants of the bottom land forests are left. They generally consist of scattered low tracts, swamps, and borders along lakes, bayous, and streams. Conversely, the uplands are almost totally wooded. Only a few scattered areas are devoted to crops, pastures, small villages, or homesteads. The uplands of Natchitoches Parish are primarily in pine, although some of the bottom lands along small streams that drain the uplands produce limited quantities of hardwood.

Natchitoches Parish contains about 622,200 acres of commercial woodland *(33)*. Commercial woodland is defined as that producing or capable of producing crops of industrial wood and not withdrawn from timber use. The acreage in commercial forest decreased by about 16,800 acres between 1964 and 1974. This acreage increased again by 23,000 acres between 1974 and 1980. The acreage of woodland in Natchitoches Parish will probably stabilize at the current level, although small acreages may be converted to urban areas, transmission and transportation corridors, and pastureland. About 22 percent of the commercial forests is public forest land, 19 percent is owned by forest industry, 10 percent is private farms, and 49 percent is miscellaneous private land.

The land in the parish is divided into two major land resource areas (MLRA): Southern Mississippi Valley Alluvium and Western Coastal Plain. Dominant trees in the Western Coastal Plain MLRA are loblolly and shortleaf pine and associated sweetgum, red oaks, and white oaks. The Southern Mississippi Valley Alluvium MLRA has ash, cottonwood, elm, and sycamore on well drained soils and ash, elm, oak, gum, cypress, pecan, and hackberry on poorly drained soils.

Commercial forests may be further divided into forest types based on tree species, site quality, or age *(33)*. As used in this survey, forest types are stands of trees of similar character, composed of the same species, and growing under the same ecological and biological conditions. The forest types are named for the dominant trees.

The loblolly-shortleaf pine forest type makes up 40 percent of the forest land in the parish. Loblolly pine is generally dominant except on drier sites. Scattered hardwoods, such as sweetgum, blackgum, southern red oak, post oak, white oak, mockernut hickory, and pignut hickory, may be mixed with pines on well drained soils. On the more moist sites, sweetgum, red maple, water oak, and willow oak may be mixed with the pines. American beech and ash are associated with this forest type on fertile, well drained coves and along stream bottoms.

The oak-pine forest type makes up about 21 percent of the forest land. About 50 to 75 percent of the stocking is hardwoods, generally upland oaks, and 25 to 50 percent is softwoods that do not include cypress. The species that make up the oak-pine type are primarily the result of soil, slope, and aspect. On the higher, drier sites, the hardwood components tend to be upland oaks, such as post, southern red, and blackjack oaks. On the more moist and fertile sites, they are white and southern red oaks. Blackgum, winged elm, red maple, and various hickories are associated with the oak-pine type on both of these broad site classifications.

The oak-hickory forest type makes up 14 percent of the forest land. Upland oaks or hickory, singly or in combination, make up a plurality of the stocking. Common associates include elm and maple.

The oak-gum-cypress forest type makes up 14 percent of the forest land in Natchitoches Parish. This type is composed of bottom land forests of blackgum, sweetgum, oak, and baldcypress, singularly or in combination. Associated trees include cottonwood, black willow, ash, hackberry, maple, and elm.

The longleaf-slash pine forest type makes up 4 percent of the forest land. In this forest type, 50 percent or more of the stand is longleaf or slash pine, singly or in combination. Common associates include other southern pines, oak, and gum.

The elm-ash-cottonwood forest type makes up 3 percent of the forest land. American elm, green ash, and eastern cottonwood constitute a plurality of the stocking. Major associates include water hickory, sweetgum, boxelder, black willow, sandbar willow, Nuttall oak, willow oak, water oak, and overcup oak.

The forest land in Natchitoches Parish, by physiographic class, is 83 percent pine and 17 percent bottom land hardwood. The marketable timber volume is about 72 percent pine and 28 percent hardwood. About 52 percent of the forest acreage is in sawtimber, 19 percent is saplings and seedlings, and 29 percent is pole timbers. Most of the more productive sites are in pasture or cropland; nevertheless, 3 percent of the forest land produces 165 cubic feet or more of wood per acre. About 14 percent produces 120 to 165 cubic feet per acre, 45 percent produces 85 to 120 cubic feet per acre, 35 percent produces 50 to 85 cubic feet per acre, and 3 percent produces less than 50 cubic feet per acre *(33)*.

The importance of timber production to the economy of the parish is significant. Most of the upland pine sites are owned by forest industries, or they are in public forest land. These forests are generally well managed; however, the small, privately-owned tracts and most of the bottom land tracts are producing well below potential. Most of these tracts would benefit if stands were improved by thinning out mature trees and undesirable species. The stands also need improvement of tree planting methods and protection from grazing, fire, insects, and diseases.

The Soil Conservation Service, Louisiana Office of Forestry, or the Louisiana Cooperative Extension Service can help determine specific woodland management needs.

Production of Forage in Woodland

The kind and amount of understory vegetation that can be produced in an area is related to the soils, climate, and amount of tree overstory. In many pine woodlands, cattle grazing can be a compatible secondary use. Grazing is not recommended on hardwood woodland. Grasses, legumes, forbs, and many woody browse species in the understory are grazable if properly managed to supplement a woodland enterprise without damage to the wood crop. In fact, on most pine woodland, grazing is beneficial because it reduces the accumulation of heavy rough, which reduces the hazard of wildfires, and it helps to suppress undesirable woody plants.

The success of a combined woodland and livestock program depends primarily on the degree and time of grazing of the forage plants. Intensity of grazing should be such that adequate cover is maintained for soil protection and the quantity and quality of trees and forage vegetation is maintained or improved.

Forage production varies according to the type of woodland and the amount of sunlight that reaches the understory vegetation during the growing season. Soils that have about the same potential to produce trees also have similar potential for producing about the same kind and amount of understory vegetation. The vegetative community on these soils can reproduce itself as long as the environment does not change. Research has proven there is a close correlation between the total potential yield of grasses, legumes, and forbs in similar soils and the amount of sunlight reaching the ground at midday in the forest. Herbage production continues to decline as the forest canopy becomes denser.

One of the main objectives in good woodland grazing management is to keep the woodland forage in excellent or good condition. If this is done, water is conserved, yields are improved, and the soils are protected.

This soil survey can be used by woodland managers planning ways to increase the productivity of forest land. Some soils respond better to fertilization than others, and some are more susceptible to erosion after roads are built and timber is harvested. Some soils require special efforts to reforest. In the section "Detailed Soil Map Units," each map unit in the survey area suitable for producing timber presents information about productivity, limitations for harvesting timber, and management concerns for producing timber. Table 8 summarizes this forestry information and rates the soils for a number of factors to be considered in management. *Slight, moderate*, and *severe* are used to indicate the degree of the major soil limitations to be considered in forest management.

The first tree listed for each soil under the column "Common trees" is the indicator species for that soil. An indicator species is a tree that is common in the area and that is generally the most productive on a given soil.

Table 8 lists the *ordination symbol* for each soil. The first part of the ordination symbol, a number, indicates the potential productivity of a soil for the indicator species in cubic meters per hectare. The larger the number, the greater the potential productivity. Potential productivity is based on the site index and the point where mean annual increment is the greatest.

The second part of the ordination symbol, a letter, indicates the major kind of soil limitation for use and management. The letter *R* indicates a soil that has a significant limitation because of steepness of slope. The letter *W* indicates a soil in which excessive water, either seasonal or year-round, causes a significant limitation. The letter *D* indicates a soil that has a limitation because of restricted rooting depth, such as a shallow soil that is underlain by hard rock, hardpan, or other layers that restrict roots. The letter *C* indicates a soil that has a limitation because of the kind or amount of clay in the upper part of the soil. The letter *S* indicates a dry, sandy soil. The letter *A* indicates a soil that has no significant restrictions or limitations for forest use and management. If a soil has more than one limitation, the priority is as follows: R, W, D, C, and S.

Ratings of the *erosion hazard* indicate the probability that damage may occur if site preparation activities or harvesting operations expose the soil. The risk is *slight* if no particular preventive measures are needed under ordinary conditions; *moderate* if erosion control measures are needed for particular silvicultural activities; and *severe* if special precautions are needed to control erosion for most silvicultural activities. Ratings of *moderate* or *severe* indicate the need for construction of higher standard roads, additional maintenance of roads, additional care in planning of harvesting and reforestation operations, or use of specialized equipment.

Ratings of *equipment limitation* indicate limits on the use of forest management equipment, year-round or seasonal, because of such soil characteristics as slope, wetness, stoniness, or susceptibility of the surface layer to compaction. As slope gradient and length increase, it becomes more difficult to use wheeled equipment. On the steeper slopes, tracked equipment must be used. On the steepest slopes, even tracked equipment cannot operate; more sophisticated systems are needed. The rating is *slight* if equipment use is restricted by soil wetness for less than 2 months and if special equipment is not needed. The rating is *moderate* if slopes are steep enough that wheeled equipment cannot be operated safely across the slope, if soil wetness restricts equipment use from 2 to 6 months per year, if stoniness restricts ground-based equipment, or if special equipment is needed to avoid or reduce soil compaction. The rating is *severe* if slopes are steep enough that tracked equipment cannot be operated safely across the slope, if soil wetness restricts equipment use for more than 6 months per year, if stoniness restricts ground-based equipment, or if special equipment is needed to avoid or reduce soil compaction. Ratings of *moderate* or *severe* indicate a need to choose the most suitable equipment and to carefully plan the timing of harvesting and other management operations.

Ratings of *seedling mortality* refer to the probability of death of naturally occurring or properly planted seedlings of good stock in periods of normal rainfall as influenced by kinds of soil or topographic features. *Seedling mortality* is caused primarily by too much water or too little water. The factors used in rating a soil for seedling mortality are texture of the surface layer, depth and duration of the water table, rock fragments in the surface layer, rooting depth, and the aspect of the slope. Mortality generally is greatest on soils that have a sandy or clayey surface layer. The risk is *slight* if, after site preparation, expected mortality is less than 25 percent; *moderate* if expected mortality is between 25 and 50 percent; and *severe* if expected mortality exceeds 50 percent. Ratings of *moderate* or *severe* indicate that it may be necessary to use containerized or larger than usual planting stock or to make special site preparations, such as bedding, furrowing, installing surface drainage, or providing artificial shade for seedings. Reinforcement planting is often needed if the risk is *moderate* or *severe*.

The potential productivity of *common trees* on a soil is expressed as a *site index*. Common trees are listed in the order of their observed general occurrence. Generally, only two or three tree species dominate.

The soils that are commonly used to produce timber have the yield predicted in cubic meters. The yield is predicted at the point where mean annual increment culminates. The productivity of the soils in this survey is mainly based on 30 years for eastern cottonwood, 35 years for American sycamore, and 50 years for all other species.

The *site index* is determined by taking height measurements and determining the age of selected trees within stands of a given species. This index is the average height, in feet, that the trees attain in a specified number of years. This index applies to fully stocked, even-aged, unmanaged stands. The procedure and technique for determining site index are given in the site index tables used for the Natchitoches Parish soil survey *(8, 9, 10, 37)*.

The *productivity class* represents an expected volume produced by the most important trees, expressed in cubic meters per hectare per year. Cubic meters per hectare can be converted to cubic feet per acre by multiplying by 14.3. It can be converted to board feet by multiplying by a factor of about 71. For example, a productivity class of 8 means the soil can be expected to produce 114 cubic feet per acre per year at the point where mean annual increment culminates, or about 568 board feet per acre per year.

Trees to plant are those that are used for reforestation or, if suitable conditions exist, natural regeneration. They are suited to the soils and will produce a commercial wood crop. Desired product, topographic position (such as a low, wet area), and personal preference are three factors of many that can influence the choice of trees to use for reforestation.

Recreation

In table 9, the soils of the survey area are rated according to the limitations that affect their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites, and access to public sewerlines. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation are also important. Soils subject to flooding are limited for recreational use by the duration and intensity of flooding and the season when flooding occurs. In planning recreation facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

In table 9, the degree of soil limitation is expressed as slight, moderate, or severe. *Slight* means that soil properties are generally favorable and that limitations are minor and easily overcome. *Moderate* means that limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or by a combination of these measures.

The information in table 9 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 12 and interpretations for dwellings without basements and for local roads and streets in table 11.

Camp areas require site preparation such as shaping and leveling the tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils have gentle slopes and are not wet or subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing campsites.

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for picnic areas are firm when wet, are not dusty when dry, are not subject to flooding during the period of use, and do not have slopes, stones, or boulders that increase the cost of shaping sites or of building access roads and parking areas.

Playgrounds require soils that can withstand intensive foot traffic. The best soils are almost level and are not wet or subject to flooding during the season of use. The surface is free of stones and boulders, is firm after rains, and is not dusty when dry. If grading is needed, the depth of the soil over bedrock or a hardpan should be considered.

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

Golf fairways are subject to heavy foot traffic and some light vehicular traffic. Cutting or filling may be required. The best soils for use as golf fairways are firm when wet, are not dusty when dry, and are not subject to prolonged flooding during the period of use. They have moderate slopes and no stones or boulders on the surface. The suitability of the soil for tees or greens is not considered in rating the soils.

Wildlife Habitat

Billy R. Craft, biologist, Soil Conservation Service, helped prepare this section.

Natchitoches Parish has a large and varied population of fish and wildlife. Habitats include open agricultural land, upland pine forest, and bottom land hardwood forests, each supporting populations of game and nongame wildlife. The Red River forms the eastern boundary of the parish and is a primary migration route for waterfowl. It provides resting areas for migrating waterfowl in the fall and spring.

Areas of cropland and pasture provide food and cover for mourning dove, bobwhite quail, snipe, woodcock, killdeer, cottontail and swamp rabbits, red fox, coyote, and many songbirds and nongame animals. Temporarily flooded fields also provide food and resting areas for large concentrations of migrating waterfowl. The main limitation to small game is a shortage of adequate fall and winter cover.

The upland pine forests provide good habitat for bobwhite quail, wild turkeys, coyotes, opossums, cottontail rabbit, and white-tailed deer. Some of the wetter sites can be developed to provide habitat for waterfowl and furbearers, such as mink and muskrat (fig. 13). However, these forests are managed mainly for loblolly and longleaf pine, and management for wildlife habitat is a secondary objective.

Most of the bottom land hardwood forests in Natchitoches Parish have been cleared for use as cropland. The remaining areas of bottom land hardwoods provide habitat for white-tailed deer, gray and fox squirrel, swamp rabbit, raccoon, bobcat, coyote, wild turkey, and many birds, reptiles, and amphibians.

About 136,000 acres of forest land in the parish is public lands within the Kisatchie National Forest. These public lands are managed for multiple use of the resources. The public forest land in the southern and southwestern parts of the parish has an excellent population of wild turkeys. Part of the National Forest in the Kisatchie Hills area has been designated as a National Wilderness Area.

The many ponds, lakes, bayous, and rivers of the parish support small to large populations of fish. Major species include largemouth bass, white bass, yellow bass, striped bass, white and black crappie, sunfish, buffalo, catfish, bowfin, gar, carp, shad, and pickerel. Sibley Lake and Cane River are popular for sport fishing. Most of the private ponds in the parish are stocked with bluegill, redear sunfish, and largemouth bass.

Soils affect the kind and amount of vegetation that is available to wildlife as food and cover. They also affect the construction of water impoundments. The kind and abundance of wildlife depend largely on the amount and distribution of food, cover, and water. Wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by promoting the natural establishment of desirable plants.

In table 10, the soils in the survey area are rated according to their potential for providing habitat for various kinds of wildlife. This information can be used in planning parks, wildlife refuges, nature study areas, and other developments for wildlife; in selecting soils that are suitable for establishing, improving, or maintaining specific elements of wildlife habitat; and in determining the intensity of management needed for each element of the habitat.

The potential of the soil is rated good, fair, poor, or very poor. A rating of *good* indicates that the element or kind of habitat is easily established, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected. A rating of *fair* indicates that the element or kind of habitat can be established, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of *poor* indicates that limitations are severe for the designated element or kind of habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and must be intensive. A rating of *very poor* indicates that restrictions for the element or kind of habitat are very severe and that unsatisfactory results can be expected. Creating, improving, or maintaining habitat is impractical or impossible.

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

Grain and seed crops are domestic grains and seed-producing herbaceous plants. Soil properties and features that affect the growth of grain and seed crops

Figure 13.—This pond in a wooded area of Beauregard silt loam, 1 to 3 percent slopes, provides water for livestock and enhances the habitat for wetland and woodland wildlife.

are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of grain and seed crops are corn, wheat, rice, and grain sorghum.

Grasses and legumes are domestic perennial grasses and herbaceous legumes. Soil properties and features that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flood hazard, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are fescue, bermudagrass, bahiagrass, clover, and vetch.

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds. Soil properties and features that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of wild herbaceous plants are bluestem, goldenrod, beggarweed, crabgrass, and wooly croton.

Hardwood trees and woody understory produce nuts or other fruit, buds, catkins, twigs, bark, and foliage. Soil properties and features that affect the growth of hardwood trees and shrubs are depth of the root zone, the available water capacity, and wetness. Examples of these plants are oak, sugarberry, cherry, sweetgum, persimmon, hawthorn, dogwood, hickory, blackberry, and huckleberry. Examples of fruit-producing shrubs that are suitable for planting on soils rated *good* are Russian-olive, blueberry, and mayhaw.

Coniferous plants furnish browse and seeds. Soil properties and features that affect the growth of coniferous trees, shrubs, and ground cover are depth of the root zone, available water capacity, and wetness. Examples of coniferous plants are pine, cedar, and baldcypress.

Shrubs are bushy woody plants that produce fruit, buds, twigs, bark, and foliage. Soil properties and features that affect the growth of shrubs are depth of the root zone, available water capacity, salinity, and soil moisture. Examples of shrubs are American beautyberry, American elder, yaupon, and Allegheny chinkapin.

Wetland plants are annual and perennial, wild herbaceous plants that grow on moist or wet sites. Submerged or floating aquatic plants are excluded. Soil properties and features affecting wetland plants are texture of the surface layer, wetness, reaction, salinity, slope, and surface stoniness. Examples of wetland plants are smartweed, wild millet, wildrice, saltgrass, cordgrass, rushes, sedges, and reeds.

Shallow water areas have an average depth of less than 5 feet. Some are naturally wet areas. Others are created by dams, levees, or other water-control structures. Soil properties and features affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability. Examples of shallow water areas are marshes, waterfowl feeding areas, and ponds.

The habitat for various kinds of wildlife is described in the following paragraphs.

Habitat for openland wildlife consists of cropland, pasture, meadows, and areas that are overgrown with grasses, herbs, shrubs, and vines. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. The wildlife attracted to these areas include bobwhite quail, mourning dove, meadowlark, field sparrow, cottontail, and red fox.

Habitat for woodland wildlife consists of areas of deciduous plants or coniferous plants or both and associated grasses, legumes, and wild herbaceous plants. Wildlife attracted to these areas include wild turkey, woodcock, thrushes, woodpeckers, squirrels, gray fox, raccoon, deer, and coyote.

Habitat for wetland wildlife consists of open, marshy or swampy shallow water areas. Some of the wildlife attracted to such areas are ducks, geese, herons, shore birds, muskrat, mink, and beaver.

Engineering

This section provides information for planning land uses related to urban development and to water management. Soils are rated for various uses, and the most limiting features are identified. The ratings are given in the following tables: Building site development, Sanitary facilities, Construction materials, and Water management. The ratings are based on observed performance of the soils and on the estimated data and test data in the "Soil Properties" section.

Information in this section is intended for land use planning, for evaluating land use alternatives, and for planning site investigations prior to design and construction. The information, however, has limitations. For example, estimates and other data generally apply only to that part of the soil within a depth of 5 or 6 feet, and because of the map scale, small areas of different soils may be included within the mapped areas of a specific soil.

The information is not site specific and does not eliminate the need for onsite investigation of the soils or for testing and analysis by personnel experienced in the design and construction of engineering works.

Government ordinances and regulations that restrict certain land uses or impose specific design criteria were not considered in preparing the information in this section. Local ordinances and regulations must be considered in planning, in site selection, and in design.

Soil properties, site features, and observed performance were considered in determining the ratings in this section. During the fieldwork for this soil survey, determinations were made about grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock within 5 to 6 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kind of adsorbed cations. Estimates were made for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, and other behavioral characteristics affecting engineering uses.

This information can be used to: evaluate the potential of areas for residential, commercial, industrial, and recreational uses; make preliminary estimates of construction conditions; evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; plan detailed onsite investigations of soils and geology; locate potential sources of gravel, sand, earthfill, and topsoil; plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and predict performance of proposed small structures and pavements by comparing the performance of existing similar structures on the same or similar soils.

The information in the tables, along with the soil maps, the soil descriptions, and other data provided in this survey can be used to make additional interpretations.

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

Building Site Development

Table 11 shows the degree and kind of soil limitations that affect shallow excavations, dwellings without basements, small commercial buildings, local roads and streets, and lawns and landscaping. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

Shallow excavations are trenches or holes dug to a maximum depth of 5 or 6 feet for basements, graves, utility lines, open ditches, and other purposes. The ratings are based on soil properties, site features, and observed performance of the soils. The ease of digging, filling, and compacting is affected by the depth to bedrock or a very firm dense layer, stone content, soil texture, and slope. The time of the year that excavations can be made is affected by the depth to a seasonal high water table and the susceptibility of the soil to flooding. The resistance of the excavation walls or banks to sloughing or caving is affected by soil texture and the depth to the water table.

Dwellings and small commercial buildings are structures built on shallow foundations on undisturbed soil. The load limit is the same as that for single-family dwellings no higher than three stories. Ratings are made for small commercial buildings without basements and for dwellings without basements. The ratings are based on soil properties, site features, and observed performance of the soils. A high water table, flooding, shrink-swell potential, and organic layers can cause the movement of footings. A high water table, depth to bedrock, large stones, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 to 6 feet are not considered.

Local roads and streets have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material, a base of gravel, crushed rock, or stabilized soil material, and a flexible or rigid surface. Cuts and fills are generally limited to less than 6 feet. The ratings are based on soil properties, site features, and observed performance of the soils. Depth to bedrock, a high water table, flooding, large stones, and slope affect the ease of excavating and grading. Soil strength (as inferred from the engineering classification of the soil), shrink-swell potential, and depth to a high water table affect the traffic-supporting capacity.

Lawns and landscaping require soils on which turf and ornamental trees and shrubs can be established and maintained. The ratings are based on soil properties, site features, and observed performance of the soils. Soil reaction, a high water table, depth to bedrock, the available water capacity in the upper 40 inches, and the content of salts and sodium affect plant growth. Flooding, wetness, slope, stoniness, and the amount of sand, clay, or organic matter in the surface layer affect trafficability after vegetation is established.

Sanitary Facilities

Table 12 shows the degree and the kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

Table 12 also shows the suitability of the soils for use as daily cover for landfills. A rating of *good* indicates that soil properties and site features are favorable for the use and that good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

Septic tank absorption fields are areas in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe. Only that part of the soil between depths of 24 and 60 inches is evaluated. The ratings are based on soil properties, site features, and observed performance of the soils. Permeability, depth to a high water table, depth to bedrock, and flooding affect absorption of the effluent. Large stones and bedrock interfere with installation.

Unsatisfactory performance of septic tank absorption fields, including excessively slow absorption of effluent, surfacing of effluent, and hillside seepage, can affect public health. Ground water can be polluted if highly permeable sand and gravel or fractured bedrock is less than 4 feet below the base of the absorption field, if slope is excessive, or if the water table is near the surface. There must be unsaturated soil material beneath the absorption field to filter the effluent effectively. Many local ordinances require that this material be of a certain thickness.

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons should have a nearly level floor surrounded by cut slopes or embankments of compacted soil. Lagoons generally are designed to hold the sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water.

Table 12 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, depth to a high water table, depth to bedrock, flooding, large stones, and content of organic matter.

Excessive seepage due to rapid permeability of the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope and bedrock can cause construction problems, and large stones can hinder compaction of the lagoon floor.

Sanitary landfills are areas where solid waste is disposed of by burying it in soil. There are two types of landfill—trench and area. In a trench landfill, the waste is placed in a trench. It is spread, compacted, and covered daily with a thin layer of soil excavated at the site. In an area landfill, the waste is placed in successive layers on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil from a source away from the site.

Both types of landfill must be able to bear heavy vehicular traffic. Both types involve a risk of ground water pollution. Ease of excavation and revegetation needs to be considered.

The ratings in table 12 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock, depth to a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, soil reaction, and content of salts and sodium affect trench type landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

Daily cover for landfill is the soil material that is used to cover compacted solid waste in an area type sanitary landfill. The soil material is obtained offsite, transported to the landfill, and spread over the waste.

Soil texture, wetness, coarse fragments, and slope affect the ease of removing and spreading the material during wet and dry periods. Loamy or silty soils that are free of large stones or excess gravel are the best cover for a landfill. Clayey soils are sticky or cloddy and are difficult to spread; sandy soils are subject to soil blowing.

After soil material has been removed, the soil material remaining in the borrow area must be thick enough over bedrock or the water table to permit revegetation. The soil material used as final cover for a landfill should be suitable for plants. The surface layer generally has the best workability, more organic matter, and the best potential for plants. Material from the surface layer should be stockpiled for use as the final cover.

Construction Materials

Table 13 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good, fair,* or *poor* as a source of roadfill and topsoil. They are rated as a probable or improbable source of sand and gravel. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

Roadfill is soil material that is excavated in one place and used in road embankments in another place. In this table, the soils are rated as a source of roadfill for low embankments, generally less than 6 feet high and less exacting in design than higher embankments.

The ratings are for the soil material below the surface layer to a depth of 5 or 6 feet. It is assumed that soil layers will be mixed during excavating and spreading. Many soils have layers of contrasting suitability within their profile. The table showing engineering index properties provides detailed information about each soil layer. This information can help determine the suitability of each layer for use as roadfill. The performance of soil after it is stabilized with lime or cement is not considered in the ratings.

The ratings are based on soil properties, site features, and observed performance of the soils. The thickness of suitable material is a major consideration. The ease of excavation is affected by large stones, a high water table, and slope. How well the soil performs in place after it has been compacted and drained is determined by its strength (as inferred from the engineering classification of the soil) and shrink-swell potential.

Soils rated *good* contain significant amounts of sand or gravel or both. They have at least 5 feet of suitable material, low shrink-swell potential, few cobbles and stones, and slopes of 15 percent or less. Depth to the water table is more than 3 feet. Soils rated *fair* are more than 35 percent silt- and clay-sized particles and have a plasticity index of less than 10. They have moderate shrink-swell potential, slopes of 15 to 25 percent, or many stones. Depth to the water table is 1 to 3 feet. Soils rated *poor* have a plasticity index of more than 10, a high shrink-swell potential, many stones, or slopes of more than 25 percent. They are wet, and the depth to the water table is less than 1 foot. They may have layers of suitable material, but the material is less than 3 feet thick.

Sand and gravel are natural aggregates suitable for commercial use with a minimum of processing. Sand and gravel are used in many kinds of construction. Specifications for each use vary widely. In table 13, only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

The properties used to evaluate the soil as a source of sand or gravel are gradation of grain sizes (as indicated by the engineering classification of the soil), the thickness of suitable material, and the content of rock fragments. Kinds of rock, acidity, and stratification are given in the soil series descriptions. Gradation of grain sizes is given in the table on engineering index properties.

A soil rated as a probable source has a layer of clean sand or gravel or a layer of sand or gravel that is up to 12 percent silty fines. This material must be at least 3 feet thick and less than 50 percent, by weight, large stones. All other soils are rated as an improbable source. Coarse fragments of soft bedrock, such as shale and siltstone, are not considered to be sand and gravel.

Topsoil is used to cover an area so that vegetation can be established and maintained. The upper 40 inches of a soil is evaluated for use as topsoil. Also evaluated is the reclamation potential of the borrow area.

Plant growth is affected by toxic material and by such properties as soil reaction, available water capacity, and fertility. The ease of excavating, loading, and spreading is affected by rock fragments, slope, a water table, soil texture, and thickness of suitable material. Reclamation of the borrow area is affected by slope, a water table, rock fragments, bedrock, and toxic material.

Soils rated *good* have friable, loamy material to a depth of at least 40 inches. They are free of stones and cobbles, have little or no gravel, and have slopes of less than 8 percent. They are low in content of soluble salts, are naturally fertile or respond well to fertilizer, and are not so wet that excavation is difficult.

Soils rated *fair* are sandy soils, loamy soils that have a relatively high content of clay, soils that have only 20 to 40 inches of suitable material, soils that have an appreciable amount of gravel, stones, or soluble salts, or soils that have slopes of 8 to 15 percent. The soils are not so wet that excavation is difficult.

Soils rated *poor* are very sandy or clayey, have less than 20 inches of suitable material, have a large amount of gravel, stones, or soluble salts, have slopes of more than 15 percent, or have a seasonal water table at or near the surface.

The surface layer of most soils is generally preferred for topsoil because of its organic matter content. Organic matter greatly increases the absorption and retention of moisture and releases a variety of plant-available nutrients as it decomposes.

Water Management

Table 14 gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas and embankments, dikes, and levees. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and are easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increase in construction costs, and possibly increased maintenance are required.

This table also gives the restrictive features that affect each soil for drainage, irrigation, terraces and diversions, and grassed waterways.

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have low seepage potential in the upper 60 inches. The seepage potential is determined by the permeability of the soil and the depth to fractured bedrock or other permeable material. Excessive slope can affect the storage capacity of the reservoir area.

Embankments, dikes, and levees are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. In this table, the soils are rated as a source of material for embankment fill. The ratings apply to the soil material below the surface layer to a depth of about 5 feet. It is assumed that soil layers will be uniformly mixed and compacted during construction.

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth greater than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of stones or boulders, organic matter, or salts or sodium. A high water table affects the amount of usable material. It also affects trafficability.

Drainage is the removal of excess surface and subsurface water from the soil. How easily and effectively the soil is drained depends on the depth to bedrock or to other layers that affect the rate of water movement, permeability, depth to a high water table or depth of standing water if the soil is subject to ponding, slope, and susceptibility to flooding. Excavating and grading and the stability of ditchbanks are affected by depth to bedrock, large stones, slope, and the hazard of cutbanks caving. The productivity of the soil after drainage is adversely affected by extreme acidity or by toxic substances in the root zone, such as salts or sodium. Availability of drainage outlets is not considered in the ratings.

Irrigation is the controlled application of water to supplement rainfall and support plant growth. The design and management of an irrigation system are affected by depth to the water table, the need for drainage, flooding, available water capacity, intake rate, permeability, erosion hazard, and slope. The construction of a system is affected by large stones and depth to bedrock. The performance of a system is affected by the depth of the root zone, the amount of salts or sodium, and soil reaction.

Terraces and diversions are embankments or a combination of channels and ridges constructed across a slope to reduce erosion and conserve moisture by intercepting runoff. Slope, wetness, large stones, and depth to bedrock affect the construction of terraces and diversions. A restricted rooting depth, a severe hazard of water erosion, an excessively coarse texture, and restricted permeability adversely affect maintenance.

Grassed waterways are natural or constructed channels, generally broad and shallow, that conduct surface water to outlets at a nonerosive velocity. Large stones, wetness, slope, and depth to bedrock affect the construction of grassed waterways. Low available water capacity, restricted rooting depth, toxic substances such as salts or sodium, and restricted permeability adversely affect the growth and maintenance of the grass after construction.

Soil Properties

Data relating to soil properties are collected during the course of the soil survey. The data and the estimates of soil and water features, listed in tables, are explained on the following pages.

Soil properties are determined by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed. During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps. Samples are taken from some typical profiles and tested in the laboratory to determine grain-size distribution, plasticity, and compaction characteristics.

Estimates of soil properties are based on field examinations and on laboratory tests of samples of similar soils in nearby areas. Tests verify field observations, verify properties that cannot be estimated accurately by field observation, and help characterize key soils.

The estimates of soil properties shown in the tables include the range of grain-size distribution and Atterberg limits, the engineering classifications, and the physical and chemical properties of the major layers of each soil. Pertinent soil and water features also are given.

Engineering Index Properties

Table 15 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

Depth to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given for each soil series under "Soil Series and Their Morphology."

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter. "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is as much as 15 percent, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the Glossary.

Classification of the soils is determined according to the Unified soil classification system *(3)* and the system adopted by the American Association of State Highway and Transportation Officials *(2)*.

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as PT. Soils exhibiting engineering properties of two groups can have a dual classification, for example, SP-SM.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20, or higher, for the poorest.

Rock fragments larger than 3 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an ovendry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in nearby areas and on estimates made in the field.

Liquid limit and *plasticity index* (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from nearby areas and on field examination.

Physical and Chemical Properties

Table 16 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

Clay as a soil separate, or component, consists of mineral soil particles that are less than 0.002 millimeter in diameter. In this table, the estimated clay content of each major soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The amount and kind of clay greatly affect the fertility and physical condition of the soil. They influence the soil's adsorption of cations, moisture retention, shrink-swell potential, permeability, plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earthmoving operations.

Moist bulk density is the weight of soil (ovendry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at 1/3 bar moisture tension. Weight is determined after drying the soil at 105 degrees C. In this table, the estimated moist bulk density of each major soil horizon is expressed in grams per cubic centimeter of soil material that is less than 2 millimeters in diameter. Bulk density data are used to compute shrink-swell potential, available water capacity, total pore space, and other soil properties. The moist bulk density of a soil indicates the pore space available for water and roots. A bulk density of more than 1.6 can restrict water storage and root penetration. Moist bulk density is influenced by texture, kind of clay, content of organic matter, and soil structure.

Permeability refers to the ability of a soil to transmit water or air. The estimates indicate the rate of movement of water through the soil when the soil is saturated. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Permeability is considered in the design of soil drainage systems, septic tank absorption fields, and construction where the rate of water movement under saturated conditions affects behavior.

Available water capacity refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage in each major soil layer is stated in inches of water per inch of soil. The capacity varies, depending on soil properties that affect the retention of water and the depth of the root zone. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

Soil reaction is a measure of acidity or alkalinity and is expressed as a range in pH values. The range in pH of each major horizon is based on many field tests. For many soils, values have been verified by laboratory analyses. Soil reaction is important in selecting crops and other plants, in evaluating soil amendments for fertility and stabilization, and in determining the risk of corrosion.

Shrink-swell potential is the potential for volume change in a soil with a loss or gain in moisture. Volume change occurs mainly because of the interaction of clay minerals with water and varies with the amount and type of clay minerals in the soil. The size of the load on the soil and the magnitude of the change in soil moisture content influence the amount of swelling of soils in place. Laboratory measurements of swelling of undisturbed clods were made for many soils. For others, swelling was estimated on the basis of the kind and amount of clay minerals in the soil and on measurements of similar soils.

If the shrink-swell potential is rated moderate to very high, shrinking and swelling can cause damage to buildings, roads, and other structures. Special design is often needed.

Shrink-swell potential classes are based on the change in length of an unconfined clod as moisture content is increased from air-dry to field capacity. The change is based on the soil fraction less than 2 millimeters in diameter. The classes are *low*, a change of less than 3 percent; *moderate*, 3 to 6 percent; and *high*, more than 6 percent. *Very high*, greater than 9 percent, is sometimes used.

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average annual rate of soil loss by sheet and rill erosion. Losses are expressed in tons per acre per year. These estimates are based primarily on percentage of silt, sand, and organic matter (up to 4 percent) and on soil structure and permeability. Values of K range from 0.02 to 0.69. The higher the value, the more susceptible the soil is to sheet and rill erosion by water.

Erosion factor T is an estimate of the maximum average annual rate of soil erosion by wind or water that can occur over a sustained period without affecting crop productivity. The rate is expressed in tons per acre per year.

Organic matter is the plant and animal residue in the soil at various stages of decomposition.

In table 16, the estimated content of organic matter in the plow layer is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of organic matter of a soil can be maintained or increased by returning crop residue to the soil. Organic matter affects the available water capacity, infiltration rate, and tilth. It is a source of nitrogen and other nutrients for crops.

Soil and Water Features

Table 17 gives estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

Hydrologic soil groups are used to estimate runoff from precipitation. Soils are assigned to one of four groups. They are grouped according to the intake of water when the soils are thoroughly wet and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Flooding, the temporary covering of the soil surface by flowing water, is caused by overflowing streams, by runoff from adjacent slopes, or by inflow from high tides. Shallow water standing or flowing for short periods after rainfall or snowmelt is not considered flooding. Standing water in swamps and marshes or in a closed depression is considered ponding.

Table 17 gives the frequency and duration of flooding and the time of year when flooding is most likely to occur.

Frequency, duration, and probable dates of occurrence are estimated. Frequency generally is expressed as *none, rare, occasional,* or *frequent. None* means that flooding is not probable. *Rare* means that flooding is unlikely but possible under unusual weather conditions (there is a 1 to 10 percent chance of flooding in any year). *Occasional* means that flooding occurs infrequently under normal weather conditions (there is a 11 to 40 percent chance of flooding in any year). *Frequent* means that flooding occurs often under normal weather conditions (there is more than a 40 percent chance of flooding in any year). *Common* is used when classification as occasional or frequent does not affect interpretations. Duration is expressed as *very brief* (less than 2 days), *brief* (2 to 7 days), *long* (7 days to 1 month), and *very long* (more than 1 month). The time of year that floods are most likely to occur is expressed in months. June-November, for example, means that flooding can occur during the period June through November. About two-thirds to three-fourths of all flooding occurs during the stated period.

The definitions of the frequency of flooding for the rare, occasional, and frequently flooded phases differ from the National Soil Conservation Service definition of flooding in that the frequency of flooding for each of these phases is slightly different.

The information on flooding is based on evidence in the soil profile, namely, thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and absence of distinctive horizons, which are characteristic of soils that are not subject to flooding.

Also considered are local information about the extent and levels of flooding and the relation of each soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

High water table (seasonal) is the highest level of a saturated zone in the soil in most years. The depth to a seasonal high water table applies to undrained soils. The estimates are based mainly on the evidence of a saturated zone, namely grayish colors or mottles in the soil. Indicated in table 17 are the depth to the seasonal high water table; the kind of water table, that is, *perched* or *apparent;* and the months of the year that the water table commonly is highest. A water table that is seasonally high for less than 1 month is not indicated in table 17.

An *apparent* water table is a thick zone of free water in the soil. It is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil. A *perched* water table is water standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

The two numbers in the "High water table-Depth" column indicate the normal range in depth to a saturated zone. Depth is given to the nearest half foot. The first numeral in the range indicates the highest water level. A plus sign preceding the range in depth indicates that the water table is above the surface of the soil. "More than 6.0" indicates that the water table is below a depth of 6 feet or that the water table exists for less than a month.

Depth to bedrock is given if bedrock is within a depth of 5 feet. The depth is based on many soil borings and on observations during soil mapping. The rock is specified as either soft or hard. If the rock is soft or fractured, excavations can be made with trenching machines, backhoes, or small rippers. If the rock is hard or massive, blasting or special equipment generally is needed for excavation.

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors creates a severely corrosive environment. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than steel in installations that are entirely within one kind of soil or within one soil layer.

For uncoated steel, the risk of corrosion, expressed as *low*, *moderate*, or *high*, is based on soil drainage class, total acidity, electrical resistivity near field capacity, and electrical conductivity of the saturation extract.

For concrete, the risk of corrosion is also expressed as *low*, *moderate*, or *high*. It is based on soil texture, acidity, and the amount of sulfates in the saturation extract.

Soil Fertility Levels

Dr. M.C. Amacher and Dr. B.J. Miller, Department of Agronomy, Louisiana Agricultural Experiment Station, Louisiana State University Agricultural Center, prepared this section.

This section gives information concerning the environmental factors and the physical and chemical properties of the soils that affect the potential for crop production. It also lists the methods used to obtain the chemical analyses of the soils sampled.

Crop composition and yield are a function of many soil, plant, and environmental factors. A list and brief description of the more important factors follows:

Environmental factors:

- Light—intensity and duration
- Temperature—air and soil
- Precipitation—distribution and amount
- Atmospheric carbon dioxide concentration

Plant factors (species and hybrid specific):

- Rate of nutrient and water uptake
- Rate of growth and related plant functions

Soil factors—physical properties:

- Particle-size distribution, texture
- Structure
- Surface area
- Bulk density
- Water retention and flow
- Aeration

Soil factors—chemical properties:

- Quantity factor—Amount of an element in the soil that is readily available for uptake by plants. To determine the quantity factor, the available supply of an element is removed from the soil, using a suitable extractant, and is analyzed.
- Intensity factor—The concentration of an element species in the soil moisture. It is a measure of the availability of an element for uptake by plant roots. Two soils that have identical quantities of an element's available supply, but have different element intensity factors will differ in element availability to the plant.
- Relative intensity factor—Effect that the availability of one element has on the availability of another element.
- Quantity/Intensity relationship factor—The relationship includes the reactions between the soil surface and soil water that control the distribution of element species between the available supply in the soil and the soil water. A special quantity/intensity relationship is the buffer capacity of the soil for a given element. The buffer capacity is the amount of a given element that must be added to or removed from the available supply to produce a given change in the intensity factor for that element.
- Replenishment factor—Rate of replenishment of the available supply and intensity factors by weathering reactions, fertilizer additions, and transport by mass flow and diffusion.

These soil factors are interdependent. The magnitude of the factors and the interactions among them control crop response. The relative importance of each factor changes from soil to soil, crop to crop, and environment to environment. The soil factors are only part of the overall system.

The goal of soil testing is to provide information for a soil and crop management program that establishes and maintains optimum levels and balance of the essential elements in the soil for crop and animal nutrition and protects the environment against the buildup of potentially toxic levels of essential and nonessential elements. Current soil tests measure only one soil factor, the available supply of nutrients in the surface or plow layer. Where crop production is clearly limited by the available supply of one or more nutrients in the plow layer, existing soil tests generally can diagnose the problem and reliable recommendations to correct the problem can be made. Soil management systems generally are based on physical and chemical alteration of the plow layer. Characteristics of this layer can vary from one location to another depending upon management practices and soil use.

The underlying layers are less subject to change or change very slowly as a result of alteration of the plow layer. The properties of the subsoil reflect the soil's inherent ability to supply nutrients to plant roots and to provide a favorable environment for root growth. If soil fertility recommendations based on current soil tests are followed, major fertility problems in the plow layer are normally corrected. Crop production is then limited by crop and environment factors, physical properties of the plow layer, and physical and chemical properties of the subsoil.

Although the soil's available nutrient supply is only one factor affecting crop production, it is an important factor. Information on the available nutrient supply in the subsoil allows evaluation of the native fertility levels of the soil.

Soils were sampled during the soil survey and analyzed for pH; organic carbon content; extractable phosphorus; exchangeable cations of calcium; magnesium, potassium; sodium; aluminum, and hydrogen; total acidity; and cation exchange capacity. The results are summarized in table 18. The methods used in obtaining the data are indicated in the list that follows. The codes in parentheses refer to published methods *(36)*. More detailed information on chemical analyses of soils is available *(1, 23, 24, 30, 31)*.

Reaction (pH)—1:1 soil/water solution (8C1a).

Organic carbon—acid-dichromate oxidation (6A1a).

Extractable phosphorus—Bray 2 extractant (0.03 molar ammonium-molar hydrochloric acid).

Exchangeable bases—pH 7, 1 molar ammonium acetate, calcium (6N2), magnesium (602), potassium (6Q2), sodium (6P2).

Exchangeable aluminum and hydrogen—1 molar potassium chloride (6G2).

Total acidity—pH 8.2, barium chloride-triethanolamine (6Hla).

Effective Cation-exchange capacity—sum of bases plus exchangeable aluminum and hydrogen (5A3b).

Sum Cation-exchange capacity—sum of bases plus total acidity (5A3a).

Base saturation—sum of bases/sum cation-exchange capacity (5C3).

Exchangeable sodium percentage—exchangeable sodium/sum cation-exchange capacity.

Aluminum saturation—exchangeable aluminum/effective cation-exchange capacity.

In general, four major soil profile types with respect to soil fertility can be distinguished. The first type includes soils containing relatively high levels of available nutrients throughout the soil profile. This type reflects the relatively high fertility status of the parent material from which the soils developed and a relatively young age or a less intense degree of weathering of the soil profile.

The second type includes soils that have relatively low levels of available nutrients in the surface horizon, but these levels generally increase with depth. These soils have relatively fertile parent material but are older soils that have been subjected to weathering over a longer period of time or to a more intense weathering. Crops grown in these soils can exhibit deficiency symptoms early in the growing season if the levels of available nutrients in the surface horizon are low enough. If the crop roots are able to penetrate to the more fertile subsoil, deficiency symptoms often disappear.

The third type includes soils that have adequate or relatively high levels of available nutrients in the surface layer, but have relatively low levels in the subsoil. Such soils developed from low fertility parent material or are older soils that have been subjected to more intense weathering over a longer period of time. The higher nutrient levels in the surface horizon generally are a result of fertilizer additions to agricultural soils or biocycling in undisturbed soils.

The fourth type includes soils that have relatively low levels of available nutrients throughout the soil profile. These soils developed from low fertility parent material or are older soils that have been subjected to intense weathering over a long period of time. These soils have not accumulated nutrients in the surface horizon as a result of fertilizer additions or biocycling.

Soil properties, such as pH and acidity, can also show the general distribution patterns described above. These distributions are a result of the interactions of parent material, weathering (climate), time, and to a lesser extent organisms and topography.

Nitrogen. Generally, over 90 percent of the nitrogen in the surface layer is in the form of organic nitrogen. Most of the nitrogen in the subsoil is in the form of fixed ammonium compounds. These forms of nitrogen are unavailable for plant uptake, but they can be converted to readily available ammonium and nitrate species.

Nitrogen is generally the most limiting nutrient element in crop production because plants have a high demand for it. Because reliable nitrogen soil tests are not available, nitrogen fertilizer recommendations are nearly always based on the nitrogen requirement of the crop rather than nitrogen soil test levels.

Despite the lack of an adequate nitrogen soil test, the amounts of readily available ammonium and nitrate-nitrogen in soils, the amount of organic nitrogen, the rate of mineralization of organic nitrogen to available forms, and the rate of conversion of fixed ammonium-nitrogen to available forms provide information on the fertility status of a soil with respect to nitrogen. Unfortunately, since the amounts and rates of transformation of the various forms of nitrogen in the soils of Natchitoches Parish are unknown, no assessment of the nitrogen fertility status of these soils can be given.

Phosphorus. Phosphorus exists as discrete solid phase minerals such as hydroxyapatite, variscite, and strengite; as occluded or coprecipitated phosphorus in other minerals; as retained phosphorus on mineral surfaces, such as carbonates, metal oxides, and layer silicates; and in organic compounds. Because most of the phosphorus in soils is unavailable for plant uptake, the availability of phosphorus in the soil is an important factor in controlling phosphorus uptake by plants.

The Bray 2 extractant tends to extract more phosphorus than the more commonly used Bray 1, Mehlich I, and Olsen extractants. The Bray 2 extractant provides an estimate of the plant available supply of phosphorus in soils. According to the soil test interpretation guidelines used in Louisiana, the Bray 2 extractable phosphorus content of most of the soils in Natchitoches Parish is very low. The very low levels of available phosphorus are a limiting factor in crop production. The soils require continual additions of fertilizer phosphorus to build up and maintain adequate levels of available phosphorus for sustained crop production.

The Betis, Bienville, Caddo, Gore, Shatta, and Wrightsville soils contain very low levels of extractable phosphorus throughout the soil profile. The Cahaba soil contains a high level of extractable phosphorus in the surface layer. This is most likely a result of the recent addition of fertilizer phosphorus. The Caspiana, Moreland, Roxana, and Severn soils contain variable amounts of phosphorus, but these levels are in the medium to high range. The extractable phosphorus content of the Gallion, Morse, Perry, and Yorktown soils increases with depth and ranges from medium to high according to soil test interpretation guidelines. The subsoil of the Caspiana and Gallion soils can be a significant source of available phosphorus to plants as the roots extend through the profile. Addition of fertilizer phosphorus is necessary, however, to maintain sustained crop production since subsoil nutrient reserves may be depleted.

Potassium. Potassium exists in three major forms in soils: exchangeable potassium associated with negatively charged sites on clay mineral surfaces, nonexchangeable potassium trapped between clay mineral interlayers, and structural potassium within the crystal lattice of minerals. The exchangeable form of potassium in soils is replaceable by other cations and is generally readily available for plant uptake. To become available to plants, the other forms of potassium must be converted to the exchangeable form via weathering reactions.

The exchangeable potassium content of the soils is an estimate of the plant available supply of potassium. According to soil test interpretation guidelines, the available supply of potassium in most of the soils of Natchitoches Parish is in the very low, low, or medium range, depending upon the soil texture. Exchangeable potassium levels are generally low throughout the Betis soils that formed in unconsolidated sands and sandy loam parent material, but the levels may increase slightly with depth, as in the Ruston soils, as clay content increases. This indicates a general lack of micaceous minerals, which are a source of exchangeable potassium during weathering. The exchangeable potassium content of the Anacoco and Bellwood soils that developed from unconsolidated acid clays generally remains about the same or increases with depth. Increases in exchangeable potassium with depth can be associated with increasing clay content. The exchangeable potassium levels in the Natchitoches soils that developed from unconsolidated alkaline clays are generally high throughout the soil profile. The exchangeable potassium content of the Beauregard and Shatta soils is generally low throughout the soil profile. The exchangeable potassium content in the Latanier, Moreland, Perry, and Yorktown soils is much higher than that of most of the other soils in the parish because of a higher clay content, but according to soil test interpretation guidelines, it is still in the low to medium range depending on the soil texture. The soils that have a relatively low clay content, such as the Severn soils, generally contain low amounts of exchangeable potassium. The higher levels of exchangeable potassium generally are in the loamy and clayey soil horizons. Higher levels are also in soils where fertilizer potassium has been applied.

Crops respond to fertilizer potassium if exchangeable potassium levels are very low to low. Low levels can be gradually built up by adding fertilizer potassium if the soils contain a sufficient amount of clay to hold the potassium. Exchangeable potassium levels can be maintained by adding enough fertilizer potassium to make up for that removed by crops, the fixation of exchangeable potassium to nonexchangeable potassium, and leaching. Some soils in Natchitoches Parish, such as the Betis soils, do not contain a sufficient amount of clay, and therefore, a sufficiently high cation exchange capacity to maintain adequate quantities of available potassium for sustained crop production. In these soils, more frequent additions of potassium are necessary because of leaching.

Magnesium. Magnesium exists in soils as exchangeable magnesium associated with negatively-charged sites on clay mineral surfaces and as structural magnesium in mineral crystal lattices. Exchangeable magnesium is generally readily available for plant uptake; structural magnesium must be converted to exchangeable magnesium during mineral weathering reactions.

According to soil test interpretation guidelines, the exchangeable magnesium content of the soils of Natchitoches Parish is low, medium, or high, depending upon soil texture. In general, the exchangeable magnesium content of the soils on uplands, such as the Bellwood soils, increases with depth. This increase is associated with an increasing clay content in the subsoil. The exception to this is the Smithdale soils where the exchangeable magnesium levels decrease with depth. In the Ruston soils, the exchangeable magnesium content greatly increases from the surface layer to the subsoil. The Anacoco soils have the highest exchangeable magnesium levels in the upper part of the subsoil. Among the soils formed in alluvium, the exchangeable magnesium levels in the Gallion soils generally increase with depth, or the levels remain about the same throughout the profile, such as in Perry soils.

Medium exchangeable magnesium levels are adequate for crop production, especially where the plant roots can exploit the high levels that are in the subsoil. Because magnesium deficiencies in some plants are possible if levels are low, additions of fertilizer magnesium can be beneficial on some of the soils.

Calcium. Calcium exists in soils as exchangeable calcium associated with negatively charged sites on clay mineral surfaces and as structural calcium in mineral crystal lattices. Exchangeable calcium is generally available for plant uptake while structural calcium is not.

According to soil test interpretation guidelines, the exchangeable calcium levels in the soils of Natchitoches Parish are low, medium, or high, depending upon soil texture. Calcium deficiencies in plants are extremely rare. Calcium is normally added to soils from liming material used to correct problems associated with soil acidity.

Calcium is normally the most plentiful exchangeable cation in soils; however, in the subsoil of the Acadia, Beauregard, Bellwood, Bienville, Gore, Keithville, Ruston, Sacul, and Shatta soils, the exchangeable magnesium levels are greater than the exchangeable calcium levels. In the other soils, the exchangeable calcium levels are greater than or about the same as the exchangeable magnesium levels.

High levels of exchangeable calcium in the surface layer are normally associated with higher pH levels than are in the subsoil. The higher levels are probably the result of applications of lime to control soil acidity. Higher levels in the subsoil are generally associated with higher clay content or with free carbonates when pH levels are high.

Organic Matter. The organic matter content of a soil greatly influences other soil properties. High organic matter levels in mineral soils are desirable, and low levels can lead to many problems. Increasing the organic matter content of a soil can greatly improve the soil's structure, drainage, and other physical properties. It can also increase moisture-holding capacity, cation exchange capacity, and nitrogen content.

Increasing organic matter content is difficult because organic matter is continually subjected to microbial degradation. This is especially true in Louisiana where higher temperatures increase microbial activity. The rate of breakdown of organic matter in native plant communities is balanced by the rate of input of fresh material. Disruption of this natural process can lead to a decline in the organic matter content of the soil. Management practices that promote soil erosion lead to a further decrease.

If no degradation of organic matter occurs, 10 tons of organic matter are needed to raise the organic matter content of the top 6 inches of soil by just 1 percent. Since breakdown of organic matter does occur in the soil, several decades of adding large amounts of organic matter to the soil are needed to produce a small increase in the organic matter content. Conservation tillage and cover crops slowly increase the organic matter content over time, or at least prevent further declines.

The organic matter content of most soils in Natchitoches Parish is low. It decreases sharply with depth because fresh organic matter is confined to the surface layer. The low levels reflect the high rate of organic matter degradation, erosion, and cultural practices that make maintenance of organic matter difficult at higher levels.

Sodium. Sodium exists in soils as exchangeable sodium associated with negatively charged sites on clay mineral surfaces and as structural sodium in mineral crystal lattices. Because primary sodium minerals are readily soluble and are generally not strongly retained by soils, well drained soils subjected to a moderate or more intense degree of weathering from rainfall do not normally contain significant amounts of sodium. Soils in low rainfall environments, soils that have restricted drainage in the subsoil, and soils on the Coastal Marsh contain significant amounts of sodium. High levels of exchangeable sodium are associated with undesirable physical properties, such as poor structure, slow permeability, and restricted drainage.

Although many soils in Natchitoches Parish contain more exchangeable sodium than exchangeable potassium, none of these soils contain excessive levels of exchangeable sodium in the root zone. Elevated levels of exchangeable sodium are in the subsoil of the Guyton soils.

pH, exchangeable aluminum and hydrogen, exchangeable and total acidity. The pH of the soil solution in contact with the soil affects other soil properties. Soil pH is an intensity factor rather than a quantity factor. The lower the pH, the more acidic the soil. Soil pH controls the availability of essential and nonessential elements for plant uptake by controlling mineral solubility, ion exchange, and adsorption/desorption reactions with the soil surface. Soil pH also affects microbial activity.

Aluminum exists in soils as exchangeable monomeric hydrolysis species, nonexchangeable polymeric hydrolysis species, aluminum oxides, and aluminosilicate minerals. Exchangeable aluminum in soils is determined by extraction with neutral salts, such as potassium chloride or barium chloride. The exchangeable aluminum in soils is directly related to pH. If pH is less than 5.5, the soils have significant amounts of exchangeable aluminum that has a charge of plus 3. This amount of aluminum is toxic to plants. The toxic effects of aluminum on plant growth can be alleviated by adding lime to convert exchangeable aluminum to nonexchangeable polymeric hydrolysis species. High levels of organic matter can also alleviate aluminum toxicity.

Sources of exchangeable hydrogen in soils include hydrolysis of exchangeable and nonexchangeable aluminum and pH-dependent exchange sites on metal oxides, certain layer silicates, and organic matter. Exchangeable hydrogen as determined by extraction with such neutral salts as potassium chloride is normally not a major component of soil acidity because it is not readily replaceable by other cations unless accompanied by a neutralization reaction. Most of the neutral salt exchangeable hydrogen in soils apparently comes from aluminum hydrolysis.

Acidity from hydrolysis of neutral salt exchangeable aluminum plus neutral salt exchangeable hydrogen from pH-dependent exchange sites makes up the exchangeable acidity in soils. Exchangeable acidity is determined at the pH of the soil. Titratable acidity is the amount of acidity neutralized to a selected pH, generally pH 7 or 8.2, and constitutes the total potential acidity of a soil determined up to a given pH. All sources of soil acidity, including hydrolysis of monomeric and polymeric aluminum species and hydrogen from pH-dependent exchange sites on metal oxides, layer silicates, and organic matter, contribute to the total potential acidity. Total potential acidity in soils is determined by titration with base or incubation with lime; extraction with a buffered extractant followed by titration of the buffered extractant (pH 8.2, barium chloride-triethanolamine method); or equilibration with buffers followed by estimation of acidity from changes in buffer pH.

Many of the soils of Natchitoches Parish have a low pH, contain significant quantities of exchangeable aluminum, and have high levels of total acidity. Examples are the Acadia, Beauregard, Caddo, Malbis, and Sacul soils. The exchangeable aluminum levels are high enough to limit crop production. High levels of exchangeable aluminum in the surface layer can be reduced by liming, but there are no economical methods available to neutralize soil acidity at depth. Exchangeable aluminum levels can be reduced by applying gypsum so that the sulfate leaches through the soil and complexes and removes the aluminum.

Cation exchange capacity. The cation exchange capacity represents the available supply of nutrient and non-nutrient cations in the soil. It is the amount of cations on permanent and pH-dependent negatively charged sites on the soil surface. Permanent charge cation exchange sites occur because a net negative charge develops on a mineral surface from substitution of ions within the crystal lattice. A negative charge developed from ionization of surface hydroxyl groups on minerals and organic matter produces pH-dependent cation exchange sites.

Methods for determining cation exchange capacity are available and can be classified as one of two types: methods that use unbuffered salts to measure the cation exchange capacity at the pH of the soil and methods that use buffered salts to measure the cation exchange capacity at a specified pH. These methods produce different results since unbuffered salt methods include only a part of the pH-dependent cation exchange capacity and the buffered salt methods include all of the pH-dependent cation exchange capacity up to the pH of the buffer (generally pH 7 or 8.2). Errors in the saturation, washing, and replacement steps can also cause different results.

The effective cation exchange capacity is the sum of exchangeable bases determined by extraction with pH 7, 1 molar ammonium acetate plus the sum of neutral salt exchangeable aluminum and hydrogen (exchangeable acidity). The sum cation exchange capacity is the sum of exchangeable bases plus the total acidity determined by extraction with pH 8.2, barium chloride-triethanolamine. The effective cation exchange capacity is generally less than the sum cation exchange capacity and includes only that part of the pH-dependent cation exchange capacity that is determined by exchange of hydrogen with a neutral salt. The sum includes all of the pH-dependent cation exchange capacity up to pH 8.2. If a soil contains no pH-dependent exchange sites or the pH of the soil is about 8.2, then the effective and sum cation exchange capacity is about the same. The larger the cation exchange capacity, the larger the capacity to store nutrient cations.

The pH-dependent charge is a significant source of the cation exchange capacity in many of the soils of Natchitoches Parish. The exceptions are soils that have a low clay content and low total acidity and soils that have a high clay content. In these soils, permanent-charge cation exchange capacity is dominant. Since the pH-dependent cation exchange capacity will increase with pH, the cation exchange capacity of many of the soils of Natchitoches Parish can be increased by liming. This would result in a greater storage capacity for nutrient cations, such as potassium, magnesium, and calcium.

Physical and Chemical Analyses of Selected Soils

The results of physical analysis of several typical pedons in the survey area are given in table 19 and the results of chemical analysis in table 20. The mineral composition of the clay fraction of selected soils is given in table 21. The data are for soils sampled at carefully selected sites. Most of the pedons are typical of the series and are described in the section "Soil Series and Their Morphology." Soil samples were analyzed by the Soil Characterization Laboratory, Louisiana Agricultural Experiment Station.

Most determinations, except those for grain-size analysis and bulk density, were made on soil material smaller than 2 millimeters in diameter. Measurements reported as percent or quantity of unit weight were calculated on an oven-dry basis. The methods used in obtaining the data are indicated in the list that follows. The codes in parentheses refer to published methods *(36)*.

Coarse materials—(2-75 mm fraction) weight estimates of the percentages of all materials less than 75 mm (3B1).

Sand—(0.05-2.0 mm fraction) weight percentages of materials less than 2 mm (3A1).

Silt—(0.002-0.05 mm fraction) pipette extraction, weight percentages of all materials less than 2 mm (3A1).

Clay—(fraction less than 0.002 mm) pipette extraction, weight percentages of materials less than 2 mm (3A1).

Water retained—pressure extraction, percentage of oven-dry weight of less than 2 mm material; 1/3 or 1/10 (3/10) bar (4B1), 15 bars (4B2).

Water-retention difference—between 1/3 bar and 15 bars for less than 2 mm material (4C1).

Moist bulk density—of less than 2 mm material, saran-coated clods; field moist (4A3a), air dry (4A1b), oven dry (4A1h).

Linear extensibility—change in clod dimension based on less than 2 mm material (4D).

Organic carbon—dichromate, ferric sulfate titration (6A1a).

Extractable cations—ammonium acetate pH 7.0, uncorrected; calcium (6N2), magnesium (602), sodium (6P2), potassium (6Q2).

Extractable acidity—barium chloride-triethanolamine I (6G2b).

Cation-exchange capacity—ammonium acetate, pH 7.0 (5A3a).

Base saturation—ammonium acetate, pH 7.0 (5C1).

Reaction (pH)—1:1 water dilution (8C1a).

Reaction (pH)—potassium chloride (8C1c).

Reaction (pH)—calcium chloride (8C1e).

Aluminum—potassium chloride extraction (6G).

Iron—dithionate-citrate extract (6Cl).

Available phosphorus(Bray 2 extraction reagents).

Classification of the Soils

The system of soil classification used by the National Cooperative Soil Survey has six categories *(34)*. Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or on laboratory measurements. Table 22 shows the classification of the soils in the survey area. The categories are defined in the following paragraphs.

ORDER. Ten soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in *sol*. An example is Entisol.

SUBORDER. Each order is divided into suborders, primarily on the basis of properties that influence soil genesis and are important to plant growth or properties that reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Fluvent(*Fluv*, meaning river, 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 development of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Udifluvents (*Ud*, meaning humid, plus *fluvent*, the suborder of the Entisols that are forming in recent water-deposited sediment).

SUBGROUP. Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective *Typic* identifies the subgroup that typifies the great group. An example is Typic Udifluvents. The formative elements and adjectives used in forming the classification name of the soils in this survey and their explanation or meaning are shown in table 23.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Mostly the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle-size class, mineral content, temperature regime, depth of the root zone, consistence, moisture equivalent, slope, and permanent cracks. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is coarse-silty, mixed, nonacid, thermic Typic Udifluvents.

SERIES. The series consists of soils that have similar horizons in their profile. The horizons are similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile. There can be some variation in the texture of the surface layer or of the substratum within a series. An example is the Roxana series, which is a member of the coarse-silty, mixed, nonacid, thermic family of Typic Udifluvents.

Soil Series and Their Morphology

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

Characteristics of the soil and the material in which it formed are identified for each series. The soil is compared with similar soils and with nearby soils of other series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the *Soil Survey Manual (32)*. Many of the technical terms used in the descriptions are defined in *Soil Taxonomy (34)*. Unless otherwise stated, colors in the descriptions are for moist soil. Following the pedon description is the range of important characteristics of the soils in the series.

The map units of each soil series are described in the section "Detailed Soil Map Units."

Acadia Series

The Acadia series consists of somewhat poorly drained, very slowly permeable soils that formed in clayey stream deposits of late Pleistocene age. These soils are on uplands. A seasonal high water table is 0.5 to 1.5 feet below the soil surface from December to April in most years. Slopes range from 0 to 2 percent. Soils of the Acadia series are fine, montmorillonitic, thermic Aeric Ochraqualfs.

The Acadia soils in Natchitoches Parish are taxadjuncts to the Acadia series because they typically have a clay loam Btg1 horizon. This difference is outside the defined range for the series, but it does not significantly affect use and management of these soils.

Acadia soils commonly are near Gore, Shatta, and Wrightsville soils. The Gore soils are on slopes at a lower elevation than the Acadia soils and have a reddish subsoil. The Shatta soils are in slightly higher positions and are fine-silty. The Wrightsville soils are in slightly lower positions and have a thick subsurface layer that extends downward into the subsoil.

Typical pedon of Acadia silt loam; about 6.5 miles northwest of Campti on Highway 480 to Grappes Bluff, 0.3 mile west on Highway 480 from junction of parish road, 300 feet north of center of highway; SW1/4SE1/4 sec. 20, T. 11 N., R. 8 W.

Ap—0 to 6 inches; dark grayish brown (10YR 4/2) silt loam; moderate medium granular structure; friable; many fine and very fine roots; few medium brown and black concretions; very strongly acid; abrupt wavy boundary.

E—6 to 8 inches; light yellowish brown (10YR 6/4) silt loam; few fine faint yellowish brown mottles; weak medium subangular blocky structure; friable; common fine and medium roots; very strongly acid; abrupt wavy boundary.

BE—8 to 16 inches; yellowish brown (10YR 5/6) clay loam; common medium distinct strong brown (7.5YR 5/6) mottles and common medium faint light brownish gray (10YR 6/2) mottles; weak medium subangular blocky structure; friable; common fine and medium roots; very strongly acid; abrupt wavy boundary.

Btg1—16 to 27 inches; light brownish gray (10YR 6/2) silty clay loam; common medium distinct strong brown (7.5YR 5/6) mottles and common fine prominent yellowish red (5YR 5/6) mottles; weak medium subangular blocky structure; firm; common fine and medium roots; thin patchy clay films on faces of peds; very strongly acid; clear wavy boundary.

Btg2—27 to 50 inches; light brownish gray (2.5Y 6/2) clay; common medium distinct yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; firm; thin patchy clay films on faces of peds; very strongly acid; clear wavy boundary.

Cg—50 to 65 inches; light brownish gray (2.5Y 6/2) clay; common medium distinct strong brown (7.5YR 5/6) mottles and common fine prominent yellowish red (5YR 5/6) mottles; massive; firm; very strongly acid.

The solum ranges from 30 to 60 inches in thickness. Depth to the fine-textured Btg horizon ranges from 10 to 20 inches. The effective cation exchange capacity is 50 percent or more saturated with exchangeable aluminum within a depth of 30 inches.

The A horizon has hue of 10YR, value of 4 or 5, and chroma of 2 or 3. It is 4 to 8 inches thick. Reaction ranges from very strongly acid to medium acid.

The E horizon has hue of 10YR, value of 5 or 6, and chroma of 2 to 4, or has hue of 2.5Y, value of 5, and chroma of 2. It is 2 to 10 inches thick. The texture is silt loam, loam, or very fine sandy loam. Reaction ranges from very strongly acid to medium acid.

The BE horizon has hue of 10YR, value of 5 or 6, and chroma of 4 to 8. The texture is silt loam, clay loam, or silty clay loam. Reaction is very strongly acid or strongly acid. Some pedons have interfingering of albic material into the lower part of the BE horizon or upper part of the Btg horizon.

The Btg horizon has hue of 10YR, value of 5 or 6, and chroma of 1 or 2; or it has hue of 2.5Y, value of 5 or 6, and chroma of 2. The texture of the Btg1 horizon is clay loam, silty clay loam, or silty clay. The Btg2 horizon is clay or silty clay. Reaction ranges from very strongly acid to medium acid.

The Cg horizon has the same range in color as the Btg horizon. The texture is clay, silty clay, or silty clay loam. Reaction ranges from very strongly acid to mildly alkaline.

Anacoco Series

The Anacoco series consists of somewhat poorly drained, very slowly permeable soils that formed in clayey marine sediment of Tertiary age. These soils are on uplands. A seasonal high water table is within 1 foot of the soil surface from December to April in most years. Slopes range from 1 to 5 percent. Soils of the Anacoco series are fine, montmorillonitic, thermic Vertic Albaqualfs.

Anacoco soils commonly are near Kisatchie, Malbis, and Oula soils. Kisatchie soils are on lower or more steeply sloping side slopes and are moderately deep to siltstone. Malbis soils are in higher positions than the Anacoco soils and are fine-loamy. Oula soils are on lower or more steeply sloping side slopes and do not have an abrupt textural change between the surface or subsurface layer and the subsoil.

Typical pedon of Anacoco loam, 1 to 5 percent slopes; about 7 miles southwest of Derry, 5.2 miles south of Derry on Highway 119, 10 miles northwest on Forest Service Lotus-Gorum Road, 3.8 miles south on Forest Service Highway 321 (Kisatchie Primitive Camp road) to L'Ivrogne Road, 400 feet east on L'Ivrogne Road, 75 feet south of road; SW1/4SE1/4 sec. 35, T. 6 N., R. 7 W.

A—0 to 5 inches; dark gray (10YR 4/1) loam; weak fine granular structure; friable; many fine and medium roots; very strongly acid; clear smooth boundary.

E—5 to 10 inches; light brownish gray (10YR 6/2) loam; common medium distinct yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; friable; many fine and medium roots; very strongly acid; clear wavy boundary.

Bt1—10 to 20 inches; light brownish gray (2.5Y 6/2) silty clay; common medium prominent yellowish red (5YR 5/6) mottles and common medium distinct yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; firm; common fine and medium roots; few thin discontinuous clay films on faces of peds; very strongly acid; gradual smooth boundary.

Bt2—20 to 38 inches; grayish brown (10YR 5/2) clay; common medium distinct yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; firm; few fine and medium roots; common thin discontinuous clay films on faces of peds; very strongly acid; gradual smooth boundary.

Bt3—38 to 53 inches; light brownish gray (2.5Y 6/2) clay; weak coarse subangular blocky structure; firm; few fine roots; few thin discontinuous clay films on faces of peds; very strongly acid; clear smooth boundary.

C—53 to 60 inches; light olive gray (5Y 6/2) clay; massive; very firm; common thin strata of light brownish gray (2.5YR 6/2) siltstone; very strongly acid.

The solum ranges from 40 to 60 inches in thickness. Depth to the clayey B horizon ranges from 6 to 12 inches. The effective cation exchange capacity is 20 to 50 percent saturated with exchangeable aluminum within a depth of 30 inches.

The A horizon has hue of 10YR, value of 4 or 5, and chroma of 1 or 2. It is 3 to 5 inches thick. The texture is very fine sandy loam or loam. Reaction ranges from very strongly acid to medium acid.

The E horizon has hue of 10YR, value of 5 or 6, and chroma of 1 to 3. It is 3 to 7 inches thick. The texture is silt loam, very fine sandy loam, or loam. Reaction ranges from very strongly acid to medium acid.

The Bt horizon has hue of 10YR, 2.5Y, or 5Y, value of 5 or 6, and chroma of 2. The texture is silty clay or clay, and the reaction is very strongly acid or strongly acid.

The C horizon has hue of 5Y, value or 4 to 6, and chroma of 2 to 4. The texture is clay, silty clay, or silty clay loam, and typically has strata of coarser textured material. Reaction is very strongly acid or strongly acid. Strata of soft siltstone or sandstone are in some pedons at a depth of 40 inches or more.

Armistead Series

The Armistead series consists of somewhat poorly drained, slowly permeable soils that formed in clayey and loamy alluvium. These soils are on natural levees of distributaries of the Red River. A seasonal high water table is 1.5 to 3 feet below the soil surface from December to April in most years. Slope is generally less than 1 percent. Soils of the Armistead series are fine-silty, mixed, thermic Aquic Argiudolls.

Armistead soils commonly are near the Caspiana, Gallion, Latanier, and Moreland soils. Caspiana and Gallion soils are in slightly higher positions on the natural levees than the Armistead soils and do not have a clayey surface layer. The Latanier and Moreland soils are in slightly lower positions and are clayey to a depth of more than 20 inches.

Typical pedon of Armistead clay; about 5 miles west of Powhatan, 6.8 miles west on Highway 485 from Highway 1 to Rock's Bayou, 1.6 miles north on parish road, 0.6 mile north on field road, about 375 feet east of ditchbank; NW1/4SW1/4 sec. 10, T. 10 N., R. 9 W.

Ap—0 to 7 inches; dark reddish brown (5YR 3/2) clay; moderate fine subangular blocky structure; very firm; common fine and very fine roots; slightly acid; clear smooth boundary.

A1—7 to 11 inches; dark reddish brown (5YR 3/3) clay; moderate coarse subangular blocky structure; very firm; common fine and very fine roots; neutral; clear smooth boundary.

2A2—11 to 16 inches; very dark gray (5YR 3/1) silty clay loam; few fine faint gray mottles; moderate medium subangular blocky structure; very firm; common fine and very fine roots; many fine and very fine pores; slightly acid; clear wavy boundary.

2A3—16 to 21 inches; dark reddish gray (5YR 4/2) silty clay loam; moderate medium subangular blocky structure; firm; common fine and very fine roots; many fine and very fine pores; neutral; clear smooth boundary.

2Bt1—21 to 29 inches; reddish brown (5YR 4/4) silty clay loam; common fine distinct dark gray (10YR 4/1) stains in root channels; weak medium subangular blocky structure; friable; common fine and very fine roots; many fine and very fine, and common coarse pores; few thin patchy clay films on faces of peds and in pores; neutral; clear smooth boundary.

2Bt2—29 to 39 inches; reddish brown (5YR 4/4) silt loam; common fine distinct dark gray (10YR 4/1) stains in root channels; weak medium subangular blocky structure; friable; few fine and very fine roots; many fine and very fine pores; few thin patchy clay films on faces of peds and in pores; neutral; clear wavy boundary.

2BC—39 to 43 inches; reddish brown (5YR 4/4) silty clay loam; weak coarse subangular blocky structure; friable; few fine and very fine roots; many fine and very fine pores; few thin patchy clay films on faces of peds; few fine and medium soft masses of calcium carbonate; few fine hard nodules of calcium carbonate; slight effervescence; moderately alkaline; clear wavy boundary.

3C—43 to 60 inches; reddish brown (2.5YR 4/4) clay; weak coarse subangular blocky structure; very firm; common pressure faces; common fine black stains; common fine to coarse soft masses of calcium carbonate; few fine hard nodules of calcium carbonate; strong effervescence; moderately alkaline.

The solum ranges from 40 to 70 inches in thickness.

The A horizon has hue of 5YR or 2.5YR, value of 2 or 3, and chroma of 2 or 3. It is 10 to 20 inches thick. Reaction ranges from slightly acid to moderately alkaline.

The 2A horizon has hue of 5YR, value of 3, and chroma of 1 to 3; or it has hue of 2.5YR, value of 3, and chroma of 2. The texture is silt loam or silty clay loam. Mottles that have chroma of 1 or 2 range from few to common. Reaction ranges from neutral to moderately alkaline.

The 2Bt and 2BC horizons have hue of 5YR or 2.5YR, value of 4 or 5, and chroma of 4 to 8. The texture is silt loam or silty clay loam. Reaction ranges from slightly acid to moderately alkaline.

The 3C horizon is in shades of brown or red. The texture is variable and ranges from very fine sandy loam to clay. Reaction ranges from neutral to moderately alkaline. The 3C horizon is typically calcareous.

Beauregard Series

The Beauregard series consists of moderately well drained, slowly permeable soils that formed in loamy stream deposits of Pleistocene age. These soils are on uplands. A seasonal high water table is 1.5 to 3 feet below the soil surface from December to March in most years. Slopes range from 1 to 3 percent. Soils of the Beauregard series are fine-silty, siliceous, thermic Plinthaquic Paleudults.

Beauregard soils commonly are near Caddo, Guyton, and Malbis soils. The Caddo and Guyton soils are in lower positions than the Beauregard soils and are grayish throughout the profile. Malbis soils are on slightly higher, more convex ridgetops and side slopes, and they are fine-loamy.

Typical pedon of Beauregard silt loam, 1 to 3 percent slopes; about 8 miles east of Creston, 7.3 miles east from Creston on Highway 156, 2.2 miles southeast on parish road to Highway 1226, 1.1 miles east on parish road, 450 feet south of road; SE1/4SE1/4 sec. 31, T. 12 N., R. 5 W.

A—0 to 5 inches; very dark gray (10YR 3/1) silt loam; weak fine granular structure; friable; many fine and very fine roots; medium acid; clear smooth boundary.

E—5 to 10 inches; dark grayish brown (10YR 4/2) silt loam; weak fine subangular blocky structure; friable; many fine and medium roots; strongly acid; clear smooth boundary.

BE—10 to 15 inches; yellowish brown (10YR 5/6) silt loam; dark grayish brown (10YR 4/2) silt loam (E) in root channels; weak fine subangular blocky structure; friable; common fine and medium roots; strongly acid; clear smooth boundary.

Bt—15 to 22 inches; yellowish brown (10YR 5/6) silt loam; many fine faint pale brown mottles and common medium prominent yellowish red (5YR 5/8) mottles; moderate medium subangular blocky structure; friable; common fine and medium roots; thin discontinuous clay films on faces of peds; few fine concretions of iron and manganese; strongly acid; clear wavy boundary.

Btv1—22 to 33 inches; yellowish brown (10YR 5/6) silt loam; many fine prominent yellowish red (5YR 5/8) mottles, common medium faint light brownish gray (10YR 6/2) mottles, and few fine faint pale brown mottles; moderate medium subangular blocky structure; firm; few fine and medium roots; thin discontinuous clay films on faces of peds; few fine concretions of iron and manganese; about 6 percent nonindurated plinthite; strongly acid; gradual wavy boundary.

Btv2—33 to 53 inches; light brownish gray (10YR 6/2) silty clay loam; common medium distinct yellowish brown (10YR 5/6) mottles with yellowish red (5YR 5/8) centers; moderate medium subangular blocky structure; firm; few fine roots; thin discontinuous clay films on faces of peds; about 7 percent plinthite nodules; strongly acid; gradual wavy boundary.

Btg—53 to 60 inches; light gray (10YR 7/1) silty clay loam; many medium distinct yellowish brown (10YR 5/6) mottles with red (2.5YR 4/8) centers; strong medium subangular blocky structure; firm, brittle; few thin patchy clay films on faces of peds; strongly acid.

The solum ranges from 50 to 90 inches in thickness. Depth to horizons that contain more than 5 percent plinthite ranges from 20 to 40 inches. The effective cation exchange capacity is 50 percent or more saturated with exchangeable aluminum within a depth of 30 inches.

The A horizon has hue of 10YR, value of 3 to 5, and chroma of 1 to 3. It is 2 to 5 inches thick. Reaction ranges from strongly acid to slightly acid.

The E horizon has hue of 10YR, value of 4 to 6, and chroma of 2 to 4. The texture is very fine sandy loam or silt loam. It is 2 to 7 inches thick. Reaction ranges from strongly acid to slightly acid.

The Bt part of the BE horizon and the Bt horizon has hue of 10YR, value of 4 to 6, and chroma of 3 to 6. Mottles are in shades of red, brown, or gray. The texture is silt loam or silty clay loam. Reaction ranges from very strongly acid to medium acid.

The Btv1 horizon has color and reaction similar to that of the Bt horizon. The Btv2 horizon has hue of 10YR and 2.5Y, value of 5 to 7, and chroma of 1 to 3. Mottles in shades of gray, red, or brown range from few to many in the Btv1 and Btv2 horizons. Nodules of plinthite make up from 5 to 10 percent of the volume of these horizons. The texture of the Btv horizon is silt loam or silty clay loam. Reaction ranges from very strongly acid to medium acid.

The Btg horizon has hue of 10YR or 2.5Y, value of 5 to 7, and chroma of 1 to 3. Mottles in shades of brown or red range from few to many. The texture is silt loam or silty clay loam. Reaction ranges from very strongly acid to medium acid.

Bellwood Series

The Bellwood series consists of somewhat poorly drained, very slowly permeable soils that formed in very fine, clayey sediment of Tertiary age. These soils are on uplands. A seasonal high water table is 2 to 4 feet below the soil surface from December to April in most years. Slopes range from 1 to 12 percent. Soils of the Bellwood series are very-fine, montmorillonitic, thermic Aquentic Chromuderts.

Bellwood soils are similar to Gore and Morse soils and commonly are near Keithville, Natchitoches, Ruston, and Sacul soils. The Gore and Morse soils are at a lower elevation than the Bellwood soils and are fine-textured. The Keithville soils are in slightly higher positions and are loamy in the upper part of the subsoil. The Natchitoches and Sacul soils are in positions similar to those of the Bellwood soils and do not have intersecting slickensides. The Ruston soils are in slightly higher positions and are fine-loamy.

Typical pedon of Bellwood clay, 1 to 5 percent slopes; about 0.8 mile northwest of Provencal, 0.15 mile north on Highway 117 from Highway 120, 0.8 mile northwest on parish road, 200 feet south of road; NW1/4SE1/4 sec. 20, T. 8 N., R. 8 W.

A—0 to 1 inches; reddish brown (5YR 4/3) silty clay loam; weak fine granular structure; friable; many fine roots; very strongly acid; abrupt irregular boundary.

Bw1—1 to 7 inches; yellowish red (5YR 4/6) clay; moderate medium subangular blocky structure; firm; many fine and medium roots; continuous shiny pressure faces; extremely acid; clear smooth boundary.

Bw2—7 to 21 inches; gray (10YR 6/1) clay; many medium prominent red (2.5YR 4/6) mottles; moderate medium angular blocky structure; very firm; common fine roots; continuous shiny pressure faces; common intersecting slickensides; extremely acid; gradual wavy boundary.

Bw3—21 to 41 inches; light brownish gray (10YR 6/2) clay; common medium prominent yellowish red (2.5YR 4/6) mottles; moderate medium angular blocky structure; very firm; common fine roots; discontinuous shiny pressure faces; many intersecting slickensides; gleying around roots; extremely acid; clear smooth boundary.

BC1—41 to 55 inches; pale brown (10YR 6/3) clay; common medium prominent strong brown (7.5YR 5/6) mottles and few fine prominent yellowish red (5YR 5/6) mottles; weak coarse and medium angular blocky structure; very firm; discontinuous shiny pressure faces; common intersecting slickensides; extremely acid; clear smooth boundary.

BC2—55 to 60 inches; pale brown (10YR 6/3) clay; common fine faint yellowish brown mottles; weak coarse angular blocky structure; very firm; shiny pressure faces; few slickensides; extremely acid.

The solum ranges from 50 to 80 inches in thickness. Depth to intersecting slickensides ranges from 7 to 21 inches. Reaction ranges from extremely acid to strongly acid throughout the solum. The effective cation exchange capacity is 50 percent or more saturated with exchangeable aluminum within a depth of 30 inches.

The A horizon has hue of 10YR, 5YR, or 2.5YR, value of 3 or 4, and chroma of 1 to 4. It is 1 to 3 inches thick. The texture is very fine sandy loam or silty clay loam.

The Bw1 horizon has hue of 5YR, 2.5YR, or 10R, value of 4 or 5, and chroma of 4 to 8. The Bw2 horizon has hue of 10YR or 2.5Y, value of 5 to 7, and chroma of 1 or 2. The Bw3 horizon has hue of 10YR or 2.5Y, value of 5 to 7, and chroma of 1 to 3. The texture is clay or silty clay.

Betis Series

The Betis series consists of somewhat excessively drained, rapidly permeable soils that formed in sandy marine sediment of Tertiary age. These soils are on uplands. Slopes range from 1 to 12 percent. Soils of the Betis series are sandy, siliceous, thermic Psammentic Paleudults.

Betis soils are similar to Bienville soils and commonly are near Briley, Guyton, Kisatchie, Ruston, and Smithdale soils. Bienville soils are on low terraces and have a base saturation of more than 35 percent. Briley soils are in positions similar to those of the Betis soils, and they have a loamy subsoil. Guyton soils are in drainageways and are fine-silty. Kisatchie soils are at a lower elevation and are clayey. Ruston and Smithdale soils are in positions similar to those of the Betis soils, and they are loamy throughout.

Typical pedon of Betis loamy fine sand, 1 to 5 percent slopes; about 3.8 miles east from Ashland on parish road, 1.3 miles north on dirt road, 250 feet east of road; NW1/4NE1/4 sec. 1, T. 13 N., R. 7 W.

A1—0 to 9 inches; dark grayish brown (10YR 4/2) loamy fine sand; weak fine granular structure; very friable;

many fine and medium roots; strongly acid; clear wavy boundary.

A2—9 to 34 inches; brown (7.5YR 5/4) loamy fine sand; single grained; loose; many fine and medium roots; medium acid; gradual wavy boundary.

Bw—34 to 48 inches; yellowish red (5YR 5/6) loamy fine sand; weak medium granular structure; clay coatings on some sand grains; very friable; few fine and medium roots; few pockets of clean sand grains; strongly acid; gradual wavy boundary.

Bt—48 to 60 inches; yellowish red (5YR 5/6) loamy fine sand; moderate medium granular structure; very friable; few fine and medium roots; coated sand grains and some clay bridging on lamellae; few pockets of clean sand grains; strongly acid; gradual wavy boundary.

The solum ranges from 60 to 80 inches in thickness. Reaction ranges from very strongly acid to medium acid throughout the solum except where lime has been added. The effective cation exchange capacity is 20 to 50 percent saturated with exchangeable aluminum within a depth of 30 inches.

The A horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 2 or 4. The combined thickness of the Al and A2 horizons is 20 to 45 inches.

Some pedons have an E horizon that has hue of 10YR, value of 5 to 7, and chroma of 3. The texture is fine sand or loamy fine sand.

The Bw horizon has hue of 5YR, 7.5YR, or 10YR, value of 5, and chroma of 6 or 8. Pockets or streaks of clean sand grains range from few to common. The texture is fine sand or loamy fine sand. Some pedons have an E/Bt horizon.

The Bt horizon has hue of 5YR, 7.5YR, or 10YR, value of 4 or 5, and chroma of 6 or 8. It has lamellae of loamy fine sand or fine sandy loam. Pockets or streaks of clean sand grains range from few to common.

Bienville Series

The Bienville series consists of somewhat excessively drained, moderately rapidly permeable soils that formed in sandy alluvium of late Pleistocene or early Holocene age. These soils are on low stream terraces. A seasonal high water table is 4 to 6 feet below the soil surface during December through April in most years. Slopes range from 1 to 5 percent. Soils of the Bienville series are sandy, siliceous, thermic Psammentic Paleudalfs.

Bienville soils in Natchitoches Parish are taxadjuncts to the Bienville series because the reaction of the E, B/E, and Bt horizons typically is slightly lower than the defined range for the series. This difference does not significantly affect use and management of these soils.

Bienville soils are similar to Betis soils and commonly are near Cahaba, Guyton, and Lotus soils. Betis soils are on terrace uplands and have a base saturation of less than 35 percent. Cahaba soils are in positions similar to those of the Bienville soils and are fine-loamy. The Guyton soils are in lower positions and are fine-silty. Lotus soils are on natural levees along stream channels. They have a seasonal high water table within 3 feet of the soil surface and have chroma of 1 to 3 throughout the profile.

Typical pedon of Bienville loamy fine sand, 1 to 5 percent slopes; about 2.9 miles east of Readhimer on Highway 126, 300 feet north of the center of Highway 126; NE1/4NW1/4 sec. 13, T. 13 N., R. 6 W.

A—0 to 12 inches; dark brown (10YR 4/3) loamy fine sand; weak fine granular structure; very friable; many fine and medium roots; very strongly acid; clear wavy boundary.

E—12 to 24 inches; yellowish brown (10YR 5/4) loamy fine sand; massive; very friable; many fine and medium roots; extremely acid; clear wavy boundary.

B/E—24 to 40 inches; strong brown (7.5YR 5/6) loamy fine sand (Bt); common spots and streaks of yellowish brown (10YR 5/4) fine sand (E); weak medium subangular blocky structure; very friable; common fine and medium roots; sand grains bridged and coated with clay; extremely acid; gradual wavy boundary.

Bt—40 to 60 inches; strong brown (7.5YR 5/6) loamy fine sand; few fine spots of pale brown (10YR 6/3) sand grains; weak medium subangular blocky structure; very friable; few thin patchy yellowish red (5YR 5/6) clay films; extremely acid.

The solum ranges from 60 to 80 inches in thickness. Content of fine particles (clay, silt, and very fine sand) ranges from 30 to 50 percent. The effective cation exchange capacity is 20 to 50 percent saturated with exchangeable aluminum within a depth of 30 inches.

The A horizon has hue of 10YR, value of 4 or 5, and chroma of 2 to 4. It is 4 to 12 inches thick. Reaction ranges from very strongly acid to slightly acid.

The E horizon has hue of 10YR or 7.5YR, value of 4 to 7, and chroma of 3 or 4. It is 10 to 30 inches thick. The texture is loamy fine sand or fine sand. Reaction ranges from extremely acid to slightly acid.

The Bt horizon has hue of 7.5YR or 5YR, value of 4 or 5, and chroma of 5 or 6. Some pedons have subhorizons that have hue of 10YR and chroma of 4. Lamellae are in some pedons. The texture of the Bt horizon is fine sandy loam, loamy fine sand, or very fine sandy loam. Reaction ranges from extremely acid to medium acid. Spots and streaks of uncoated sand grains range from few to common.

Briley Series

The Briley series consists of well drained, moderately permeable soils that formed in sandy and loamy marine sediment of Tertiary age. These soils are on uplands.

Slopes range from 1 to 20 percent. Soils of the Briley series are loamy, siliceous, thermic Arenic Paleudults.

Briley soils commonly are near Betis, Guyton, Kisatchie, Ruston, Sacul, and Smithdale soils. Betis soils are in positions similar to those of the Briley soils and are sandy throughout the profile. Guyton soils are in drainageways and are fine-silty. Kisatchie soils are at a lower elevation and have a clayey subsoil. Ruston, Sacul, and Smithdale soils are in positions similar to those of the Briley soils. Ruston and Smithdale soils are fine-loamy. Sacul soils have a clayey subsoil.

Typical pedon of Briley loamy fine sand, 1 to 5 percent slopes; about 3 miles northeast of Provencal, 2 miles east of Provencal on Highway 120 from its junction with Highway 117, 2.9 miles north and east on local road, 400 feet east on logging road; SE1/4NW1/4 sec. 24, T. 8 N., R. 8 W.

A—0 to 8 inches; dark grayish brown (10YR 4/2) loamy fine sand; weak fine granular structure; very friable; many fine roots; strongly acid; clear wavy boundary.

E—8 to 28 inches; yellowish brown (10YR 5/4) loamy fine sand; weak fine granular structure; very friable; many fine and medium roots; strongly acid.

BE—28 to 33 inches; yellowish red (5YR 5/6) fine sandy loam; common fine distinct light yellowish brown (10YR 6/4) spots and streaks; weak medium subangular blocky structure; very friable; few fine roots; medium acid; irregular smooth boundary.

Bt—33 to 60 inches; red (2.5YR 4/6) sandy clay loam; moderate medium subangular blocky structure; friable; few fine roots; few thin discontinuous clay films on faces of peds; strongly acid.

The solum ranges from 60 to 80 inches in thickness.

The A horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 2 to 4. It is 4 to 14 inches thick. Reaction ranges from very strongly acid to slightly acid.

The E horizon has hue of 10YR or 7.5YR, value of 5 to 7, and chroma of 2 to 4. It is 10 to 30 inches thick. Reaction ranges from very strongly acid to medium acid.

The BE horizon has hue of 7.5YR, 5YR, or 2.5YR, value of 4 or 5, and chroma of 4 to 8. The texture is fine sandy loam or loamy fine sand. Reaction ranges from very strongly acid to medium acid. Some pedons do not have a BE horizon.

The Bt horizon has hue of 5YR or 2.5YR, value of 4 or 5, and chroma of 6 or 8. The texture is typically sandy clay loam, but it is sandy loam or loam in some pedons. Reaction ranges from very strongly acid to medium acid.

Caddo Series

The Caddo series consists of poorly drained, slowly permeable soils that formed in loamy alluvium of Pleistocene age. These soils are on broad flats on uplands. A seasonal high water table is within 2 feet of the soil surface from December to April in most years. Slopes are generally less than 1 percent. Soils of the Caddo series are fine-silty, siliceous, thermic Typic Glossaqualfs.

Caddo soils are similar to Wrightsville soils and commonly are near Beauregard, Guyton, and Malbis soils. Beauregard and Malbis soils are in slightly higher positions than the Caddo soils and contain more than 5 percent plinthite in the subsoil. Guyton soils are in concave positions and do not contain plinthite. Wrightsville soils are in slightly lower positions and have a clayey subsoil.

Typical pedon of Caddo very fine sandy loam; about 3.5 miles southeast of Gorum, 5.5 miles southeast from Gorum on Highway 119 to Highway 8, 0.3 mile northeast on Highway 8 to Chopin Road, 1.2 miles north on Chopin Road, 0.4 mile west of road on fire lane, 200 feet south of fire lane; NW1/4NW1/4 sec. 15, T. 5 N., R. 5 W.

A—0 to 4 inches; grayish brown (10YR 5/2) very fine sandy loam; few fine faint light brownish gray mottles; weak fine subangular blocky structure; friable; many fine and medium roots; common brown organic stains; strongly acid; abrupt smooth boundary.

Eg1—4 to 13 inches; light brownish gray (10YR 6/2) very fine sandy loam; common medium faint yellowish brown (10YR 5/4) mottles; weak fine subangular blocky structure; friable; many fine and medium roots; strongly acid; gradual smooth boundary.

Eg2—13 to 26 inches; light brownish gray (10YR 6/2) very fine sandy loam; few fine distinct yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; friable; common fine roots; strongly acid; abrupt irregular boundary.

B/E—26 to 34 inches; gray (10YR 6/1) silty clay loam (Bt); common medium distinct strong brown (7.5YR 5/6) mottles and few fine prominent red (2.5YR 4/6) mottles; weak medium subangular blocky structure; firm; common fine and medium roots; thin patchy clay films on faces of peds; tongues of very fine sandy loam (E) 2 to 5 centimeters wide extend to a depth of 32 inches; few fine and medium nodules of plinthite; medium acid; clear wavy boundary.

Btg—34 to 60 inches; gray (10YR 5/1) silty clay loam; common medium distinct strong brown (7.5YR 5/6) mottles; weak medium subangular blocky structure; firm; few fine roots; light brownish gray (10YR 6/2) silt coatings on faces of some peds; common fine nodules of plinthite; strongly acid.

The solum ranges from 60 to 100 inches in thickness. Total thickness of the A and Eg horizons is 15 to 35 inches. Tongues of the Eg horizon extend into the Bt horizon. The effective cation exchange capacity is 50 percent or more saturated with exchangeable aluminum within a depth of 30 inches.

The A horizon has hue of 10YR, value of 4 or 5, and chroma of 2. It is 2 to 8 inches thick. Reaction ranges from very strongly acid to medium acid.

The Eg horizon and E part of the B/E horizon have hue of 10YR, value of 5 or 6, and chroma of 1 or 2. The texture is silt loam, loam, or very fine sandy loam. Reaction ranges from very strongly acid to medium acid.

The Bt horizon and Bt part of the B/E horizon have hue of 10YR, value of 5 to 7, and chroma of 1 or 2. Mottles in shades of red, yellow, and brown range from few to many. Content of plinthite ranges from 1 to 5 percent in some subhorizons. The texture is silt loam, loam, or silty clay loam. Reaction ranges from very strongly acid to medium acid.

Some pedons have a Cg horizon that is mottled in shades of gray, yellow, brown, or red. The texture is silt loam, loam, or silty clay loam. Reaction is strongly acid or medium acid.

Cahaba Series

The Cahaba series consists of well drained, moderately permeable soils that formed in loamy and sandy alluvium. These soils are on low stream terraces. Slopes range from 1 to 5 percent. Soils of the Cahaba series are fine-loamy, siliceous, thermic Typic Hapludults.

The Cahaba soils in Natchitoches Parish are taxadjuncts to the Cahaba series because the reaction of the A, A/B, and Bt1 horizons is slightly higher than the defined range for the series. This difference does not significantly affect use and management of these soils.

Cahaba soils are similar to Ruston and Smithdale soils and commonly are near Bienville and Guyton soils. Bienville soils are in positions similar to those of the Cahaba soils and are sandy throughout. The Guyton soils are in lower positions and are fine-silty. The Ruston and Smithdale soils are on the terrace uplands and have sola more than 60 inches thick.

Typical pedon of Cahaba fine sandy loam, 1 to 5 percent slopes; about 1 mile east of Hagewood on Highway 6, 0.5 mile northeast on local road to pasture, 0.5 mile north on trail in pasture; NE1/4NE1/4 sec. 33, T. 9 N., R. 8 W.

A—0 to 8 inches; dark brown (10YR 4/3) fine sandy loam; weak fine granular structure; very friable; many fine and medium roots; slightly acid; gradual smooth boundary.

A/B—8 to 16 inches; yellowish brown (10YR 5/4) sandy loam (A); yellowish red (5YR 5/8) sandy loam (B); weak fine subangular blocky structure; very friable; many fine and medium roots; slightly acid; clear smooth boundary.

Bt1—16 to 26 inches; red (2.5YR 4/6) sandy clay loam; moderate medium subangular blocky structure; friable; common fine and medium roots; few thin patchy clay films on faces of peds and in pores; slightly acid; gradual wavy boundary.

Bt2—26 to 48 inches; yellowish red (5YR 4/6) loam; moderate medium subangular blocky structure; friable; few fine roots; few thin patchy clay films on faces of some peds; very strongly acid; gradual wavy boundary.

C—48 to 66 inches; strong brown (7.5YR 5/6) fine sandy loam; common medium distinct light brownish gray (10YR 6/2) and yellowish red (5YR 5/6) mottles; massive; very friable; few fine roots; extremely acid.

The solum ranges from 36 to 60 inches in thickness. The soil ranges from extremely acid to slightly acid throughout. The effective cation exchange capacity is 20 to 50 percent saturated with exchangeable aluminum within a depth of 30 inches.

The A horizon has hue of 10YR, value of 3 to 5, and chroma of 2 to 4. It is 4 to 8 inches thick.

Some pedons have a thin E horizon that has hue of 10YR or 2.5Y, value of 3 to 6, and chroma of 2 to 4. The texture is fine sandy loam, sandy loam, or loamy fine sand.

The Bt horizon has hue of 5YR or 2.5YR, value of 4 or 5, and chroma of 6 or 8. The texture is sandy clay loam, clay loam, or loam.

Some pedons have a BC or CB horizon that is strong brown, yellowish red, or red. The texture is sandy loam or fine sandy loam.

The C horizon ranges from yellowish brown to red and is commonly stratified sand, loamy sand, and fine sandy loam.

Caspiana Series

The Caspiana series consists of well drained, moderately permeable soils that formed in loamy alluvium. These soils are on old natural levees of distributaries of the Red River. Slopes are generally less than 1 percent. Soils of the Caspiana series are fine-silty, mixed, thermic Typic Argiudolls.

Caspiana soils commonly are near Armistead, Gallion, Latanier, and Moreland soils. The Armistead and Latanier soils are in lower positions than the Caspiana soils and are clayey in the upper part. Gallion soils are in slightly higher positions and do not have a dark color surface layer. Moreland soils are in lower positions and are clayey throughout.

Typical pedon of Caspiana silty clay loam; about 4.5 miles west of Lake End, 2.5 miles southwest on Highway 174 from Highway 1, 0.4 mile north on parish road, 2.1 miles west and 0.7 mile north on parish road, 0.3 mile west on farm road, 100 feet south of road; Spanish Land Grant 37, T. 11 N., R. 10 W.

Ap—0 to 5 inches; dark brown (7.5YR 3/2) silty clay loam; weak medium subangular blocky structure; friable; few fine roots; neutral; clear smooth boundary.

A—5 to 12 inches; very dark gray (10YR 3/1) silty clay loam; weak medium subangular blocky structure; friable; few fine roots; neutral; clear smooth boundary.

BA—12 to 27 inches; very dark gray (5YR 3/1) silty clay loam; few fine distinct reddish brown (5YR 4/4) mottles; weak medium subangular blocky structure; friable; few fine roots; many fine pores; few thin patchy clay films on faces of peds; neutral; gradual smooth boundary.

Bt1—27 to 42 inches; reddish brown (5YR 4/4) silty clay loam; weak medium subangular blocky structure; friable; few fine roots; common fine pores; thick continuous clay films on faces of peds; mildly alkaline; clear smooth boundary.

BC—42 to 48 inches; yellowish red (5YR 4/6) silt loam; weak medium subangular blocky structure; friable; thin patchy clay films on faces of peds; moderately alkaline; gradual smooth boundary.

C—48 to 60 inches; yellowish red (5YR 5/6) silt loam; massive; firm; strong effervescence; moderately alkaline.

The solum ranges from 30 to 60 inches in thickness.

The A horizon has hue of 10YR, 7.5YR, or 5YR, value of 3, and chroma of 1 to 3. It is 7 to 20 inches thick. Reaction ranges from medium acid to moderately alkaline.

The BA horizon has the same range in colors as that of the A horizon. The texture is silt loam or silty clay loam. Reaction ranges from medium acid to moderately alkaline.

The Bt horizon has hue of 7.5YR, 5YR or 2.5YR, value of 4 or 5, and chroma of 3 to 6. The texture is silty clay loam or silt loam. Reaction ranges from medium acid to moderately alkaline.

The BC and C horizons have the same range in color as that of the Bt horizon. The texture is silty clay loam, silt loam, loam, or very fine sandy loam. Reaction ranges from slightly acid to moderately alkaline. The C horizon is calcareous in some pedons.

Gallion Series

The Gallion series consists of well drained, moderately permeable soils that formed in loamy alluvium. These soils are on natural levees of distributaries of the Red River. Slopes are generally less than 1 percent. Soils of the Gallion series are fine-silty, mixed, thermic Typic Hapludalfs.

Gallion soils are similar to Roxana and Severn soils and commonly are near Armistead, Caspiana, and Latanier soils. Armistead and Latanier soils are in lower positions than the Gallion soils and are clayey in the upper part. Caspiana soils are in slightly lower positions and have a dark color surface layer. Roxana and Severn soils are on natural levees along the present channel of the Red River, and they are coarse-silty.

Typical pedon of Gallion silt loam; about 3.6 miles east of Bermuda on Highway 1220 from Highway 119, 400 feet south from center of highway; Spanish Land Grant 48, T. 8 N., R. 6 W.

Ap—0 to 8 inches; brown (7.5YR 4/2) silt loam; weak fine and medium granular structure; friable; few fine and medium roots; many fine pores; strongly acid; clear smooth boundary.

Bt1—8 to 18 inches; yellowish red (5YR 4/6) silt loam; weak medium subangular blocky structure; friable; distinct nearly continuous clay films on faces of peds; few fine roots; few fine pores; slightly acid; clear smooth boundary.

Bt2—18 to 33 inches; yellowish red (5YR 5/6) loam; weak medium subangular blocky structure; friable; few fine roots; few fine pores; spots of light reddish brown (5YR 6/4) silt coatings; distinct nearly continuous clay films on faces of peds; slightly acid; clear wavy boundary.

BC—33 to 53 inches; yellowish red (5YR 4/6) loam; weak medium subangular blocky structure; friable; few fine roots; few fine pores; slightly acid; clear wavy boundary.

C1—53 to 60 inches; yellowish red (5YR 5/6) very fine sandy loam; weak platy structure; very friable; many fine pores; slightly acid; clear smooth boundary.

C2—60 to 71 inches; strong brown (7.5YR 5/6) very fine sandy loam; structureless; very friable; neutral.

The solum ranges from 40 to 60 inches in thickness.

The A horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 2 to 4. It is 4 to 14 inches thick. The texture is silt loam or silty clay loam. Reaction ranges from strongly acid to neutral.

The Bt horizon has hue of 7.5YR or 5YR, value of 4 or 5, and chroma of 4 to 6. The texture is silt loam, loam, clay loam, or silty clay loam. Reaction ranges from medium acid to mildly alkaline.

The BC horizon has colors similar to those of the Bt horizon. The texture is very fine sandy loam, silt loam, loam, clay loam, or silty clay loam. Reaction ranges from slightly acid to moderately alkaline.

The C horizon has the same range in color, reaction, and texture as that of the BC horizon. Concretions of calcium carbonate are in the C horizon of some pedons.

Gore Series

The Gore series consists of moderately well drained, very slowly permeable soils that formed in clayey stream deposits of late Pleistocene age. These soils are on uplands. Slopes range from 1 to 5 percent. Soils of the Gore series are fine, mixed, thermic Vertic Paleudalfs.

Gore soils are similar to Bellwood soils and commonly are near Acadia and Morse soils. Acadia soils are on slightly higher ridgetops than those of the Gore soils, and they are brownish and grayish throughout the profile. Bellwood soils are at a higher elevation, are very fine-textured, and have intersecting slickensides. Morse soils are on steeper side slopes and are calcareous to the surface.

Typical pedon of Gore silt loam, 1 to 5 percent slopes; about 8.3 miles northwest of Campti on Highway 480, 0.4 mile north on trail, 50 feet east of trail; NW1/4SE1/4 sec. 18, T. 11 N., R. 8 W.

A—0 to 4 inches; dark brown (10YR 4/3) silt loam; weak fine subangular blocky structure; friable; many fine and medium roots; strongly acid; clear wavy boundary.

BE—4 to 8 inches; reddish yellow (7.5YR 6/6) silt loam; few medium distinct pale brown (10YR 6/3) mottles; weak medium subangular blocky structure; friable; few fine roots; few fine pores; strongly acid; clear wavy boundary.

Bt1—8 to 18 inches; yellowish red (5YR 5/6) clay; moderate medium subangular blocky structure; firm; common fine and medium roots; few fine pores; thin patchy clay films on faces of peds; strongly acid; gradual wavy boundary.

Bt2—18 to 32 inches; light brownish gray (10YR 6/2) clay; common medium prominent red (2.5YR 4/8) mottles; moderate medium subangular blocky structure; very firm; few fine roots; few fine pores; thin patchy clay films on faces of peds and in pores; very strongly acid; gradual wavy boundary.

BC—32 to 45 inches; red (2.5YR 4/6) clay; common medium prominent light brownish gray (10YR 6/2) mottles; moderate medium subangular blocky structure; massive; very firm; very strongly acid; abrupt wavy boundary.

C—45 to 60 inches; yellowish red (5YR 5/6) clay; common fine distinct pale brown (10YR 6/3) mottles; massive; firm; medium acid.

The solum ranges from 40 to 60 inches in thickness. The effective cation exchange capacity is 20 to 50 percent saturated with exchangeable aluminum within a depth of 30 inches.

The A horizon has hue of 10YR, value of 3 to 5, and chroma of 2 or 3. It is 1 to 4 inches thick. Reaction ranges from very strongly acid to medium acid.

Some pedons have an E horizon that has hue of 10YR, value of 5 to 7, and chroma of 2 or 3.

The BE horizon has hue of 10YR, 7.5YR, or 5YR, value of 4 to 6, and chroma of 4 to 8. The texture is silty clay loam or silt loam. Reaction ranges from very strongly acid to medium acid.

The upper part of the Bt horizon has hue of 2.5YR or 5YR, value of 3 to 5, and chroma of 4 to 6. The lower part has the same range in colors as that of the upper part, or it has hue of 10YR or 2.5Y, value of 5 or 6, and chroma of 1 or 2. Mottles are in shades of red, brown, and gray. The texture of the Bt horizon is clay, silty clay, or silty clay loam. Reaction ranges from very strongly acid to neutral.

The upper part of the BC horizon has the same range in color and texture as that of the Bt horizon. The lower part has hue of 2.5YR or 5YR, value of 4 to 6, and chroma of 4 to 6. Reaction of the BC horizon ranges from very strongly acid to neutral.

The C horizon is reddish clay or silty clay. Reaction ranges from medium acid to moderately alkaline. Concretions of calcium carbonate range from none to common in the BC and C horizons.

Guyton Series

The Guyton series consists of poorly drained, slowly permeable soils that formed in silty alluvium and old stream deposits. These soils are on flood plains of streams and on uplands and low stream terraces. They are subject to flooding unless protected by levees. A seasonal high water table is within 1.5 feet of the soil surface from December to May in most years. Slope is generally less than 1 percent. Soils of the Guyton series are fine-silty, siliceous, thermic Typic Glossaqualfs.

Guyton soils commonly are near Beauregard, Bienville, Caddo, Cahaba, and Lotus soils. Beauregard soils are in higher positions on terrace uplands than the Guyton soils and contain more than 5 percent plinthite. Bienville and Cahaba soils are in higher positions on low stream terraces. Bienville soils are sandy throughout the profile, and Cahaba soils are fine-loamy. Caddo soils are in more convex positions on terrace uplands, and they contain plinthite. Lotus soils are in slightly higher positions on flood plains and are sandy throughout.

Typical pedon of Guyton silt loam, frequently flooded; about 3 miles north of Goldonna, 1.7 miles north of Goldonna on parish road, 0.7 mile northeast on U.S. Forest Service Road 585, 0.8 mile east on trail, 20 feet south of trail; NE1/4NW1/4 sec. 5, T. 12 N., R. 5 W.

A—0 to 4 inches; dark grayish brown (10YR 4/2) silt loam; weak medium and fine granular structure; friable; few fine roots; very strongly acid; clear wavy boundary.

Eg1—4 to 11 inches; grayish brown (10YR 5/2) silt loam; few fine faint yellowish brown mottles; weak medium subangular blocky structure; friable; few fine roots; few fine pores; very strongly acid; gradual wavy boundary.

Eg2—11 to 19 inches; light brownish gray (10YR 6/2) silt loam; common medium faint light yellowish brown (10YR 6/4) and yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; friable; few fine roots; few fine pores; pockets and streaks of light gray silt; very strongly acid; abrupt irregular boundary.

B/E—19 to 30 inches; gray (10YR 5/1) silty clay loam (Bt); common medium distinct strong brown (7.5YR

5/6) mottles; moderate medium subangular blocky structure; firm; few fine roots; common discontinuous clay films on faces of peds; about 15 percent, by volume, tongues of light brownish gray (10YR 6/2) silt loam (E); very strongly acid; clear wavy boundary.

Btg—30 to 41 inches; grayish brown (10YR 5/2) silty clay loam; common medium distinct strong brown (7.5YR 5/8) mottles; moderate medium and coarse subangular blocky structure; friable; few thin clay films on faces of peds; very strongly acid; clear smooth boundary.

BC—41 to 60 inches; light brownish gray (10YR 6/2) clay loam; common medium distinct strong brown (7.5YR 5/8) mottles; moderate medium and coarse subangular blocky structure; firm; few thin discontinuous clay films on faces of peds; few fine brown concretions; very strongly acid.

The solum ranges from 50 to 80 inches in thickness. Exchangeable sodium ranges from 10 to 40 percent of the sum of the cation exchange capacity in the lower part of the solum. The effective cation exchange capacity is 20 to 50 percent saturated with exchangeable aluminum within a depth of 30 inches.

The A or Ap horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 2 or 3. It is 2 to 8 inches thick. Reaction ranges from extremely acid to medium acid.

The Eg horizon has hue of 10YR or 2.5Y, value of 5 to 7, and chroma of 1 or 2. It is 11 to 24 inches thick. The texture is silt loam or very fine sandy loam. Reaction ranges from extremely acid to medium acid. Tongues of E material extend into the B/E horizon.

The Btg horizon has hue of 10YR or 2.5Y, value of 5 or 6, and chroma of 1 or 2. The texture is silt loam, silty clay loam, or clay loam. Reaction ranges from very strongly acid to medium acid. Mottles of strong brown, yellowish brown, or gray range from few to many.

The BC horizon has the same range in color as that of the Bt horizon. The texture is silt loam, silty clay loam, clay loam, or sandy clay loam. Reaction ranges from very strongly acid to medium acid. Some pedons do not have a BC horizon.

Keithville Series

The Keithville series consists of moderately well drained, very slowly permeable soils that formed in loamy and clayey marine deposits of Tertiary age. These soils are on uplands. A seasonal high water table is 2 to 3 feet below the soil surface from December to April in most years. Slopes range from 1 to 5 percent. Soils of the Keithville series are fine-silty, siliceous, thermic Glossaquic Paleudalfs.

Keithville soils in Natchitoches Parish are taxadjuncts to the Keithville series because the Bt2 and 2Bt5 horizons are clay loam. This difference is outside the defined range for the series, but it does not significantly affect use and management of these soils.

Keithville soils commonly are near Bellwood, Malbis, Natchitoches, and Sacul soils. Bellwood and Natchitoches soils are at a lower elevation and are clayey throughout the subsoil. Malbis soils are in slightly higher positions than the Keithville soils and are fine-loamy. Sacul soils are at a lower elevation and have a subsoil that is clayey in the upper part.

Typical pedon of Keithville loam, 1 to 5 percent slopes; about 3 miles west of Chestnut, 3.5 miles west and southwest on parish road from Chestnut post office to road junction, 0.15 mile west of junction, 5 feet south of road; NE1/4SE1/4 sec. 3, T. 12 N., R. 7 W.

A—0 to 7 inches; dark brown (10YR 4/3) loam; weak fine granular structure; very friable; many fine and medium roots; very strongly acid; clear smooth boundary.

Bt1—7 to 14 inches; strong brown (7.5YR 5/6) loam; few fine faint brownish yellow mottles; weak fine subangular blocky structure; friable; many fine roots; common fine pores; common medium soft dark brown concretions of iron-manganese; thin patchy clay films on faces of peds; very strongly acid; clear smooth boundary.

Bt2—14 to 22 inches; strong brown (7.5YR 5/6) clay loam; few fine faint brownish yellow mottles; moderate medium subangular blocky structure; firm; many fine roots; few medium and coarse dark brown concretions of iron-manganese; thin patchy clay films on faces of peds; very strongly acid; clear wavy boundary.

B/E—22 to 26 inches; brownish yellow (10YR 6/6) clay loam (Bt); common medium faint strong brown (7.5YR 5/6) mottles and common medium distinct grayish brown (10YR 5/2) mottles; weak medium subangular blocky structure; firm; few fine roots; many fine pores; common coarse chert pebbles; about 15 percent, by volume, light brownish gray (10YR 6/2) silt coatings (E) 2 to 5 millimeters thick on peds; many fine and medium brown concretions of iron-manganese; thin patchy clay films on faces of peds; strongly acid; abrupt smooth boundary.

2Bt3—26 to 54 inches; red (2.5YR 4/6) clay; common medium prominent light brownish gray (10YR 6/2) mottles and few fine faint light yellowish brown mottles; weak medium subangular blocky structure; very firm; common fine roots; thin patchy clay films on faces of peds; very strongly acid; clear wavy boundary.

2Bt4—54 to 60 inches; light brownish gray (10YR 6/2) clay loam; common medium prominent red (2.5YR 4/6) mottles and few fine faint light yellowish brown mottles; weak medium subangular blocky structure; very firm; very strongly acid.

The solum is more than 60 inches thick. Reaction ranges from very strongly acid to medium acid throughout the profile except where lime has been added. Depth to the clayey 2Bt horizon ranges from 30 to 40 inches. The effective cation exchange capacity is 50 percent or more saturated with exchangeable aluminum within a depth of 30 inches.

The A horizon has hue of 10YR, value of 3 to 6, and chroma of 2 to 4. It is 2 to 7 inches thick. Some pedons have a thin E horizon that is silt loam, loam, or very fine sandy loam.

The Bt horizon has hue of 5YR or 7.5YR, value of 5 or 6, and chroma of 6 or 8. The texture is loam, silt loam, silty clay loam, or clay loam.

The Bt part of the B/E horizon is mottled in hue of 2.5YR to 10YR, value of 3 to 6, and chroma of 3 to 6. The texture is silt loam, loam, silty clay loam, or clay loam. The E part of the B/E horizon is grayish uncoated silt or very fine sand.

The matrix of the 2Bt horizon ranges from red to gray, and it is mottled in shades of gray, red, and brown. The texture is silty clay, clay, or clay loam.

Kisatchie Series

The Kisatchie series consists of well drained, very slowly permeable soils that are moderately deep to siltstone. These soils are on uplands. They formed in clayey marine deposits over siltstone or sandstone of Tertiary age. Slopes range from 1 to 40 percent. Soils of the Kisatchie series are fine, montmorillonitic, thermic Typic Hapludalfs.

Kisatchie soils commonly are near Anacoco, Betis, Briley, Guyton, Oula, and Smithdale soils. Anacoco soils are on flatter parts of ridgetops than Kisatchie soils and do not have siltstone within 40 inches of the surface. Betis and Briley soils are at a higher elevation and are sandy from the surface to a depth of 20 inches or more. Guyton soils are in drainageways and are fine-silty. Oula and Smithdale soils are in positions similar to those of the Kisatchie soils. Oula soils do not have siltstone within 40 inches of the surface. Smithdale soils are fine-loamy.

Typical pedon of Kisatchie silt loam, in an area of Kisatchie-Anacoco complex, 1 to 5 percent slopes; about 7 miles southwest of Derry, 5.2 miles south of Derry on Highway 119, 10 miles northwest on Forest Service Lotus-Gorum Road, 3.1 miles south on Forest Service Road 321, 1.25 miles west on Forest Service Road 365, 0.5 mile south on Forest Service Road 365A, 300 feet west of road; NE1/4NW1/4 sec. 34, T. 6 N. R. 7 W.

A—0 to 6 inches; dark grayish brown (10YR 4/2) silt loam; weak fine granular structure; friable; many fine roots; strongly acid; clear wavy boundary.

Bt1—6 to 11 inches; grayish brown (2.5Y 5/2) silty clay; moderate medium subangular blocky structure; very firm; few fine roots; thin patchy clay films on faces of peds; very strongly acid; clear wavy boundary.

Bt2—11 to 19 inches; pale olive (5Y 6/3) silty clay loam; moderate coarse subangular blocky structure; firm; few fine roots; thin patchy clay films on faces of peds; very strongly acid; clear wavy boundary.

Bt3—19 to 36 inches; light olive gray (5Y 6/2) clay loam; common medium faint pale olive (5Y 6/3) mottles; moderate coarse subangular blocky structure; firm; few fine roots; thin patchy clay films on faces of peds; few small fragments of siltstone; very strongly acid; clear smooth boundary.

2Cr—36 to 60 inches; light gray (2.5Y 7/2) siltstone; weakly cemented plates 1 to 5 centimeters thick; few fine roots in cracks; slightly acid.

The solum ranges from 20 to 40 inches in thickness and is underlain by siltstone or sandstone. Reaction is extremely acid or very strongly acid throughout the solum except for the A horizon. Reaction of the A horizon is very strongly acid or strongly acid.

The A horizon has hue of 10YR, value of 2 to 4, and chroma of 1 or 2. It is 1 to 7 inches thick. The texture is silt loam, fine sandy loam, or silty clay loam. Where these soils are severely eroded, the texture can be clay.

Some pedons have an E horizon that has hue of 10YR, value of 4 or 5, and chroma of 1 or 2. Texture is silt loam, very fine sandy loam, or fine sandy loam. Combined thickness of the A and E horizons is 5 to 12 inches.

The Bt horizon has hue of 10YR, 2.5Y, or 5Y, value of 5 or 6, and chroma of 2 to 6; or it has hue of 7.5YR, value of 5, and chroma of 2 or 4. Texture is silty clay, clay, silty clay loam, or clay loam.

The 2Cr horizon is siltstone or sandstone.

Latanier Series

The Latanier series consists of somewhat poorly drained, very slowly permeable soils that formed in clayey alluvium underlain by loamy alluvium. These soils are on natural levees of the Red River. A seasonal high water table is within 1 to 3 feet of the soil surface from December to April in most years. Slopes are generally less than 1 percent. Soils of the Latanier series are clayey over loamy, mixed, thermic Vertic Hapludolls.

Latanier soils commonly are near Armistead, Gallion, Moreland, and Roxana soils. Armistead soils are in slightly higher positions than Latanier soils and are clayey to a depth of less than 20 inches. Gallion and Roxana soils are in higher positions and are loamy throughout the profile. Moreland soils are in lower positions and have a subsoil that is clayey to a depth of 40 inches or more.

Typical pedon of Latanier clay; about 3.5 miles northeast of Chopin, 3.2 miles northeast of Highway 1 on Highway 490, 0.65 mile north on field road, 0.25 mile east on field road, 200 feet south of center of field road; Spanish Land Grant 70, T. 6 N., R. 4 W.

Ap—0 to 6 inches; dark brown (7.5YR 3/2) clay; strong coarse subangular blocky structure; very firm; few fine roots; neutral; gradual wavy boundary.
Bw1—6 to 17 inches; dark reddish brown (5YR 3/3) clay; moderate coarse prismatic structure parting to moderate medium and fine subangular blocky; very firm; few fine roots; neutral; abrupt wavy boundary.
Bw2—17 to 26 inches; reddish brown (5YR 4/4) clay; moderate medium subangular blocky structure; very firm; few fine roots; neutral; clear wavy boundary.
2C1—26 to 56 inches; yellowish red (5YR 5/6) silt loam; massive; friable; few fine roots; slight effervescence in lower part; neutral; clear wavy boundary.
2C2—56 to 60 inches; yellowish red (5YR 5/8) silt loam; massive; very friable; strong effervescence; mildly alkaline.

Thickness of the solum and depth to the loamy 2C horizon range from 20 to 40 inches. Reaction ranges from neutral to moderately alkaline throughout the profile.

The A horizon has hue of 7.5YR or 5YR, value of 3, and chroma of 2 or 3. It is 4 to 8 inches thick.

The Bw horizon has hue of 2.5YR or 5YR, value of 3 or 4, and chroma of 3 or 4. The texture is clay or silty clay.

The 2C horizon is monotextured or stratified very fine sandy loam, silt loam, or silty clay loam. It typically is calcareous.

Lotus Series

The Lotus series consists of moderately well drained to somewhat poorly drained, rapidly permeable soils that formed in sandy alluvium. These soils are on natural levees of streams that drain the uplands. They are subject to frequent flooding. A seasonal high water table is 1.5 to 3 feet below the soil surface from December to April in most years. Slopes are generally less than 1 percent but range to 3 percent. Soils of the Lotus series are thermic, coated Aquic Quartzipsamments.

Lotus soils commonly are near Bienville, Cahaba, and Guyton soils. Bienville and Cahaba soils are on nearby stream terraces. Bienville soils have lamellae in the subsoil, and Cahaba soils are fine-loamy. Guyton soils are on flood plains in slightly lower positions than the Lotus soils and are fine-silty.

Typical pedon of Lotus sand, in an area of Guyton-Lotus association, frequently flooded; about 2.3 miles south of Bellwood, 3.2 miles east on U.S. Forest Service Lotus-Gorum Road, 350 feet south of road in woods; SE1/4SE1/4 sec. 24, T. 6 N., R. 8 W.

A—0 to 2 inches; grayish brown (10YR 5/2) sand; weak fine granular structure; very friable; many fine and medium roots; slightly acid; clear smooth boundary.
C—2 to 10 inches; light brownish gray (10YR 6/2) sand; single grained; loose; many fine and medium roots; medium acid; clear wavy boundary.
Ab—10 to 21 inches; grayish brown (10YR 5/2) sand; single grained; loose; common fine roots; strongly acid; clear smooth boundary.
Cb1—21 to 40 inches; light brownish gray (10YR 6/2) loamy sand; common medium distinct yellowish brown (10YR 5/4) mottles; single grained; loose; few medium and fine roots; few pockets of uncoated sand grains; strongly acid; clear wavy boundary.
Cb2—40 to 65 inches; light gray (10YR 7/1) loamy sand; common medium distinct yellowish brown (10YR 5/4) mottles; single grained; loose; common pockets of uncoated sand grains; very strongly acid; clear wavy boundary.

Depth to layers that have a texture finer than loamy fine sand ranges from 60 inches to more than 80 inches. Reaction ranges from strongly acid to slightly acid in the A horizon and from very strongly acid to medium acid in all other horizons. The effective cation exchange capacity is 20 to 50 percent saturated with exchangeable aluminum within a depth of 30 inches.

The A horizon has hue of 7.5YR or 10YR, value of 3 to 5, and chroma of 2 or 3. It is 1 to 14 inches thick. Some pedons have an Ab horizon that has the same range in color as that of the A horizon. The texture of the Ab horizon is sand, fine sand, or loamy fine sand.

The C and Cb horizons have hue of 10YR, value of 5 to 7, and chroma of 1 to 3. The texture is sand, fine sand, loamy sand, or loamy fine sand. Mottles in shades of brown or gray are in some pedons.

Malbis Series

The Malbis series consists of moderately well drained, moderately slowly permeable soils that formed in loamy stream deposits of Tertiary and Pleistocene age. These soils are on uplands. A seasonal high water table is 2.5 to 4 feet below the soil surface from December to March in most years. Slopes range from 1 to 5 percent. Soils of the Malbis series are fine-loamy, siliceous, thermic Plinthic Paleudults.

Malbis soils commonly are near Anacoco, Beauregard, Keithville, and Ruston soils. Anacoco and Keithville soils are at a lower elevation than the Malbis soils and have a clayey subsoil. Beauregard soils are on less convex slopes and are fine-silty. Ruston soils are on more convex ridgetops and side slopes and do not have plinthite in the subsoil.

Typical pedon of Malbis fine sandy loam, 1 to 5 percent slopes; about 3 miles east of Kisatchie, 3 miles north from Kisatchie on Highway 117 to Kisatchie

Lookout Tower, 4.7 miles southeast on Forest Service Road 350, 150 feet south of road; SW1/4SE1/4 sec. 7, T. 5 N., R. 7 W.

A—0 to 6 inches; grayish brown (10YR 5/2) fine sandy loam; few fine faint dark grayish brown mottles; weak medium granular structure; very friable; common fine and medium roots; common medium pores; very strongly acid; gradual wavy boundary.

E—6 to 10 inches; yellowish brown (10YR 5/4) fine sandy loam; few coarse faint yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; very friable; few fine roots; common fine and medium tubular pores; strongly acid; gradual wavy boundary.

BE—10 to 17 inches; strong brown (7.5YR 5/6) and yellowish brown (10YR 5/6) loam; moderate medium subangular blocky structure; few fine roots; few fine and medium tubular pores; very strongly acid; gradual wavy boundary.

Bt—17 to 35 inches; strong brown (7.5YR 5/6) and reddish yellow (7.5YR 6/8) sandy clay loam; moderate medium subangular blocky structure; firm; few fine roots; common fine and medium tubular pores; few thin patchy clay films on faces of peds; very strongly acid; gradual wavy boundary.

Btv1—35 to 44 inches; yellowish brown (10YR 5/6) sandy clay loam; many coarse prominent red (2.5YR 4/6) mottles; moderate medium subangular blocky structure; firm; few fine roots; few thin patchy clay films on faces of peds; common coarse rounded nodules of plinthite; very strongly acid; gradual wavy boundary.

Btv2—44 to 56 inches; brownish yellow (10YR 6/6) and strong brown (7.5YR 5/6) sandy clay loam; many coarse prominent red (2.5YR 4/6) mottles and common medium light gray (10YR 6/1) mottles; firm; few fine roots; common thin continuous clay films on faces of peds; common medium concretions of iron oxide and common rounded crystals of silica; common fine to coarse nodules of plinthite; very strongly acid; gradual wavy boundary.

Btv3—56 to 75 inches; light gray (10YR 6/1) and red (10R 4/6) sandy clay loam; few coarse distinct strong brown (7.5YR 5/6) mottles; moderate medium subangular blocky structure; firm; few fine roots; thin patchy clay films on faces of peds; common coarse nodules of plinthite; very strongly acid.

The solum is more than 60 inches thick. Depth to a horizon that has 5 percent or more plinthite ranges from 25 to 40 inches. The effective cation exchange capacity is 50 percent or more saturated with exchangeable aluminum within a depth of 30 inches.

The A or Ap horizon has hue of 10YR, value of 3 to 5, and chroma of 2 or 3. It is 4 to 8 inches thick. Reaction ranges from very strongly acid to medium acid.

The E horizon has hue of 10YR, value of 5 or 6, and chroma of 4. Some pedons do not have an E horizon.

The BE and Bt horizons have hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 4 to 8. Some pedons do not have a BE horizon. The Btv horizon has colors similar to those of the Bt horizon, and includes hue of 10YR, value of 6, and chroma of 6 or 8 and hue of 10R, value of 6, and chroma of 6 or 8 with shades of gray in the lower part. The texture of the BE, Bt, and Btv horizons is loam, sandy clay loam, or clay loam. Reaction is very strongly acid or strongly acid. Content of plinthite in the Btv horizon ranges from 5 to 25 percent.

Moreland Series

The Moreland series consists of somewhat poorly drained, very slowly permeable soils that formed in clayey alluvium. These soils are in low positions on natural levees and in depressions on the flood plain. These soils are subject to flooding unless protected by levees. A seasonal high water table is within 1.5 feet of the soil surface from December to April in most years. Slopes range from 0 to 3 percent. Soils of the Moreland series are fine, mixed, thermic Vertic Hapludolls.

Moreland soils are taxadjuncts to the Moreland series because the particle-size control section typically has an average clay content of slightly more than 60 percent. In addition, Moreland soils in map unit Md have a reddish brown surface layer. These differences are outside the defined range for the series, but they do not significantly affect use and management of these soils.

Moreland soils commonly are near Armistead, Gallion, Latanier, Perry, and Yorktown soils. Armistead and Latanier soils are in slightly higher positions than Moreland soils and have a loamy subsoil or underlying material. Gallion soils are in higher positions and are fine-silty. Perry soils are in slightly lower positions and do not have a dark color surface layer. Yorktown soils are in depressional areas, and because they generally are wet, they do not crack during dry seasons.

Typical pedon of Moreland clay; about 2.4 miles southeast of Powhatan on Highway 1, 0.5 mile west on farm road, 300 feet north of culvert crossing on canal; SW1/4SW1/4 sec. 27, T. 10 N., R. 8 W.

Ap—0 to 6 inches; dark reddish brown (5YR 3/3) clay; moderate fine subangular blocky structure; very firm; many fine and medium roots; neutral; clear smooth boundary.

A—6 to 16 inches; dark reddish brown (5YR 3/3) clay; moderate fine subangular blocky structure; very firm; few fine and medium roots; shiny surfaces on peds; neutral; gradual wavy boundary.

Bw—16 to 26 inches; dark reddish brown (5YR 3/4) clay; thin strata of reddish brown (5YR 4/4) clay; moderate medium subangular blocky structure; very firm; few fine roots; few shiny pressure faces; neutral; gradual wavy boundary.

Bk1—26 to 52 inches; reddish brown (5YR 4/3) clay; few fine distinct gray (N 5/0) mottles; moderate medium subangular blocky structure; very firm; common pressure faces and slickensides; common fine and medium masses of carbonates; strong effervescence; mildly alkaline; gradual wavy boundary.

Bk2—52 to 63 inches; reddish brown (5YR 4/4) clay; weak coarse angular blocky structure; firm; common pressure faces and slickensides; common fine and medium hard and soft masses of carbonates; strong effervescence; few dark stains; mildly alkaline.

The solum ranges from 40 to more than 60 inches in thickness. Depth to calcareous layers ranges from 10 to 40 inches.

The A horizon has hue of 5YR or 7.5YR, value of 3, and chroma of 2 or 3. It is 7 to 20 inches thick. The texture is clay or silt loam. Reaction ranges from slightly acid to mildly alkaline.

The Bw horizon has hue of 7.5YR or 5YR, value of 3 or 4, and chroma of 2 to 4. The Bk horizon has hue of 5YR, value of 3 or 4, and chroma of 3 or 4. The texture of the Bw and Bk horizons is silty clay or clay. Reaction of these horizons ranges from neutral to moderately alkaline. Some pedons have silt loam or silty clay loam strata in the Bk horizon.

Buried grayish layers are common below a depth of 40 inches.

Morse Series

The Morse series consists of well drained, very slowly permeable soils that formed in calcareous, clayey sediment of Pleistocene age. These soils are on uplands. Slopes range from 5 to 12 percent. Soils of the Morse series are fine, mixed, thermic Entic Chromuderts.

Morse soils are similar to Bellwood soils and commonly are near Acadia, Gore, Guyton, and Moreland soils. Except for the Bellwood soils, none of these soils have intersecting slickensides. The Acadia and Gore soils are at a slightly higher elevation than the Morse soils. The Acadia soils are somewhat poorly drained, and the Gore soils are moderately drained. Bellwood soils are in positions similar to those of the Morse soils and are acid throughout the profile. Guyton soils are in drainageways and are fine-silty. Moreland soils are on the flood plain and are leached of carbonates in the upper part of the profile.

Typical pedon of Morse clay, 5 to 12 percent slopes; about 1.3 miles south of Flora, 1.3 miles southwest of Highway 120 on Highway 478, 0.75 mile east on gravel road, 0.25 mile south in pasture on hillside; NW1/4NE1/4 sec. 16, T. 17 N., R. 7 W.

A—0 to 4 inches; dark reddish brown (5YR 3/3) clay; weak medium granular structure; firm; many fine and medium roots; moderate effervescence; mildly alkaline; clear wavy boundary.

AC—4 to 16 inches; reddish brown (5YR 4/4) clay; weak coarse subangular blocky structure; very firm; common fine and medium roots; strong effervescence; moderately alkaline; clear wavy boundary.

C1—16 to 30 inches; reddish brown (5YR 4/4) clay; weak very coarse subangular blocky structure; very firm; few fine roots; many black stains; common large intersecting slickensides in the lower part; common soft brown masses of calcium carbonate; common fine and medium concretions of calcium carbonate; strong effervescence; mildly alkaline; gradual wavy boundary.

C2—30 to 60 inches; red (2.5YR 4/6) clay; few fine prominent pale brown (10YR 6/3) mottles; moderate coarse subangular blocky structure; very firm; common large intersecting slickensides; few black stains; common fine and medium concretions of calcium carbonate; common soft masses of calcium carbonate; strong effervescence; mildly alkaline.

The depth to free carbonates ranges from 0 to 15 inches.

The A horizon has hue of 2.5YR, 5YR, or 7.5YR, value of 2 to 4, and chroma of 2 to 4. It is 1 to 8 inches thick. Reaction is mildly alkaline or moderately alkaline. Concretions of calcium carbonate are in some pedons.

The AC horizon has hue of 2.5YR, 5YR, or 7.5YR, value of 3 to 5, and chroma of 4 or 6. The texture is clay or silty clay. Reaction ranges from neutral to moderately alkaline.

The C horizon has hue of 2.5YR or 5YR, value of 4 or 5, and chroma of 4 to 8. Reaction is mildly alkaline or moderately alkaline.

Natchitoches Series

The Natchitoches series consists of well drained, very slowly permeable soils that formed in thick, clayey marine sediment of Tertiary age. These soils are on uplands. Slopes range from 1 to 12 percent. Soils of the Natchitoches series are very-fine, montmorillonitic, thermic Vertic Hapludalfs.

Natchitoches soils commonly are near Bellwood, Keithville, and Sacul soils. Bellwood and Sacul soils are in positions similar to those of the Natchitoches soils, and they do not have appreciable amounts of glauconite in the subsoil. Keithville soils are at a slightly higher elevation and are loamy in the upper part of the subsoil.

Typical pedon of Natchitoches sandy clay loam, 1 to 5 percent slopes; about 0.5 mile northwest of Chestnut Post Office on parish road, 225 feet south of parish road; SE1/4SW1/4 sec. 31, T. 13 N., R. 6 W.

A—0 to 4 inches; dark reddish brown (5YR 3/2) sandy clay loam; weak fine granular structure; friable; common medium roots; strongly acid; clear wavy boundary.

Bt1—4 to 11 inches; reddish brown (5YR 4/4) clay; few fine distinct red (2.5YR 4/6) mottles; moderate fine subangular blocky structure; very firm; common fine roots; thick continuous clay film on faces of peds; prominent greenish glauconite sand; very strongly acid; clear wavy boundary.

Bt2—11 to 38 inches; red (10R 4/6) clay; many medium prominent olive (5Y 5/3) mottles; moderate medium subangular blocky structure; firm; few fine roots; thin patchy clay films on faces of peds; many nonintersecting slickensides; about 20 percent greenish glauconite sand; very strongly acid; clear wavy boundary.

C1—38 to 46 inches; yellowish brown (10YR 5/6) and light olive brown (2.5Y 5/4) clay; common fine distinct light olive gray (5Y 6/2) mottles; massive; very firm; common nonintersecting slickensides; about 30 percent greenish glauconite sand; slightly acid; clear wavy boundary.

C2—46 to 63 inches; light yellowish brown (2.5Y 6/4) clay; common fine distinct strong brown (7.5YR 5/6) and yellowish brown (10YR 5/6) mottles; massive; firm; about 30 percent greenish glauconite sand; common soft masses of calcium carbonate; common medium concretions of calcium carbonate; neutral.

The solum ranges from 30 to 50 inches in thickness. Greenish glauconite sand is prominent in the Bt and C horizons. The effective cation exchange capacity is 20 to 50 percent saturated with exchangeable aluminum within a depth of 30 inches.

The A horizon has hue of 2.5YR, 5YR, 7.5YR, value of 3 to 5, and chroma of 2 to 4. It is 1 to 6 inches thick. The texture is fine sandy loam or sandy clay loam. Reaction ranges from strongly acid to slightly acid.

The Bt horizon has hue of 5YR, 2.5YR, or 10R, value of 4, and chroma of 4 to 8. The texture is clay or sandy clay. Reaction ranges from very strongly acid to medium acid.

The C horizon is mottled in shades of brown, red, olive, and gray. The texture is sandy clay or clay. Most pedons have common accumulations and concretions of carbonate. Reaction ranges from medium acid to mildly alkaline.

Oula Series

The Oula series consists of moderately well drained, very slowly permeable soils that formed in stratified clayey and loamy marine deposits of Tertiary age. These soils are on uplands. Slopes range from 5 to 40 percent. Soils of the Oula series are fine, montmorillonitic, thermic Vertic Hapludalfs.

Oula soils are similar to Gore soils and commonly are near Anacoco, Betis, Guyton, Kisatchie, and Smithdale soils. Anacoco soils are on ridgetops at a higher elevation than the Oula soils and have an abrupt textural change between the subsurface layer and the subsoil. Betis soils are in positions similar to those of the Oula soils and are sandy throughout the profile. Gore soils are at a lower elevation and have a thicker solum. Guyton soils are in drainageways and are fine-silty. Kisatchie and Smithdale soils are in positions similar to those of the Oula soils. Kisatchie soils are moderately deep to bedrock, and Smithdale soils are fine-loamy.

Typical pedon of Oula fine sandy loam, in an area of Kisatchie-Oula fine sandy loams, 5 to 40 percent slopes; about 2.5 miles southeast of Gorum, 3.5 miles east and south on Highway 119 from the Gorum school, 0.5 mile south on woodland trail, 275 feet east of benchmark on painted 1/4 section line, 20 feet north of line; SW1/4NE1/4 sec. 17, T. 5 N., R. 5 W.

A—0 to 6 inches; brown (10YR 4/3) fine sandy loam; weak fine granular structure; very friable; many fine and very fine roots, common medium and coarse roots; about 5 to 10 percent sandstone fragments; extremely acid; clear smooth boundary.

Bt1—6 to 14 inches; light brownish gray (10YR 6/2) sandy clay; common fine and medium prominent strong brown (7.5YR 5/8) mottles and common fine and medium distinct yellowish brown (10YR 5/6, 5/4) mottles; moderate medium subangular blocky structure; firm; common fine, medium, and coarse roots; common thin discontinuous clay films on faces of peds; common dark grayish brown (10YR 4/2) sandy clay loam fillings in cracks; extremely acid; clear wavy boundary.

Bt2—14 to 23 inches; light brownish gray (2.5Y 6/2) clay; many fine and medium prominent strong brown (7.5YR 5/8) mottles and few fine distinct olive yellow (2.5Y 6/6) mottles; moderate medium subangular blocky structure; very firm; common fine, medium, and coarse roots; common thin patchy clay films on faces of peds; few slickensides; common dark grayish brown (10YR 4/2) sandy clay loam fillings in cracks; extremely acid; clear wavy boundary.

Bt3—23 to 40 inches; light brownish gray (2.5Y 6/2) clay; common fine and medium distinct olive yellow (2.5Y 6/6, 6/8) mottles and few fine and medium prominent strong brown (7.5YR 5/8) mottles; weak medium subangular blocky structure; very firm; few fine, medium, and coarse roots; common thin patchy clay films on faces of peds; few slickensides; extremely acid; gradual wavy boundary.

Bt4—40 to 50 inches; light brownish gray (2.5Y 6/2) clay; common coarse distinct olive yellow (2.5Y 6/8) mottles and medium prominent dark yellowish brown (10YR 4/4) mottles; weak coarse subangular blocky structure; very firm; few fine, medium, and coarse roots; few thin patchy clay films on faces of peds; extremely acid; gradual wavy boundary.

C—50 to 63 inches; light brownish gray (2.5Y 6/2) silty clay; few medium distinct olive yellow (2.5Y 6/6) mottles and few medium prominent dark yellowish brown (10YR 4/4) mottles; weak very coarse subangular blocky structure; faint rock structure; very firm; very few fine roots; extremely acid.

The solum ranges from 25 to 50 inches in thickness. Some pedons are underlain by siltstone or sandstone bedrock below a depth of 60 inches. Fragments of siltstone or sandstone range from none to common throughout the soil. The effective cation exchange capacity is 20 to 50 percent saturated with exchangeable aluminum within a depth of 30 inches.

The A horizon has hue of 10YR, value of 3 or 4, and chroma of 2 or 3. It is 1 to 6 inches thick. Reaction ranges from extremely acid to medium acid.

Some pedons have an E horizon that has hue of 10YR, value of 4 to 6, and chroma of 2 to 4. The texture is fine sandy loam or very fine sandy loam. Reaction ranges from extremely acid to medium acid.

The Bt horizon has hue of 10YR or 2.5Y, value of 5 or 6, and chroma of 2 to 4; or it has hue of 7.5YR, value of 4 or 5, and chroma of 4 to 6. The texture is sandy clay, clay, or silty clay. Reaction ranges from extremely acid to strongly acid.

The C horizon has the same range in colors as that of the Bt horizon. The texture ranges from clay to loam and is commonly stratified. Reaction ranges from extremely acid to strongly acid.

Perry Series

The Perry series consists of poorly drained, very slowly permeable soils that formed in clayey alluvium. These soils are in low positions on flood plains and are subject to flooding unless protected by levees. A seasonal high water table is within 2 feet of the soil surface from December to June in most years. Slopes are generally less than 1 percent. Soils of the Perry series are very-fine, montmorillonitic, nonacid, thermic Vertic Haplaquepts.

Perry soils commonly are near the Gallion, Latanier, Moreland, and Yorktown soils. Gallion soils are in higher positions than the Perry soils and are fine-silty. Latanier and Moreland soils are in slightly higher positions and have a dark color surface layer. Yorktown soils are in depressional areas, and because they are generally wet, they do not crack.

Typical pedon of Perry clay, occasionally flooded; about 2 miles southwest of Montrose, 3 miles southwest from Highway 1 on Highway 493, 1.1 miles southwest on U.S. Forest Service Road 339, 0.6 mile northwest on U.S. Forest Service Road 341, 1.5 miles north on trail, 300 feet east of trail end; NE1/4SW1/4 Spanish Land Grant 63, T. 7 N., R. 6 W.

A—0 to 6 inches; gray (10YR 5/1) clay; common medium distinct strong brown (7.5YR 5/6) mottles; moderate medium subangular blocky structure; very firm; few fine roots; medium acid; clear smooth boundary.

Bg1—6 to 14 inches; gray (10YR 5/1) clay; many medium strong brown (7.5YR 4/6) mottles; moderate medium subangular blocky structure; very firm; few fine roots; few slickensides; medium acid; clear smooth boundary.

Bg2—14 to 22 inches; gray (10YR 5/1) clay; common medium distinct strong brown (7.5YR 5/6) and yellowish red (5YR 5/4) mottles; moderate medium subangular blocky structure; very firm; few fine roots; few slickensides; neutral; clear wavy boundary.

2BCk—22 to 35 inches; reddish brown (5YR 4/4) clay; moderate medium subangular blocky structure; very firm; few fine roots; common fine and medium concretions of calcium carbonate; few slickensides; mildly alkaline; clear smooth boundary.

2C—35 to 61 inches; reddish brown (5YR 4/4) clay; moderate medium subangular blocky structure; very firm; common medium concretions of calcium carbonate; strong effervescence; moderately alkaline.

The Perry soils are clay throughout the profile. The solum ranges from 30 to 60 inches in thickness. Depth to the 2B horizon ranges from 14 to 36 inches.

The A horizon has hue of 10YR, value of 3 to 6, and chroma of 1 or 2. It is 4 to 9 inches thick. Reaction ranges from very strongly acid to medium acid.

The Bg horizon has hue of 10YR, value of 4 to 6, and chroma of 1. Mottles in shades of brown and red range from few to many. Clay content ranges from 55 to 85 percent. Reaction ranges from strongly acid to neutral.

The 2BCk horizon has hue of 5YR, value of 3 or 4, and chroma of 2 or 4. Reaction ranges from slightly acid to moderately alkaline.

The 2C horizon has hue of 10YR, 7.5YR, or 5YR, value of 4 to 5, and chroma of 1 to 4. It is calcareous and contains few to many concretions of calcium carbonate. Reaction is mildly alkaline or moderately alkaline.

Roxana Series

The Roxana series consists of well drained, moderately permeable soils that formed in loamy alluvium. These soils are on natural levees of the Red River. A seasonal high water table is 4 to 6 feet below the soil surface from December to April in most years. Slopes are generally less than 1 percent. Soils of the

Roxana series are coarse-silty, mixed, nonacid, thermic Typic Udifluvents.

Roxana soils commonly are near Gallion, Latanier, and Severn soils. Gallion soils are on natural levees of abandoned distributary channels and have a well-developed subsoil. Latanier soils are in lower positions than the Roxana soils and have a clayey surface layer and subsoil. Severn soils are in positions similar to those of the Roxana soils, and they are calcareous in all horizons below a depth of 10 inches.

Typical pedon of Roxana very fine sandy loam; about 1 mile east of Natchitoches, 1.7 miles northeast on Highway 1224 from its junction with Highway 1, 600 feet south of center of road; N1/2 sec. 22, T. 9 N., R. 7 W.

Ap—0 to 6 inches; yellowish red (5YR 4/6) very fine sandy loam; weak fine granular structure; very friable; common fine and very fine roots; neutral; abrupt smooth boundary.

C1—6 to 19 inches; yellowish red (5YR 5/6) very fine sandy loam; weak fine granular structure; very friable; common fine roots; neutral; clear smooth boundary.

C2—19 to 27 inches; yellowish red (5YR 5/6) very fine sandy loam; massive; very friable; few fine roots; distinct bedding planes; slight effervescence; moderately alkaline; clear smooth boundary.

C3—27 to 42 inches; yellowish red (5YR 4/6) silt loam; massive; very friable; few fine roots; distinct bedding planes; strong effervescence; moderately alkaline; abrupt smooth boundary.

2Ab—42 to 48 inches; dark brown (10YR 3/3) silt loam; weak medium subangular blocky structure; friable; strong effervescence; mildly alkaline; abrupt smooth boundary.

2C4—48 to 66 inches; strong brown (7.5YR 5/6) fine sandy loam; massive; faint bedding planes; very friable; mildly alkaline.

Bedding planes are in the 10- to 40-inch control section.

The A horizon has hue of 10YR, 7.5YR, or 5YR, value of 3 or 4, and chroma of 4 to 6. It is 3 to 10 inches thick. Reaction ranges from slightly acid to moderately alkaline. The 2Ab horizon is fine sandy loam, very fine sandy loam, loam, silt loam, or silty clay loam. Reaction ranges from neutral to moderately alkaline. Some pedons do not have a 2Ab horizon.

The C horizon has hue of 5YR or 7.5YR, value of 4 or 5, and chroma of 4 to 8. The texture is loamy very fine sand, very fine sandy loam, fine sandy loam, or silt loam. Reaction ranges from neutral to moderately alkaline. Buried horizons are common below a depth of 40 inches.

Ruston Series

The Ruston series consists of well drained, moderately permeable soils that formed in thick, loamy stream deposits of Tertiary and Pleistocene age. These soils are on uplands. Slopes range from 1 to 5 percent. Soils of the Ruston series are fine-loamy, siliceous, thermic Typic Paleudults.

Ruston soils are similar to Cahaba soils and commonly are near Briley, Malbis, Sacul, and Smithdale soils. Briley soils are in positions similar to those of the Ruston soils, and they have a thick sandy surface layer. Cahaba soils are on low terraces and have a solum that is thinner than the solum in the Ruston soils. Malbis soils are on slightly less convex slopes and have more than 5 percent plinthite in the subsoil. Sacul soils are on lower side slopes and in positions similar to those of the Ruston soils, and they have a clayey subsoil. Smithdale soils are on side slopes and do not have a profile with a bisequum.

Typical pedon of Ruston fine sandy loam, 1 to 5 percent slopes; about 5.5 miles northeast of Clarence, 3.7 miles east from Clarence on Highway 84, 7 miles north on Highway 1226, 0.4 mile southeast on dirt road, 350 feet north of dirt road; SE1/4SW1/4 sec. 36, T. 11 N., R. 6 W.

Ap—0 to 4 inches; dark grayish brown (10YR 4/2) fine sandy loam; weak medium granular structure; very friable; common fine and very fine roots; slightly acid; clear smooth boundary.

E—4 to 12 inches; light yellowish brown (10YR 6/4) fine sandy loam; weak medium subangular blocky structure; very friable; common fine roots; many fine pores; slightly acid; clear smooth boundary.

Bt1—12 to 21 inches; yellowish red (5YR 5/6) sandy clay loam; moderate medium subangular blocky structure; friable; thick continuous clay films on faces of peds; common fine roots; few fine pores; medium acid; clear wavy boundary.

Bt2—21 to 31 inches; yellowish red (5YR 5/6) sandy clay loam; weak medium subangular blocky structure; friable; few fine spots of light yellowish brown (10YR 6/4) sandy loam; thick discontinuous clay films on faces of peds; strongly acid; clear wavy boundary.

B/E'—31 to 36 inches; yellowish red (5YR 5/6) loam (Bt); few fine distinct red (2.5YR 4/6) mottles; common streaks and pockets of light yellowish brown (10YR 6/4) sandy loam (E); weak medium subangular blocky structure; friable; few thin patchy clay films on faces of peds; few fine pores; very strongly acid; clear wavy boundary.

B't—36 to 62 inches; yellowish red (5YR 5/6) sandy clay loam; common medium light gray (10YR 7/2) mottles; weak medium subangular blocky structure;

firm; thin patchy clay films on faces of peds; very strongly acid.

The solum is more than 60 inches thick. The B/E' horizon is definitive for the series. Quartz gravel or ironstone fragments are within the solum of some pedons. The effective cation exchange capacity is 20 to 50 percent saturated with exchangeable aluminum within a depth of 30 inches.

The A horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 2 or 3. It is 3 to 6 inches thick. Reaction ranges from very strongly acid to slightly acid.

The E horizon has hue of 10YR or 7.5YR, value of 5 or 6, and chroma of 2 to 4. The texture is sandy loam, fine sandy loam, or loamy fine sand. Reaction ranges from very strongly acid to slightly acid. Some pedons have a thin BE horizon.

The Bt and B't horizons have hue of 2.5YR or 5YR, value of 4 to 6, and chroma of 4 to 8. The texture is sandy clay loam, loam, or clay loam. Reaction ranges from very strongly acid to medium acid.

The E' part of the B/E' horizon has hue of 10YR, value of 5 or 6, and chroma of 3 or 4. The texture is fine sandy loam, loamy sand, or sandy loam and is in streaks and pockets.

Sacul Series

The Sacul series consists of moderately well drained, slowly permeable soils that formed in loamy and clayey marine deposits of Tertiary age. These soils are on uplands. Slopes range from 1 to 12 percent. Soils of the Sacul series are clayey, mixed, thermic Aquic Hapludults.

The Sacul soils in map unit Sa are taxadjuncts to the Sacul series because they have slightly more sand in the Bt4 horizon and slightly more organic matter in the A horizon than the defined range for the Sacul series. These minor differences do not significantly affect the use and management of these soils.

Sacul soils commonly are near Bellwood, Guyton, Keithville, Natchitoches, Ruston, and Smithdale soils. Bellwood and Natchitoches soils are in positions similar to those of the Sacul soils, and they are very fine textured. Guyton soils are in drainageways and are fine-silty. Keithville soils are at a slightly higher elevation and are loamy in the upper part of the subsoil. Ruston soils are on slightly higher ridgetops and in positions similar to those of the Sacul soils, and they are loamy throughout.

Typical pedon of Sacul fine sandy loam, 1 to 5 percent slopes; about 4 miles southwest of Lake End, 4.2 miles southwest from Highway 1 on Highway 174, 150 feet south of Highway 174; SW1/4SE1/4 sec. 35, T. 11 N., R. 10 W.

Ap—0 to 2 inches; dark brown (10YR 4/3) fine sandy loam; moderate medium granular structure; very friable; many fine and medium roots; strongly acid; clear smooth boundary.

E—2 to 10 inches; brown (10YR 5/3) fine sandy loam; weak fine subangular blocky structure; very friable; many fine and medium roots; strongly acid; clear smooth boundary.

Bt1—10 to 20 inches; red (2.5YR 4/8) clay; strong medium angular blocky structure; very firm; common fine roots; continuous clay film on faces of peds; strongly acid; clear smooth boundary.

Bt2—20 to 28 inches; red (2.5YR 4/8) clay; common medium distinct dark yellowish brown (10YR 4/6) mottles and few fine distinct light brownish gray (10YR 6/2) mottles; strong medium angular blocky structure; very firm; few fine roots; continuous thin clay film on faces of peds; strongly acid; clear smooth boundary.

Bt3—28 to 40 inches; red (10R 4/8) clay; common medium distinct dark yellowish brown (10YR 4/6) and light brownish gray (10YR 6/2) mottles; moderate medium angular blocky structure; very firm; continuous thin clay film on faces of peds; strongly acid; clear wavy boundary.

Bt4—40 to 45 inches; red (2.5YR 5/6) sandy clay loam; common medium prominent pale brown (10YR 6/3) and light gray (10YR 7/2) mottles; moderate medium subangular blocky structure; firm; continuous thin clay film on vertical faces of peds; common fine and medium fragments of ironstone; thin dark yellowish brown (10YR 4/4) rind around the fragments of ironstone; strongly acid; clear smooth boundary.

BC—45 to 58 inches; light gray (10YR 7/2) silty clay loam; common medium prominent red (2.5YR 4/8) mottles; moderate medium subangular blocky structure; firm; continuous thin clay films on vertical faces of peds; strongly acid; clear smooth boundary.

C—58 to 60 inches; mottled light gray (10YR 7/1) and yellowish red (5YR 5/8) sandy clay loam; massive; firm; common thin strata of sandy loam; strongly acid.

The solum ranges from 40 to more than 72 inches in thickness. Reaction is very strongly acid or strongly acid except where lime has been added. The effective cation exchange capacity is 50 percent or more saturated with exchangeable aluminum within a depth of 30 inches.

The A or Ap horizon has hue of 10YR, value of 3 or 4, and chroma of 2 or 3. It is 1 to 4 inches thick.

The E horizon has hue of 10YR, value of 4 to 6, and chroma of 3 or 4. It is 4 to 10 inches thick. The texture is fine sandy loam, sandy loam, or loam.

The upper part of the Bt horizon has hue of 5YR, 2.5YR, or 10R, value of 3 to 5, and chroma of 6 or 8. The texture is silty clay or clay. The lower part of the Bt horizon and the BC horizon have the same range in color as the upper part of the Bt horizon and also include value of 6 or 7 and chroma of 2 to 4; or they are mottled in shades of brown, red, and gray. The texture is silty clay loam, clay loam, sandy clay loam, or silt loam.

The C horizon is mottled in shades of red, yellow, and gray and is stratified. The texture is clay loam, sandy clay loam, sandy loam, or shale bedrock. Some pedons do not have a C horizon.

Severn Series

The Severn series consists of well drained, moderately permeable soils that formed in loamy alluvium on natural levees and sand bars adjacent to the Red River. Slopes range from 0 to 2 percent. Soils of the Severn series are coarse-silty, mixed (calcareous), thermic Typic Udifluvents.

The Severn soils in map unit Sf are taxadjuncts to the Severn series because the C horizon is typically neutral and mildly alkaline rather than moderately alkaline and the A horizon typically has less than 0.5 percent organic matter content. These differences are outside the range defined for the series; however, they do not significantly affect the use and management of the soils.

Severn soils commonly are near Latanier, Moreland, and Roxana soils. Latanier and Moreland soils are in lower positions than the Severn soils and have a clayey subsoil. Roxana soils are in positions similar to those of the Severn soils, and they are not calcareous in all horizons below a depth of 10 inches.

Typical pedon of Severn very fine sandy loam, frequently flooded; about 1 mile west of Clarence, 0.9 mile west of Highway 71 and 84 on Highway 6, 1,600 feet south of highway on sandbar; irregular sec. 61, T. 10 N., R. 7 W.

A—0 to 5 inches; reddish brown (5YR 4/4) very fine sandy loam; weak fine granular structure; very friable; common fine and very fine roots; moderately alkaline; abrupt smooth boundary.

C1—5 to 15 inches; yellowish red (5YR 5/6) loamy very fine sand; massive; very friable; common fine roots; distinct bedding planes; slight effervescence; neutral; clear smooth boundary.

C2—15 to 47 inches; yellowish red (5YR 5/6) loamy very fine sand; massive; very friable; few fine roots; distinct bedding planes; slight effervescence; mildly alkaline; clear smooth boundary.

C3—47 to 53 inches; yellowish red (5YR 5/4) very fine sandy loam; massive; very friable; distinct bedding planes; slight effervescence; mildly alkaline; clear smooth boundary.

C4—53 to 60 inches; yellowish red (5YR 4/6) loamy very fine sand; massive; very friable; distinct bedding planes; slight effervescence; mildly alkaline.

These soils are calcareous in all horizons below a depth of 10 inches.

The A horizon has hue of 5YR or 7.5YR, value of 3 or 4, and chroma of 2 to 4. It is 3 to 16 inches thick. Reaction is mildly alkaline or moderately alkaline.

The C horizon has hue of 5YR or 7.5YR, value of 4 to 6, and chroma of 4 to 8. The texture is loamy very fine sand, very fine sandy loam, or silt loam. Reaction ranges from neutral to moderately alkaline.

Shatta Series

The Shatta series consists of moderately well drained, slowly permeable soils that formed in loamy stream deposits of late Pleistocene age. These soils are on uplands. A seasonal high water table is 1.5 to 3 feet below the soil surface from December to April in most years. Slopes range from 1 to 5 percent. Soils of the Shatta series are fine-silty, siliceous, thermic Typic Fragiudults.

Shatta soils commonly are near Acadia, Gore, Guyton, Malbis, and Ruston soils. Acadia and Gore soils are at a slightly lower elevation than the Shatta soils and have a clayey subsoil. Guyton soils are in lower positions and are grayish throughout the profile. Malbis and Ruston soils are in slightly higher positions and do not have a fragipan.

Typical pedon of Shatta very fine sandy loam, 1 to 5 percent slopes; about 0.7 mile southeast of Messick on Highway 71 and 84, 400 feet south of highway in pasture; SW1/4NE1/4 sec. 3, T. 11 N., R. 8 W.

Ap—0 to 7 inches; brown (10YR 5/3) very fine sandy loam; weak medium and fine granular structure; very friable; many fine and medium roots; slightly acid; abrupt smooth boundary.

E—7 to 12 inches; pale brown (10YR 6/3) very fine sandy loam; weak medium subangular blocky structure; very friable; many fine and medium roots; medium acid; clear wavy boundary.

Bt1—12 to 23 inches; strong brown (7.5YR 5/6) clay loam; weak medium subangular blocky structure; friable; few fine roots; thin patchy clay films on faces of peds; medium acid; gradual wavy boundary.

Bt2—23 to 32 inches; yellowish brown (10YR 5/8) clay loam; common medium distinct yellowish red (5YR 5/6) mottles and few fine faint light yellowish brown mottles; weak medium subangular blocky structure; firm, about 35 percent brittle; few fine roots; few fine pores; thin patchy clay films on faces of peds; few fine and medium brown concretions; strongly acid; gradual wavy boundary.

Bx1—32 to 47 inches; yellowish brown (10YR 5/6) loam; moderate coarse and very coarse prismatic structure; about 80 percent firm and brittle, 20 percent friable; few fine roots; thin patchy clay films on faces of peds; many soft yellowish red (5YR 5/6) masses; many light gray (10YR 7/2) silt coatings on faces of peds; strongly acid; gradual wavy boundary.

Bx2—47 to 70 inches; yellowish brown (10YR 5/6) clay loam; common medium distinct yellowish red (5YR 4/6) and light gray (10YR 7/2) mottles; weak very coarse prismatic structure parting to moderate medium subangular blocky; firm and brittle; strongly acid.

The solum ranges from 60 to 90 inches in thickness. Depth to the fragipan ranges from 20 to 36 inches. The effective cation exchange capacity is 20 to 50 percent saturated with exchangeable aluminum within a depth of 30 inches.

The A horizon has hue of 10YR, value of 3, and chroma of 1 or 2; or value of 4 or 5 and chroma of 2 or 3. It is 3 to 8 inches thick. Reaction ranges from very strongly acid to slightly acid.

The E horizon has hue of 10YR, value of 5 or 6, and chroma of 2 or 3. It is silt loam, very fine sandy loam, or loam. Reaction ranges from very strongly acid to medium acid. Some pedons do not have an E horizon.

Some pedons have a BE horizon that has hue of 10YR, value of 5, and chroma of 4 to 8. The texture is silt loam or loam. Reaction ranges from very strongly acid to medium acid.

The Bt horizon has the same range in color as that of the BE horizon, and in addition, it has hue of 7.5YR. The texture is clay loam, silty clay loam, loam, or silt loam. Reaction ranges from very strongly acid to medium acid. The Bt horizon has more than 25 percent sand with less than 15 percent coarser than very fine sand.

The Bx horizon has hue of 10YR or 7.5YR, value of 5, and chroma of 4 to 8. It is mottled in shades of brown, yellow, red, or gray. The texture is silt loam, loam, clay loam, or silty clay loam. Reaction ranges from very strongly acid to medium acid.

Some pedons have a BC horizon that has hue of 10YR or 7.5YR, value of 5, and chroma of 4 to 8. The texture is fine sandy loam, very fine sandy loam, sandy loam, loam, or sandy clay loam. Reaction ranges from very strongly acid to medium acid.

Smithdale Series

The Smithdale series consists of well drained, moderately permeable soils that formed in loamy stream deposits of Tertiary and Pleistocene age. These soils are on uplands. Slopes range from 8 to 20 percent. Soils of the Smithdale series are fine-loamy, siliceous, thermic Typic Hapludults.

The Smithdale soils in Natchitoches Parish are taxadjuncts to the Smithdale series because the reaction of the A and BE horizons is slightly higher than the defined range for the series. This difference does not significantly affect use and management of these soils.

Smithdale soils are similar to Cahaba soils and commonly are near Guyton, Kisatchie, Malbis, Ruston, and Sacul soils. Cahaba soils are on low terraces and have thinner sola. The Guyton soils are in drainageways and are poorly drained. Kisatchie and Sacul soils are in positions similar to those of the Smithdale soils, and they have a fine-textured subsoil. Malbis soils are on gently sloping ridgetops and have a browner subsoil. Ruston soils are on gently sloping ridgetops and have a bisequum in the profile.

Typical pedon of Smithdale fine sandy loam, 8 to 20 percent slopes; about 4 miles northwest of Goldonna, 3.5 miles northwest on Highway 479 from its junction with Highway 156, 0.7 mile west on U.S. Forest Service Road 524 to road junction, 200 feet west of junction; SW1/4NE1/4 sec. 10, T. 12 N., R. 6 W.

A—0 to 9 inches; dark grayish brown (10YR 4/2) fine sandy loam; weak fine granular structure; very friable; common fine and medium roots; slightly acid; clear smooth boundary.

BE—9 to 16 inches; brown (7.5YR 4/4) fine sandy loam; weak medium granular structure; very friable; common fine and medium roots; medium acid; clear smooth boundary.

Bt1—16 to 33 inches; red (2.5YR 4/6) sandy clay loam; moderate medium subangular blocky structure; friable; few fine roots; thin patchy clay films on faces of peds; very strongly acid; clear smooth boundary.

Bt2—33 to 46 inches; red (2.5YR 4/6) sandy clay loam; weak medium subangular blocky structure; very friable; thin patchy clay films on faces of peds; very strongly acid; clear smooth boundary.

Bt3—46 to 66 inches; red (2.5YR 4/8) sandy loam; weak medium subangular blocky structure; very friable; few thin patchy clay films on faces of peds; common streaks and pockets of pale brown (10YR 6/3) sand grains; very strongly acid.

The solum is more than 60 inches thick. The effective cation exchange capacity is 20 to 50 percent saturated with exchangeable aluminum within a depth of 30 inches.

The A horizon has hue of 10YR or 7.5YR, value of 3 or 4, and chroma of 2 or 3. It ranges from 2 to 10 inches in thickness but is less than 5 inches thick if the color value is 3. Reaction ranges from very strongly acid to slightly acid.

Some pedons have an E horizon that has hue of 10YR, value of 5 or 6, and chroma of 2 to 4. The texture is fine sandy loam, sandy loam, loamy fine sand, or loamy sand. Reaction ranges from very strongly acid to medium acid.

The BE horizon has hue of 7.5YR, 10YR, or 5YR, value of 4 or 5, and chroma of 4 to 8. It has the same range in texture and reaction as that of the E horizon. Some pedons do not have a BE horizon.

The upper part of the Bt horizon has hue of 2.5YR or 5YR, value of 4 or 5, and chroma of 6 to 8. The texture is sandy clay loam, clay loam, or loam. The lower part of the Bt horizon has the same range in color as the upper part, and it commonly has from few to many pockets of pale brown to brownish yellow sand grains. The texture is sandy clay loam, sandy loam, or loam. The Bt horizon in some pedons has chert or ironstone gravel that constitutes as much 10 percent of the volume. Reaction of the Bt horizon ranges from very strongly acid to medium acid.

Wrightsville Series

The Wrightsville series consists of poorly drained, very slowly permeable soils that formed in loamy and clayey stream deposits of late Pleistocene age. These soils are in level or depressional areas on the uplands. A seasonal high water table is within 1.5 feet of the soil surface from December to April in most years. Slopes are less than 1 percent. Soils of the Wrightsville series are fine, mixed, thermic Typic Glossaqualfs.

Wrightsville soils commonly are near Acadia, Caddo, and Gore soils. Caddo soils are in higher positions than Wrightsville soils and are fine-silty. Acadia and Gore soils are on more convex slopes. Acadia soils have a subsoil that is loamy and brownish in the upper part, and Gore soils have a reddish clayey subsoil.

Typical pedon of Wrightsville silt loam; about 8.3 miles northwest of Campti on Highway 480, 0.8 mile north on trail, 50 feet east of trail; NW1/4NE1/4 sec. 18, T. 11 N., R. 8 W.

A—0 to 2 inches; dark grayish brown (10YR 4/2) silt loam; weak fine granular structure; very friable; many fine roots; strongly acid; clear smooth boundary.

Eg—2 to 15 inches; light grayish brown (2.5Y 6/2) silt loam; common medium distinct strong brown (7.5YR 5/8) mottles; weak medium subangular blocky structure; very friable; many fine and medium roots; common fine pores; common black concretions; extremely acid; abrupt irregular boundary.

B/Eg—15 to 27 inches; light brownish gray (2.5Y 7/2) silty clay loam (Bt); about 15 percent tongues of light gray (10YR 7/1) silt loam (Eg); common medium distinct strong brown (7.5YR 5/8) mottles; moderate medium subangular blocky structure; firm; few thin clay films on faces of peds and in pores; very strongly acid; gradual wavy boundary.

Btg—27 to 54 inches; light brownish gray (2.5Y 6/2) clay; few fine faint light gray mottles; moderate medium subangular blocky structure; very firm; few fine roots; few fine pores; few thin clay films on faces of peds and in pores; very strongly acid; gradual wavy boundary.

2C—54 to 60 inches; reddish brown (2.5YR 4/4) clay; massive; very firm; very strongly acid.

The solum ranges from 40 to 70 inches in thickness. Reaction ranges from extremely acid to strongly acid throughout the solum. The effective cation exchange capacity is 20 to 50 percent saturated with exchangeable aluminum within a depth of 30 inches.

The A horizon has hue of 10YR, value of 3 to 5, and chroma of 2. It is 1 to 5 inches thick.

The Eg horizon has hue of 10YR, value of 5 to 7, and chroma of 1 or 2; or hue of 2.5Y, value of 6 or 7, and chroma of 2. The texture is silt, silt loam, or silty clay loam. Tongues of Eg material extend into the Bt horizon. The Eg horizon is 13 to 26 inches thick.

The Btg horizon has the same range in color as the Eg horizon, and it has few to many brownish mottles. The texture is silty clay loam, silty clay, or clay.

Some pedons have a C horizon that has colors and textures similar to those of the Btg horizon. The 2C horizon is brownish clay or silty clay. Some pedons do not have a 2C horizon.

Yorktown Series

The Yorktown series consists of very poorly drained, very slowly permeable soils that formed in clayey alluvium. These soils are in old channel scars and depressional areas on the alluvial plain. Yorktown soils are ponded or flooded for long periods each year. A high water table is within 0.5 foot of the soil surface throughout the year in most years. Slopes are less than 1 percent. Soils of the Yorktown series are very-fine, montmorillonitic, nonacid, thermic Typic Fluvaquents.

Yorktown soils are taxadjuncts to the Yorktown series because the reaction of the A and BC horizons is typically lower than the reaction range defined for the series. This difference does not significantly affect use and management of the soils.

Yorktown soils commonly are near Gallion, Moreland, and Perry soils. These soils are in slightly higher positions than the Yorktown soils. Gallion soils are fine-silty. Moreland and Perry soils have cracks to a depth of 20 inches or more during dry periods.

Typical pedon of Yorktown clay, frequently flooded; about 3 miles northeast of Clarence, 3.7 miles east of Clarence on Highway 84, 2.6 miles north on Highway I226, 0.5 mile west on levee, 0.3 mile north to edge of Clear Lake, 300 feet north from edge of high bank; NW1/4NE1/4 sec. 15, T. 10 N., R. 6 W.

A—0 to 6 inches; gray (5Y 5/1) clay; few fine prominent strong brown (7.5YR 5/6) mottles; weak medium subangular blocky structure; firm; many fine roots; strongly acid; clear smooth boundary.

Bg1—6 to 16 inches; dark gray (5Y 4/1) clay; common fine prominent strong brown (7.5YR 5/6) mottles; moderate medium subangular blocky structure; very firm; common fine roots; neutral; clear smooth boundary.

Bg2—16 to 26 inches; dark gray (5Y 4/1) clay; common medium prominent yellowish red (5YR 4/6) mottles; moderate medium subangular blocky structure; very firm; common fine roots; few fine black concretions of iron and manganese; neutral; abrupt smooth boundary.

Bg3—26 to 41 inches; dark gray (5Y 4/1) clay; common medium prominent yellowish red (5YR 4/6) mottles; weak medium subangular blocky structure; very firm; common fine concretions of iron and manganese; neutral; abrupt smooth boundary.

BC1—41 to 46 inches; reddish brown (5YR 4/4) clay; common medium prominent dark gray (5Y 4/1) mottles; strong medium subangular blocky structure; very firm; common pressure faces; few fine concretions of iron and manganese; neutral; abrupt smooth boundary.

BC2—46 to 65 inches; dark reddish brown (2.5YR 3/4) clay; strong medium subangular blocky structure; very firm; few fine concretions of iron and manganese; neutral.

The Yorktown soils are clay throughout the profile. The solum ranges from 50 to 80 inches in thickness. Depth to the BC horizon ranges from 40 to 60 inches.

The A horizon has hue of 5Y or 10YR, value of 4 to 6, and chroma of 1 or 2, or it is neutral and has value of 4 to 6. It is 4 to 10 inches thick. Reaction ranges from strongly acid to neutral.

The Bg horizon has hue of 5Y or 10YR, value of 4 to 6, and chroma of 1; or it is neutral and has value of 4 or 5. Mottles are in shades of red and brown. Reaction ranges from medium acid to neutral.

The BC horizon has hue of 5YR or 2.5YR, value of 3 to 5, and chroma 3 or 4. Mottles are in shades of gray. Reaction ranges from neutral to moderately alkaline.

Formation of the Soils

Wayne H. Hudnall, Agronomy Department, Louisiana Agricultural Experiment Station, Louisiana State University Agricultural Center, prepared this section.

This section explains soil genesis and the processes and factors of soil formation as they relate to the soils of Natchitoches parish.

The Genesis of the Soils

Soil genesis is that phase of soil science that deals with the processes and factors of soil formation. It is the study of the formation of soils on the land surface and changes in soil bodies and is the science of the evolution of soils that are conceived of as natural units *(11, 27)*.

Soils are influenced by internal and external forces. The internal forces generally are synonymous with soil-forming processes, and the external forces with soil-forming factors. Soils generally are perceived to be a stable component of our environment because very little change is evident unless the soils are disturbed. Soil scientists, however, view soils as a dynamic system and may observe minute but important changes in the composition of the soil, depending upon when and how samples are taken. The following information should give a better understanding of how the soil survey can be used and how interpretations can be derived from it.

Processes of Soil Formation

The complex soil-forming processes can be described as the gains, losses, translocations, and transformations occurring in soils that influence the kind and degree of development of soil horizons *(29)*. Soil-forming processes result in additions of organic, mineral, and gaseous materials to the soil; losses of these same materials from the soil; translocations of materials from one point to another within the soil; and physical and chemical transformations of mineral and organic materials within the soil.

The addition of organic matter to soils is a very important process. It occurs to some extent in all soils; however, accumulations of organic matter are greater in some soils than in others. Organic matter contributes to dark color, increases available water and cation-exchange capacities, contributes to granulation, and serves as a source of plant nutrients in the soil. Because organic matter accumulation is greatest in and above the surface horizon, the surface horizon is higher in organic matter content and darker than the lower horizons. The Armistead, Caspiana, Latanier, and Moreland soils have a dark surface horizon as a result of significant additions of organic matter.

The content of organic matter in soils can be maintained or increased by leaving crop residue and allowing leaf litter and other organic material to accumulate. These accumulations are decomposed and mixed into the soil mainly by the activity of living organisms. Increasing the content of organic matter in soils significantly decreases their erodibility.

The additions of mineral material on the surface has been important in the formation of some soils in Natchitoches Parish. The added material, generally in the form of alluvium, provides new parent material in which the processes of soil formation can occur. In many cases, accumulation of new material has been faster than the processes of soil formation could appreciably alter the material. This is evident as depositional strata in the lower horizons of many of the soils that developed in alluvial sediment. Although most of the soils in Natchitoches Parish formed in alluvial parent material, the depositional strata are evident only in the Roxana and Severn soils. These soils are forming in recent or relatively young alluvial sediment. Materials added to soils in the form of liquids or gases are generally compounds of nitrates and sulfates that are dissolved or trapped in rainwater.

Loss of components from the soil is less noticeable than most additions to the soil during soil formation, but they are important in the overall process of soil development. For example, when organic matter is decomposed, carbon dioxide is emitted into the atmosphere. Water also escapes from the soil by evaporation and transpiration from plants. Erosion removes both mineral and organic materials from some soils. These losses are natural, to some extent, but they may be accelerated by human activities. In Natchitoches Parish, most erosion is caused by moving water.

Losses also occur in soils during the process of leaching. Many compounds and elements in soils are soluble in water. As water moves through the soils, these soluble elements are carried in the water. In many soils, the soluble elements have been moved completely out of the soil profile. Sandy soils, such as the Cahaba and Gallion soils, are sufficiently permeable to allow the leaching of most soluble bases in a relatively short time. In less permeable and more clayey soils, water from rainfall moves slowly through the soil and leaching is less pronounced. In some pedons of the Gore, Latanier, Moreland, Morse, and Perry soils, most of the free carbonates that were initially present remain in the soil, but they have been leached from the upper part of the profile to the lower part. Where rainfall is sufficient, however, the soluble elements in these less permeable soils may be completely leached out of the soil profile. The effects of leaching are least pronounced in soils developed in relatively young parent material that was initially high in bases, such as the Roxana and Severn soils. Also, in most areas of the Severn soils, alluvial sediment high in carbonates is added to the surface almost yearly.

The translocation of material in the soil has been an important process during the development of most of the soils in the parish. Eluviation is the movement of solids out of part of the soil profile, and the illuviation is the movement of solids into a lower part of the soil profile. In soils that have large pores, soil material small enough to go through these pores can be suspended in water as it moves downward. Clay particles, because of their small size, are moved downward in this manner. In Natchitoches Parish, the translocation and accumulation of clay in the profile is evident in the Anacoco, Cahaba, Gallion, Ruston, Smithdale, and Wrightsville soils.

Many soils in the parish exhibit the movement of iron and manganese and an accumulation of these in the lower part of the profile. These accumulations are the result of alternating oxidizing and reducing conditions associated primarily with fluctuating water-saturated zones within the soils. Reducing occurs when the soil is saturated with water for relatively long periods and when low amounts of oxygen are in the soil. Reduced compounds of iron and manganese result in gray colors characteristic in the Bg and Cg horizons in the Caddo and Guyton soils. If the reduced conditions are prevalent for a sufficient time and if the level of the water table is fluctuating, the iron and manganese may be translocated to a lower horizon and precipitated at the top of the saturated zone. Brownish or reddish mottles in grayish horizons are common in the Beauregard, Keithville, Malbis, Sacul, and Wrightsville soils.

The transformations of mineral and organic substances in soils is also a major process in soil formation. Some transformations in soil are referred to as geochemical weathering. Processes that take place as part of geochemical weathering are oxidation, reduction, combinations of these in alternating cycles, hydration, solution, and hydrolysis. Oxidation is a geochemical reduction that occurs in well aerated soils and parent material. The most easily recognized oxidation reaction is that of the oxidation of the ferrous ion to the ferric ion. This process is most common in soils that are rich in ferrous iron. Ferrous iron is in the mineral species of high iron-bearing hornblends and pyroxenes of the primary mineral group and in soils in which glauconite or siderite compose a part of the parent material. Oxidation is an important soil-forming process in the Natchitoches soils that contain both glauconite and siderite.

Hydration is the union of water molecules or hydroxyl groups with minerals without being a part of the mineral itself. It occurs primarily on the surfaces or edges of mineral grains, or it can be part of the structure as in simple salts. An excellent example of this chemical reaction is the hydration of anhydrite to form the mineral. Gypsum is commonly in clayey soils in which there is a source of sulfate, presumable from a marine environment, and a source of calcium, either from the sediments themselves or from mineral weathering. The Kisatchie and Morse soils can contain gypsum.

Hydrolysis is the chemical reaction of the hydrogen ion with individual elements within crystal structures. The highly reactive hydrogen ion replaces one of the basic ions in the structure of the mineral. Hydrolysis generally is the most important chemical weathering process and results in a complete disintegration of primary minerals in all soils. This process makes plant nutrients available to plants.

Solution is the simple process of dissolving salts, such as carbonates and sulfates. As water moves through the soil, the dissolved salts can be removed from the soil system or deposited at a lower depth. The accumulation of carbonates and sulfates (gypsum) in a soil horizon is indicated by subscripts "k" (carbonates) and "y" (gypsum). Examples are the Bk1 and Bk2 horizons in the Moreland series.

Several hypotheses have been offered to explain the formation of fragipans in soils. Either chemical or physical reactions, or both, have resulted in their formation. Fragipans are dense, brittle layers in the subsoil of some soils, such as the Shatta soils. The material is dense and has many vesicular pores, but it restricts water movement.

Factors of Soil Formation

The character and development of soils are controlled by external factors *(14)*. A study of these factors can be a great help in understanding the genesis of soils. A factor of soil formation is an agent, force, condition, relationship, or a combination of these that influence or influenced parent material *(11)*. Soils are a function of five factors that define the state and history of soil systems—climate, organisms, parent material, relief, and time *(21)*. The factors define the soil system in terms of variables that control the characteristics of the system and not in terms of processes, causes, or forces that are active in the system. These soil-forming factors can vary independently, either singly or together.

Climate

Detailed information on the climate in Natchitoches Parish is given in the section "General Nature of the Survey Area."

Rainfall and temperature are the most commonly measured features of climate that have been most closely correlated to soil properties *(11)*. Although average climatic conditions are often used, the extremes of climate occurring within a given region may be more influential in the development of certain properties in the soil. Rainfall and temperature can be changed or altered, depending upon the relief or elevation within a general area.

Rainfall is relatively uniform throughout the parish. Major differences within the soils are not a result of differences in rainfall. The Betis and Bienville soils are some of the most highly leached soils in the parish, but their properties are a result of both water and parent material. When temperature increases in the summer, the solubility of elements in minerals increases. If temperatures are below freezing, the physical action of water (primarily ice) plays an important role in the physical destruction of the soils. Since Natchitoches Parish does not experience extremely cold conditions, this latter influence of water is minimal. To some degree, the intensity and annual distribution of rainfall is more important than the absolute amount of rainfall. Rainfall in the parish is not equally distributed throughout the year, and there are some severe storms. This affects the type and rate of reactions in which water is involved.

Except for the role of water in erosion and deposition of soil material, the important functions of water are within the soil profile. Morphological characteristics may be observed that are a result of excessive or inadequate water. Excessive water is exhibited in soils that are highly leached and acid by grayish colors in the profile. The gray is caused by reduction. Excess dryness is exhibited in the very clayey soils as the clay shrinks upon drying and swells upon becoming wet. The Bellwood, Morse, and to a certain extent the Perry and Moreland soils crack when they are dry. These cracks are a few inches to several inches across and from a few inches to several inches deep, depending upon the soil and how dry the soil becomes. Soil material can fall into the cracks; then as the soil becomes wet, the clays expand, eliminating the cracks. This engulfs and effectively churns the soil. The uneven distribution of rainfall is also exhibited in other soils in which there has been eluviation and illuviation within the soil, such as in the Beauregard, Betis, Briley, and Sacul soils.

Temperature, considered an independent soil-forming factor by many scientists, influences the reactions involved in the processes of forming soils. It is the driving force in most models of evapotranspiration. When combined with the uneven distribution of rainfall, the influence of evapotranspiration may be the most important climatic condition to be considered in soil-forming processes. Van't Hoff's temperature rule, "for every ten degrees rise in temperature the speed of a chemical reaction increases by a factor of two to three," is true in soil-forming processes *(38)*. Solar radiation generally increases with elevation. The rate of increase is most rapid in the lower, dust-filled layers of the air. The absorption of solar radiation at the soil surface is affected by many variables, such as soil color, orientation of the surface with respect to incoming radiation (southern slopes are always warmer than northern slopes), and the plant cover. Although solar radiation may increase with increased elevation, generally temperature decreases with elevation. Although there is significant change in elevation within Natchitoches Parish, this change in elevation is not sufficient to cause a significant change in the mean annual soil temperature.

Organisms

The effect of organisms as a soil-forming factor is indicated by the presence or absence of major horizons and the properties associated with the organisms. Living organisms play an important role in the cycling of carbon through the atmosphere, oceans, and soils, and nitrogen is interrelated with the carbon cycle.

The biosphere serves as a major sink for the carbon cycle. In photosynthesis, carbon is the energy from the sun to produce organic material. Nitrogen is a major plant nutrient and is used in the process of photosynthesis in the production of organic material. Whenever organic matter is decomposed, nitrogen is released for plant use and carbon is returned directly to the atmosphere in the form of carbon dioxide. The somewhat resistant organic material generally referred to as humus, is retained in the soil. Because of the size and chemical composition of the humus, it increases infiltration, available water capacity, and cation exchange capacity, and the ability of the soil to absorb and store such nutrients as calcium, magnesium, and potassium is also increased. Soil tilth is also improved.

The natural vegetation in Natchitoches Parish is quite diverse. Soils in low-lying flats and drainageways are vegetated primarily by hardwoods. The gently sloping areas are in mixed hardwood and pine, and areas on the upper slopes and ridges are in pine and a few hardwoods. If the parent material is held constant, generally the reaction of the soil under hardwoods would be slightly higher than that under pine. Soils developed under hardwoods, pines, and mixed pines and hardwoods generally have a thicker eluvial horizon than soils that developed under prairie vegetation. The surface horizon in soils developed under grass is generally thicker and contains more organic matter than soils formed under pine or mixed hardwood and pine. These are generalities. The amount of organic matter that has accumulated in the soils is dependent upon other factors, such as temperature and rainfall. Under conditions optimal for microbial activity, organic matter production and decomposition are in equilibrium. Accumulation will not occur unless there is a change in that factor controlling the equilibrium. Additions of organic matter occur when annual production is high and conditions are not optimal for its decomposition. In Natchitoches Parish, most soils exist in an ecosystem in which decomposition of organic matter exceeds the ability of the vegetation to return organic matter to the soil; therefore, the soils are low in organic matter.

Parent Material

Parent material is "the state of the soil system at time zero of soil formation" *(21)*. It is that physical body and its associated chemical and mineralogical properties at the starting point that is changed by other soil-forming factors over time. The younger the soil, the greater the influence of the parent material on soil properties. For example, the young Severn soils exhibit more properties associated with the initial deposits than the much older Ruston soils, which may have very few properties that can be associated with the initial parent material. In weathered soils, however, the influence of the parent material may be visible and the parent material can still be an independent factor. The nature of the parent material can be expressed in the color, texture, and mineralogy of the soil. These properties can be related to physical and chemical properties, such as heat absorption, susceptibility to erosion, shrink-swell potential, and cation exchange capacity. The characteristics associated with parent material in the parish are described in the section "Landforms and Surface Geology."

Relief

The relief in Natchitoches Parish is variable and ranges from low on the flood plain and natural terraces of the Red River to high on the steep and strongly dissected hills. Relief associated with the physiographic and geologic units within the parish is described in more detail in the section, "Landforms and Surface Geology."

Relief and physiographic units associated with the geology influence soil formation by the effect they have on soil drainage, runoff, and erosion. In Natchitoches Parish, it is somewhat difficult to separate the relationship between parent material and relief. Within specific geographic regions, several soil properties associated or related to relief are depth of the solum, thickness of the A horizon and its content of organic matter, wetness or dryness of the profile, color of the profile, degree of horizon differentiation, soil reaction, and soluble salt content.

Soils developed on north- and south-facing slopes may also differ. Organic matter content and available moisture for plant growth is generally higher on north-facing slopes than on south-facing slopes. Mixed hardwoods are more prevalent on north-facing slopes, whereas pine or mixed pine and hardwoods occur on south-facing slopes.

Relief also affects the moisture relationships in the soil, either in the form of ground water or the amount of water that is available for photosynthesis. The water table is closer to the soil surface in depressions than on high points of the landscape. If the parent material is held constant, a seasonal high water table is more commonly in soils that have low relief than in soils on convex landscapes. If the parent material is clayey and has low relief, the ridgetops may be the wettest soil within the landscape.

Time

Pedologists normally do not think in terms of inches or centimeters in the formation of soils, but rather in terms of horizons, sola, and profile development. Time is not considered in terms of absolute time but in the rate of change as it effects soil properties. Time, or rate of change, can be described with respect to relative stage of development, absolute dating of horizons and profiles, rate of formation, and relation to the age and slope in the landform and associated weathering complex *(15, 17)*.

Several hypotheses or models in regard to time have been developed. The hypothesis of the continuous steady state system determined that time is uninterrupted and soil development begins at time zero *(7, 22)*. The continuous steady state model dictates that once a process or feature has begun, it continues to develop with time until there is a major change in one of the soil-forming factors. Assuming that there was no major change, as time progressed the morphological feature would develop to maximum without giving way to other features. For example, if at time zero the Severn soil has no subhorizons, as the processes of soil development begin a cambic horizon is initiated in the soil. Under the steady state concept, this horizon would develop through time until it reached its maximum. This assumes that there is no additional change in the other soil-forming processes and that the only thing that changes is time. Because soils do represent a dynamic system, it would appear that the continuous steady state hypothesis in relationship to time to pedogenic development is in error.

The sequential model of soil formation is another hypothesis *(5, 12)*. This is one in which all stages of soil development operate concurrently. Some processes of soil development proceed so slowly that they have very little effect, whereas others are so rapid that they are dominant features of the soil. As long as the relative rates of the process continue unchanged, soil development is expressed by a given set of properties. The sequential model, sometimes referred to as polygenesis, has two major features—a soil morphological entity may be a consequence of a combination of several genetic factors, and the morphological expression of soil processes may be a result of several pathways. For example, if a soil begins to form from loamy parent material on gently sloping uplands of pine forest in a climate similar to that of the present, the soil might progress in the formation of a darkened surface horizon because of the accumulation of organic carbon. The subsoil might develop sequentially with a cambic argillic horizon with the formation of an E horizon as the argillic formed. A soil similar to the Ruston soils may result. As long as the factors associated with parent material, climate, organisms, and relief did not change substantially with time, the soil would have formed sequentially. It is possible, however, for the factors to have changed. When some major factor changes, time as a factor of formation returns to zero. However, because the morphological expressions of the factors during that period of time could remain, the total amount of time might not appear to differ from one soil to another.

Several methods are available in which actual dates may be obtained from soils; however, morphological properties are most commonly used to determine the age of soils. For example, the Betis soils that have a thick E horizon would normally be considered older than the Sacul soils that have a relatively thin E horizon. However, other factors, such as parent material, climate, and living organisms, also play an important role in horizon thicknesses. On a gross scale, geology can be used as an indicator of the relative age of the soil. One must remember, however, that pedogenic time is returned to zero each time there is a major or catastrophic event that would affect the landscape. It is these catastrophic events that generally are used to define the beginning of one major geologic period from another.

The rate of change of weathering decreases with time *(13)*. It becomes constant when an equilibrium thickness of the weathering residue is reached. Soil formation is seldom a uniform, undirectional process through time. Minor fluctuations in the environmental conditions are a built-in characteristic of the system, which result in constant readjustment.

Landforms and Surface Geology

Wayne H. Hudnall, Agronomy Department, Louisiana Agricultural Experiment Station, Louisiana State University Agricultural Center, prepared this section.

Natchitoches Parish can be separated into three general physiographic areas—the recent flood plains and low stream terraces, the Pleistocene terraces and uplands, and the Tertiary uplands. Each of these areas can be further subdivided on the basis of differences in parent material, time of deposition, or physiographic features.

Recent Flood Plains and Terraces

The soils on the flood plains formed in Holocene and late Pleistocene terrace alluvial deposits of the Red River, Saline Bayou, and many small streams that drain the uplands.

The flood plains of the Red River and its tributaries and distributaries make up about 28 percent of the parish. The width of the flood plain is less than 4 miles at its narrowest point just north of Natchitoches and more than 16 miles at its widest point. The Red River north of Natchitoches has been forced into a narrow channel by resistant Tertiary beds that prevented the channel and river valley from becoming wider. These beds are also exposed in the northeastern part of the parish.

The most recent and highest natural levees of the Red River alluvial plain are those flanking the present channel. Levees on the western side of the river, north of the restriction caused by the Tertiary beds, are better developed than those on the eastern side. They have not been constricted or hampered by the proximity of the valley wall. In areas where the river approaches the valley wall, the levees are narrow and the back slopes are steep and well developed. Rim swamps are numerous. The average height of the levees is about 10 feet, but they reach a maximum height of not more than 15 feet above the backswamps. The slope from the crest of the Red River natural levees to the backswamps is between 3 and 4 feet per mile.

The Red River raft was a great log jam that choked the main channel of the Red River for about 175 years. The raft exerted a marked influence on the drainage pattern and the nature of the alluvial sediments deposited by the Red River system *(20)*. While the main channel of the Red River was blocked, natural levees formed along the outlet bayous. The damming of tributaries formed large lakes, which were destroyed when the raft was removed. After the raft was removed and the outlet bayous were closed by manmade plugs and levees, the river was forced to begin cutting and enlarging its main channel. This process lowered the base level of the stream bed and eventually resulted in the partial drainage of many other raft-formed lakes *(25)*. Agricultural drainage has completed this process. Only remnants remain of these extensive lakes that once provided routes for steam boats to get around the log jam. Deposition of alluvium has been minor and localized since the outlets were closed by levees constructed after the raft was removed *(16)*.

The partial sorting of sediments that occurs when a stream overflows results in a depositional pattern that constructs high, sandy or loamy natural levees near the stream channel. The natural levees extend downslope and away from the channel to more clayey backswamps. Soils of the Roxana-Gallion, Severn, Moreland-Yorktown, and Moreland-Lantanier-Armistead general soil map units formed in the alluvial plain of the Red River.

The Roxana and Severn soils are associated with natural levees. The Severn soils are on the natural levees and low sandbars between the Red River and the high manmade levees along the river. The soils between the levee and the river channel are subject to occasional or frequent flooding and receive increment additions of sediment each year. The Roxana soils are in high positions on natural levees adjacent to the Red River and its former channels and distributaries. These soils are protected from flooding by a network of levees. The Severn soils typically are calcareous higher in the profile than the Roxana soils.

The Gallion soils formed in loamy alluvium on natural levees of former channels of the Red River. These soils exhibit the facies of a natural levee associated with a dying distributary in that they are finer-textured than the Roxana and Severn soils.

The Caspiana soils also formed on old natural levees of the Red River; however, they are slightly downslope from the Gallion soils and formed mainly in silty and clayey sediments. The natural vegetation on the Caspiana soils was probably marsh grasses. The Caspiana soils are more poorly drained than the Gallion soils, and decomposition of organic matter in the Caspiana soils was comparatively slow, allowing a greater accumulation of organic matter.

The Armistead soils are in slightly lower positions on the landscape than the Caspiana soils and are somewhat poorly drained. These soils formed in clayey backswamp deposits overlying loamy alluvium. The clayey surface was probably deposited as backwater sediment at the time of the great raft. Since the removal of the raft, these soils are not subject to flooding.

The Latanier soils are in about the same position on the present natural levees as the Armistead soils are on the old distributary natural levees. The lower horizons in the Latanier soils are loamy and were deposited during periods in which either the stream bedload was mostly loamy material, the amount of overdeposit of the natural levees was greater than it is today, or the river was in a different channel. The clayey surface horizon was deposited as backswamp sediment.

The Moreland and Perry soils are in low positions on the natural levees and in depressional areas on the flood plain. Unless these soils are protected by levees, they are subject to flooding. They formed as an accumulation of backswamp clays.

The Yorktown soils are very poorly drained. These soils formed in backswamp clayey alluvium in old channel scars and depressional areas on the alluvial plain. They are ponded or completely flooded for long periods of the year.

The Guyton, Lotus, Bienville, Cahaba, and Wrightsville soils are mapped in association with the present flood plains and low stream terraces. Their source of sediments is not associated with the Red River. The Lotus and Guyton soils formed in recent alluvial sediment associated with the present drainage systems. These drainage systems are narrow, have weakly expressed natural levees, and are subject to flooding by runoff from the uplands. The Guyton soils are in the drainageways and are fine-silty. The Lotus soils are on sandy natural levees along drainageways of the sandy uplands. The Lotus soils formed on sandy natural levees along Spring Branch and Cypress Branch of Devil's Creek. The sands were probably eroded from the Betis and Briley soils on uplands.

The Bienville and Cahaba soils formed on terraces that are slightly higher than the flood plains. These terraces are associated with drainageways of the Tertiary and older Pleistocene uplands. The Bienville soils are sandier than the Cahaba soils.

The Wrightsville soils are on relatively stable fluvial terraces. The upper horizons of these soils are loamy and formed in more recent alluvium than the horizons in the lower part of the profile. The alluvium is from the dissection and erosion of the uplands.

Pleistocene Age Terraces and Uplands

The Pleistocene age was characterized by periods of deposition associated with continental glaciation. Each period produced alluvial terraces. The oldest terrace occupies the highest elevation, and each subsequent terrace is at a slightly lower elevation. The sediments were deposited as lobes of a major delta system. Sources of these sediments are varied. Each terrace associated with each period of deposition are referred to by number—T1 for the youngest, T2 next oldest, and so forth. Each terrace has a toposequence of soils that is unique to that terrace.

The Red River was one of the major distributary sources of Pleistocene sediment. The toposequence of soils on the T2 Red River terrace are the Acadia, Gore, Morse, Shatta, and Wrightsville soils. The Acadia soils are somewhat poorly drained and are on the flat ridgetops. They formed in clayey deposits. The Gore soils are at a slightly lower elevation on slightly steeper side slopes, and they have a reddish subsoil. Morse soils formed in clayey backswamp deposits and are on the more steeply sloping and less stable side slopes. These soils exhibit morphological features of a young soil although they are formed in relatively old deposits. In the northeastern part of the parish, the Morse soils commonly are near the Bellwood soils; however, the Bellwood soils formed in acid, Tertiary sediment.

The Shatta soils are on terraces that are as dissected as T3 terraces, but the soils are in an intermediate position between the T2 and T3 terraces. As the T3 terrace eroded, an erosional surface was formed and loamy T2-aged material was deposited onto the surface. This surface was stable, and the Shatta soils formed in a mixture of T2 and T3 sediments. Because the soil contains a fragipan, which is more resistant to erosion than most subsoils, the soil is in an intermediate position between the T2 and T3 terraces. Sediments from the Red River and the mid-continental glaciation probably are the parent material for the Shatta soils. There may be a loess component since the Shatta is siltier than any of the surrounding soils.

The oldest Pleistocene terrace (T3) typically has a toposequence of Malbis, Beauregard, and Caddo soils. The T3 surface is dissected and is characterized by many low ridges and gentle side slopes leading onto broad flats. The Malbis soils are on the convex ridgetops and side slopes. The Beauregard soils are on the gently sloping side slopes between the Malbis and Caddo soils. The Caddo soils are on broad flats. These soils are similar to Wrightsville soils. The Caddo soils are slightly higher on the landscape and are formed in T3 sediments.

Tertiary Uplands

Although a detailed geologic study of Natchitoches Parish has not been published, literature on the Tertiary geology of central Louisiana is available *(6, 26, 28)*. The Tertiary sediments are in the Wilcox Group. The Sabinetown, Pendleton, Marthaville, Lime Hill, and Hall Summit Formations outcrop in Natchitoches Parish. These outcrops are a result of the Sabine Uplift and subsequent erosion. The Sabine Uplift is a flat-topped dome in northwestern Louisiana and northeastern Texas. The uplift is the highest structural point in northwest and north-central Louisiana *(18, 19, 25)*.

The major Tertiary upwarping of the Sabine Uplift probably resulted from subcrustal adjustments associated with the subsidence of the area to the south. The Miocene deltaic sedimentation is in south-central Louisiana. Subsidence and resultant down dragging of this area accompanied and followed the accumulation of the great deltaic masses.

The Wilcox Group consists of fluvitile sediments deposited in brackish and marine environments. The sediment of the Wilcox Group probably accumulated as a result of a cycling series of depositions, which are similar to the present deposition of the Mississippi River deltaic deposits. Each cycle began with an encroachment of the sea as a result of the cessation of deltaic deposition. Basal beach sands and marls were deposited first. These were overlain by fossiliferous clays as the sea advanced inland. The cycle reached completion with recurrent deltaic sedimentation and seaward building of the land. Preceeding this seaward advance of the land, the raw materials for shales were deposited at the margins of the great deltaic masses. These lignitic shales formed from what are commonly called prodeltaic sediments *(16)*.

Continued deltaic sedimentation resulted in the deposition of thick masses of sand and lignitic shales that were incorporated with fluvitile sediments. Tilting of the land coincided with the downwarping of the continental margin of the Gulf Coast geosyncline and upwarping of the Sabine Uplift. These events exposed the Wilcox sediments in Natchitoches Parish *(4)*.

Extensive faulting has accompanied the Sabine Uplift, which further confuses the soil-geology relationship within the parish. The soils and the geology of the Tertiary uplands are very complex and complicated. Similar soils can be mapped on adjacent landscapes that have different geologic materials, and dissimilar soils can occur on opposite side slopes because of the tilting and faulting of the landscape. The confusion is compounded because a thin veneer of Pleistocene sediments was deposited over the Tertiary sediments.

The soils of the Tertiary uplands can be divided into two groups, the sandy to loamy soils and the clayey soils. When sediments are uplifted and faulted, clayey and loamy sediments can be on adjoining and similar landscapes. Soils commonly associated with Pleistocene sediments are at a higher elevation than most Tertiary soils and probably formed in the prodelta loamy sediments.

Sandy to Loamy Soils. The Betis, Briley, Keithville, Malbis, Ruston, and Smithdale soils are in this group.

The Betis and Briley soils are on the convex ridgetops and side slopes of the Tertiary uplands. These soils probably formed in the sandy beach sediments of the Hall Summit Formation. Because each major formation began with sandy deposits, the sandy part of each formation is difficult to differentiate. The Ruston, Smithdale, Malbis, and Keithville soils formed in Tertiary and Pleistocene sediments. The Ruston and Malbis soils are on convex ridgetops, but the Malbis soils are less sloping and are on broader ridgetops. The Malbis soils probably formed on surfaces that have a Pleistocene cap, and the Ruston soils formed on surfaces, some of which do not have Pleistocene sediments. The Smithdale soils are on side slopes of the loamy Tertiary uplands. These soils are younger and less developed than the Ruston soils. The Keithville soils formed in loamy and clayey marine deposits on gentle, erosional side slopes between the Malbis and Sacul soils. The upper horizons formed in Pleistocene sediments, and the clayey subsoil formed in Tertiary, acid, marine sediments.

Clayey soils. The Anacoco, Bellwood, Kisatchie, Natchitoches, Oula, and Sacul soils are in this group.

The Anacoco and Kisatchie soils formed from siltstone and marine clays. The Anacoco soils are on rounded ridgetops, and the Kisatchie soils are on gentle to steep side slopes. The Anacoco soils are on a more stable landscape than the Kisatchie soils, have a thicker solum and more clayey parent material, and are less erosive. The Oula soils formed in marine clays and are in positions similar to those of the Kisatchie soils. The loamy surface layer probably represents a Pleistocene cap or a thin Tertiary prodelta deposit. The Oula soils are similar to the Keithville soils except they have clayey horizons nearer the surface and are thinner because of erosion. The Bellwood soils are generally in a lower position on the landscape than the Keithville, Oula, and Kisatchie soils. The Bellwood soils formed in very fine marine clay deposited as lagoonal clay. Because of the fineness, mineralogy of the clay, and side slope position, profile development has been minimal. The original sediments probably contained iron sulfite (pyrite) that oxidized to produce sulfuric acid. The sediments are extremely acid and are 50 percent or more saturated by aluminum.

The Sacul soils occupy several landscape positions and are associated with loamy and clayey marine sediments. Since the Tertiary System contained many deltaic advances and because of faulting, tilting, and uplifting, the sediments occur at several elevations. The Sacul soils are generally on side slopes at a lower elevation than the other clayey Tertiary soils. The acidity and aluminum saturation are indications that the original sediments were backwater and overflow deposits that contained pyrite. The upper horizons are reddish and are in a well oxidized zone. The lower horizons are grayish because the parent material was gray and not because the material was changed in a reducing environment. The Natchitoches soils formed in glauconitic-rich marine sediments and are only in the Hall Summit Formation. They are in positions similar to those of the Bellwood and Sacul soils. The Natchitoches soils are sometimes called the "Christmas" soils because the subsoil is contrasting red and green.

References

(1) Adams, F. 1984. Soil acidity and liming. Agron. Mono. 12, 2nd ed. Am. Soc. Agron.

(2) American Association of State Highway and Transportation Officials. 1982. Standard specifications for highway materials and methods of sampling and testing. Ed. 13, 2 vol., illus.

(3) American Society for Testing and Materials. 1986. Standard test method for classification of soils for engineering purposes. ASTM Stand. D 2487.

(4) Anderson, H.V. 1960. Geology of Sabine Parish. La. Dep. Conserv. Geol. Surv. Bull. 34, 164 pp.

(5) Arnold, R.W. 1965. Multiple working hypothesis in soil genesis. Soil sci. Soc. Am. Proc. 29:7171-724.

(6) Barry, J.O. and R.J. LeBlanc. 1942. Lower Eocene Faunal units of Louisiana. La. Dep. Conserv. Geol. Surv. Bull. 23, 208 pp.

(7) Birkeland, P.W. 1984. Soils and geomorphology. Ed. 2, 372 pp.

(8) Broadfoot, Walter M. and R.M. Krinard, 1959. Guide for evaluating sweetgum sites. U.S. Dep. Agr., Forest Serv., South. Forest Exp. Stn. Occas. Pap. 176, 8 pp., illus.

(9) Broadfoot, Walter M. 1960. Field guide for evaluating cottonwood sites. U.S. Dep. Agric., Forest Serv., South. Forest Exp. Stn. Occas. Pap. 178, 6 pp., illus.

(10) Broadfoot, Walter M. 1963. Guide for evaluating water oak sites. U.S. Dep. Agric., Forest Serv., South. Forest Exp. Stn. Res. Pap. SO-1, 8 pp., illus.

(11) Buol, S.W., F.D. Hale, and R.J. McCracken. 1980. Soil genesis and classification. Ed. 2. Iowa State Univ. 404 pp., illus.

(12) Bushnell, T.M. 1943. Some aspects of the soil catena concept. Soil Sci. Soc. Am. Proc. 7:477-476.

(13) Coleman, S.M. 1981. Rock-weathering rates as function of time. Quant. Res. 15:250-264

(14) Crowther, E.M. 1953. The sceptical soil chemist. J. Soil Sci. 4:107-122.

(15) Davis, W.M. 1899. The geographical cycle. Geograph. J. 14:481-504.

(16) Fisk, H.N. 1940. Geology of Avoyelles and Rapides Parishes. La. Geol. Surv. Geol. Bull. 18, 239 pp.

(17) Hack, J.T. 1960. Interpretations of erosional topography in humid temperate regions. J. Am. Sci. 258A:80-97.

(18) Harris, G.D. 1907. Rock salt in Louisiana. La. Dep. Conserv. Geol. Surv. Bull. 7.

(19) Harris, G.D. 1910. The lower Tertiaries of Louisiana. Sci. n.s. Vol. 31:502.

(20) Harris, G.D., and A.C. Veatch. 1899. A preliminary report of the geology of Louisiana. La. State Univ. and A&M Coll. Part V, 354 pp., illus.

(21) Jenny, Hans. 1941. Factors of soil formation. 281 pp., illus.

(22) Jenny, Hans. 1961. Derivation of state factor equations of soil and ecosystem. Soil Sci. Soc. Am. Proc. 25:385-388.

(23) Khasawneh, F.E., E.C. Sample, and E.J. Kamprath, eds. 1980. The role of phosphorus in agriculture. Am. Soc. Agron.

(24) Kilmer, Victor J., S.E. Younts, and N.C. Brady, eds. 1968. The role of potassium in agriculture. Am. Soc. Agron.

(25) Murray, G.E. 1948. Geology of Red River and DeSoto Parishes. La. Dep. Conser. Geol. Surv. Bull. 25, 312 pp., illus.

(26) Murray, G.E. 1955. Midway Stage, Sabie Stage and Wilcox Group. Am. Assoc. Petrol. Geol. Bull. 39:671-689.

(27) Pomerening, J.A. and E.G. Knox. 1962. A test for natural soil groups within the Willamette Catena population. Soil Sci. Soc. Am. Proc. 26:282-287.

(28) Pope, D.E. 1980. Composite columnar section of Louisiana. La. Geol. Surv.

(29) Simonson, Roy W. 1959. Outline of a generalized theory of soil genesis. Soil Sci. Soc. Am. Proc. 23: 152-156, illus.

(30) Stevenson, F.J. 1982. Humus chemistry.

(31) Stevenson, F.J., 1982. Nitrogen in agricultural soils. Agron. Mono. 22. Am. Soc. Agron.

(32) United States Department of Agriculture. 1951 (Being revised). Soil survey manual. U.S. Dep. Agric. Handb. 18, 503 pp., illus. (Supplements replacing pp. 173-188 issued May 1962.)

(33) United States Department of Agriculture. 1975. Forest statistics for Louisiana parishes. Forest Serv., South. Forest Exp. Stn. Resour. Bull., pp. 50-52.

(34) United States Department of Agriculture. 1975. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. Soil Conserv. Serv., Agric. Handb. 436, 754 pp., illus.

(35) United States Department of Agriculture. 1978. Procedure to establish priorities in landscape architecture. Soil Conserv. Serv. Tech. Release 65.

(36) United States Department of Agriculture. 1984. Procedures for collecting soil samples and methods of analysis for soil survey. Soil Surv. Invest. Rep. 1, 68 pp., illus.

(37) United States Department of Agriculture. 1985. Site index and yield of second growth baldcypress. Soil Conserv. Serv., Tech. Note No. 5, 2 pp.

(38) Van't Hoff, J.H. 1884. Etudes de Dynamique Chimique. (Studies of dynamic chemistry).

Glossary

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.

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Area reclaim (in tables). An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

Association, soil. A group of soils geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as—

	Inches
Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	9 to 12
Very high	more than 12

Base saturation. The degree to which material having cation-exchange properties is saturated with exchangeable bases (sum of Ca, Mg, Na, K), expressed as a percentage of the total cation-exchange capacity.

Bedding planes. Fine stratifications, less than 5 millimeters thick, in unconsolidated alluvial, eolian, lacustrine, or marine sediments.

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Bisequum. Two sequences of soil horizons, each of which consists of an illuvial horizon and the overlying eluvial horizons.

Bottom land. The normal flood plain of a stream, subject to flooding.

Boulders. Rock fragments larger than 2 feet (60 centimeters) in diameter.

Calcareous soil. A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

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.

Chiseling. Tillage with an implement having one or more soil-penetrating points that shatter or loosen hard compacted layers to a depth below normal plow depth.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels, i.e., clay coating, clay skin.

Coarse fragments. If round, mineral or rock particles 2 millimeters to 25 centimeters (10 inches) in diameter; if flat, mineral or rock particles (flagstone) 15 to 38 centimeters (6 to 15 inches) long.

Coarse textured soil. Sand or loamy sand.

Complex slope. Irregular or variable slope. Planning or constructing terraces, diversions, and other water-control measures on a complex slope is difficult.

Complex, soil. A map unit of two or more kinds of soil in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils are somewhat similar in all areas.

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.

Conservation tillage. A tillage system that does not invert the soil and that leaves a protective amount of crop residue on the surface throughout the year.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard; little affected by moistening.

Contour stripcropping. Growing crops in strips that follow the contour. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

Control section. The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is that part of the soil profile between depths of 10 inches and 40 or 80 inches.

Corrosive. High risk of corrosion to uncoated steel or deterioration of concrete.

Cover crop. A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

Cutbanks cave (in tables). The walls of excavations tend to cave in or slough.

Depth to rock (in tables). Bedrock is too near the surface for the specified use.

Diversion (or diversion terrace). A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:

Excessively drained.—Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.

Somewhat excessively drained.—Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.

Well drained.—Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.

Moderately well drained.—Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically they are wet long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum, or periodically receive high rainfall, or both.

Somewhat poorly drained.—Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.

Poorly drained.—Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.

Very poorly drained.—Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients.

Drainage, surface. Runoff, or surface flow of water, from an area.

Eluviation. The movement of material in true solution or colloidial 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.

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion (geologic)—Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

Erosion (accelerated)—Erosion much more rapid than geologic erosion, mainly as a result of the activities of man or other animals or of a catastrophe in nature, such as fire, that exposes the surface.

Excess fines (in tables). Excess silt and clay are in the soil. The soil is not a source of gravel or sand for construction purposes.

Fast intake (in tables). The movement of water into the soil is rapid.

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*.

Fine textured soil. Sandy clay, silty clay, and clay.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Fragipan. A loamy, brittle subsurface horizon low in porosity and content of organic matter and low or moderate in clay but high in silt or very fine sand. A fragipan appears cemented and restricts roots. When dry, it is hard or very hard and has a higher bulk density than the horizon or horizons above. When moist, it tends to rupture suddenly under pressure rather than to deform slowly.

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. Commonly a succession of microbasins and microknolls in nearly level areas or of microvalleys and microridges parallel with the slope. Typically, the microrelief of Vertisols—clayey soils having a high coefficient of expansion and contraction with changes in moisture content.

Gleyed soil. Soil that formed under poor drainage, resulting in the reduction of iron and other elements in the profile and in gray colors and mottles.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Gravel. Rounded or angular fragments of rock up to 3 inches (2 millimeters to 7.5 centimeters) in diameter. An individual piece is a pebble.

Gravelly soil material. Material that is 15 to 50 percent, by volume, rounded or angular rock fragments, not prominently flattened, up to 3 inches (7.5 centimeters) in diameter.

Ground water (geology). Water filling all the unblocked pores of underlying material below the water table.

Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an upper case letter represents the major horizons. Numbers or lower case letters that follow represent subdivisions of the major horizons. An explanation of the subdivisions is given in the *Soil Survey Manual*. The major horizons of mineral soil are as follows:

O horizon.—An organic layer of fresh and decaying plant residue at the surface of a mineral soil.

A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, a plowed surface horizon, most of which was originally part of a B horizon.

E horizon.—The mineral horizon in which the main feature is loss of silicate clay, iron, aluminum, or some combination of these.

B horizon.—The mineral horizon below an O, A, or E horizon. The B horizon is, in part, a layer of transition from the overlying horizon to the underlying C horizon. The B horizon also has distinctive characteristics, such as accumulation of clay, sesquioxides, humus, or a combination of these; prismatic or blocky structure; redder or browner colors than those in the A horizon; or a combination of these. The combined A and B horizons are generally called the solum, or true soil. If a soil does not have a B horizon, the A horizon alone is the solum.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the A or B horizon. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, the Arabic numeral 2 precedes the letter C.

R layer.—Consolidated rock (unweathered bedrock) beneath the soil. The rock commonly underlies a C horizon, but can be directly below an A or a B horizon.

Hydrologic soil groups. Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

Illuviation. The movement of soil material from one horizon to another in the soil profile. Generally, material is removed from an upper horizon and deposited in a lower horizon.

Infiltration. The downward entry of water into the immediate surface of soil or other material. This contrasts with percolation, which is movement of water through soil layers or material.

Infiltration rate. The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

Intake rate. The average rate of water entering the soil under irrigation. Most soils have a fast initial rate; the rate decreases with application time. Therefore, intake rate for design purposes is not a constant but is a variable depending on the net irrigation application. The rate of water intake in inches per hour is expressed as follows:

Less than 0.2	very low
0.2 to 0.4	low
0.4 to 0.75	moderately low
0.75 to 1.25	moderate
1.25 to 1.75	moderately high
1.75 to 2.5	high
More than 2.5	very high

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are—

Controlled flooding.—Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.

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. into an area without controlled distribution.

Large stones (in tables). Rock fragments that are 3 inches (7.5 centimeters) or more across. Large stones adversely affect the specified use of the soil.

Leaching. The removal of soluble material from soil or other material by percolating water.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Low strength. The soil is not strong enough to support loads.

Medium textured soil. Very fine sandy loam, loam, silt loam, or silt.

Minimum tillage. Only the tillage essential to crop production and prevention of soil damage.

Moderately coarse textured soil. Sandy loam and fine sandy loam.

Moderately fine textured soil. Clay loam, sandy clay loam, and silty clay loam.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

Mottling, soil. Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance—*few, common,* and *many*; size—*fine, medium,* and *coarse*; and contrast—*faint, distinct,* and *prominent*. The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium*, from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse*, more than 15 millimeters (about 0.6 inch).

Munsell notation. A designation of color by degrees of the three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color of 10YR hue, value of 6, and chroma of 4.

Neutral soil. A soil having a pH value between 6.6 and 7.3. (See Reaction, soil.)

Nutrient, plant. Any element taken in by a plant essential to its growth. Plant nutrients are mainly nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, and zinc obtained from the soil and carbon, hydrogen, and oxygen obtained from the air and water.

Open space. A relatively undeveloped green or wooded area provided mainly within an urban area to minimize feelings of congested living.

Organic matter. Plant and animal residue in the soil in various stages of decomposition.

Pan. A compact, dense layer in a soil that impedes the movement of water and the growth of roots. For example, *hardpan, fragipan, claypan, plowpan,* and *traffic pan*.

Parent material. The unconsolidated organic and mineral material in which soil forms.

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percolation. The downward movement of water through the soil.

Percs slowly (in tables). The slow movement of water through the soil adversely affects the specified use.

Permeability. The quality of the soil that enables water to move through the profile. Permeability is measured as the number of inches per hour that water moves through the saturated soil. Terms describing permeability are:

Very slow	less than 0.06 inch
Slow	0.06 to 0.2 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

Phase, soil. A subdivision of a soil series based on features that affect its use and management. For example, slope, stoniness, and thickness.

pH value. A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

Piping (in tables). Subsurface tunnels or pipelike cavities are formed by water moving through the soil.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plastic limit. The moisture content at which a soil changes from semisolid to plastic.

Plinthite. The sesquioxide-rich, humus-poor, highly weathered mixture of clay with quartz and other diluents. It commonly appears as red mottles, usually in platy, polygonal, or reticulate patterns. Plinthite changes irreversibly to an ironstone hardpan or to irregular aggregates on 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. It is a form of laterite.

Plowpan. A compacted layer formed in the soil directly below the plowed layer.

Ponding. Standing water on soils in closed depressions. Unless the soils are artificially drained, the water can be removed only by percolation or evapotranspiration.

Poor filter (in tables). Because of rapid permeability, the soil may not adequately filter effluent from a waste disposal system.

Poor outlets (in tables). In these areas, surface or subsurface drainage outlets are difficult or expensive to install.

Productivity, soil. The capability of a soil for producing a specified plant or sequence of plants under specific management.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Reaction, soil. A measure of the acidity or alkalinity of a soil expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degree of acidity or alkalinity is expressed as—

	pH
Extremely acid	below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Relief. The elevations or inequalities of a land surface, considered collectively.

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 (in tables). There is a shallow root zone. The soil is shallow over a layer that greatly restricts roots.

Root zone. The part of the soil that can be penetrated by plant roots.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Sandstone. Sedimentary rock containing dominantly sand-size particles.

Sedimentary rock. Rock made up of particles deposited from suspension in water. The chief kinds of sedimentary rock are conglomerate, formed from gravel; sandstone, formed from sand; shale, formed from clay; and limestone, formed from soft masses of calcium carbonate. There are many intermediate types. Some wind-deposited sand is consolidated into sandstone.

Seepage (in tables). The movement of water through the soil adversely affects the specified use.

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the underlying material. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Shale. Sedimentary rock formed by the hardening of a clay deposit.

Sheet erosion. The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and surface runoff.

Shrink-swell. The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

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.

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.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.

Slope (in tables). Slope is great enough that special practices are required to ensure satisfactory performance of the soil for a specific use.

Slow intake (in tables). The slow movement of water into the soil.

Slow refill (in tables). The slow filling of ponds, resulting from restricted permeability in the soil.

Small stones (in tables). Rock fragments less than 3 inches (7.5 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

Soil. A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil separates. Mineral particles less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes of separates recognized in the United States are as follows:

	Millimeters
Very coarse sand	2.0 to 1.0
Coarse sand	1.0 to 0.5
Medium sand	0.5 to 0.25
Fine sand	0.25 to 0.10
Very fine sand	0.10 to 0.05
Silt	0.05 to 0.002
Clay	less than 0.002

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A, E, and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and plant and animal activities are largely confined to the solum.

Stones. Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter.

Stripcropping. Growing crops in a systematic arrangement of strips or bands that provide vegetative barriers to wind and water erosion.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grained* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Stubble mulch. Stubble or other crop residue left on the soil or partly worked into the soil. It protects the soil from wind and water erosion after harvest, during preparation of a seedbed for the next crop, and during the early growing period of the new crop.

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Subsoiling. Breaking up a compact subsoil by pulling a special chisel through the soil.

Substratum. The part of the soil below the solum.

Subsurface layer. Technically, the A2 horizon. Generally refers to a leached horizon lighter in color and lower in organic matter content than the overlying surface layer.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Taxadjuncts. Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use and behavior.

Terrace. An embankment, or ridge, constructed on the contour or at a slight angle to the contour across sloping soils. The terrace intercepts surface runoff, so that water soaks into the soil or flows slowly to a prepared outlet.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Thin layer (in tables). An therwise suitable soil material that is too thin for the specified use.

Tilth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Topsoil. The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Weathering. All physical and chemical changes produced by atmospheric agents in rocks or other deposits at or near the earth's surface. These changes result in disintegration and decomposition of the material.

Wilting point (or permanent wilting point). The moisture content of soil, on an ovendry basis, at which a plant (specifically sunflower) wilts so much that it does not recover when placed in a humid, dark chamber.