SOIL SURVEY OF

Red River County, Texas

This is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and agencies of the States, usually the Agricultural Experiment Stations. In some surveys, other Federal and local agencies also contribute. The Soil Conservation Service has leadership for the Federal part of the National Cooperative Soil Survey.

Major fieldwork for this soil survey was completed in the period 1957-70. Soil names and descriptions were approved in 1972. Unless otherwise indicated, statements in the publication refer to conditions in the county in 1970. This survey was made cooperatively by the Soil Conservation Service and the Texas Agricultural Experiment Station. It is part of the technical assistance furnished to the Red River Soil and Water Conservation District.

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

HOW TO USE THIS SOIL SURVEY

THIS SOIL SURVEY contains information that can be applied in managing farms, ranches, and woodlands; in selecting sites for roads, ponds, buildings, and other structures; and in judging the suitability of tracts of land for farming, industry, and recreation.

Locating Soils

All the soils of Red River County are shown on the detailed map at the back of this publication. This map consists of many sheets made from aerial photographs. Each sheet is numbered to correspond with a number on the Index to Map Sheets.

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show soils that have the same limitation or suitability. For example, soils that have a slight limitation for a given use can be colored green, those with a moderate limitation can be colored yellow, and those with a severe limitation can be colored red.

Farmers and those who work with farmers can learn about use and management of the soils from the soil descriptions and from the discussions of the capability units, the pasture and hayland groups, the woodland suitability groups, and the woodland grazing groups.

Foresters and others can refer to the section "Woodland," where the soils of the county are grouped according to their suita-

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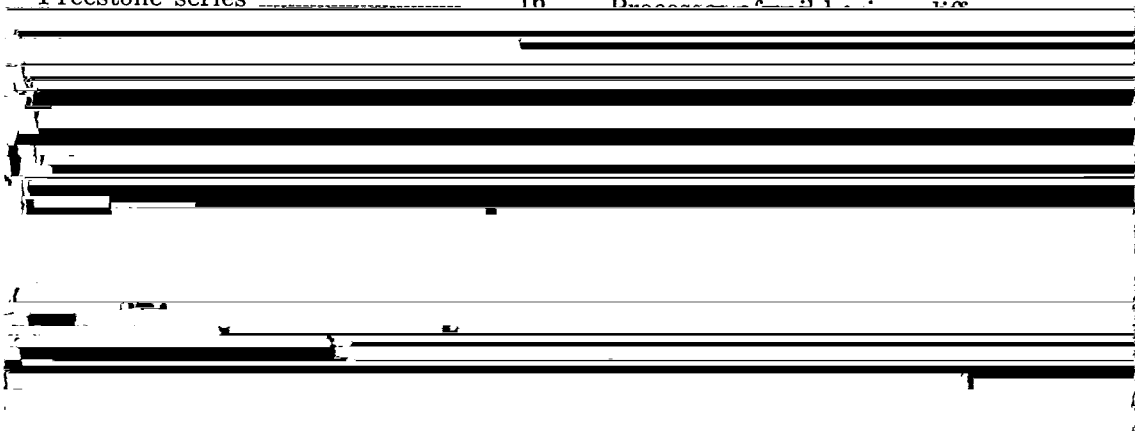

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Wrightsville soils, 9 percent Annona soils, and 46 percent less extensive soils.

Woodtell soils are moderately well drained. They are gently sloping to strongly sloping and moderately eroded to severely eroded. The surface layer is dark grayish-brown fine sandy loam about 6 inches thick. The next layer is 6 inches of yellowish-red clay mottled with light yellowish brown. The next layer is 17 inches of red clay mottled with gray and yellowish red. Below this is 16 inches of yellowish-brown clay loam mottled with gray and red. The underlying material to a depth of 72 inches is stratified light olive-gray and gray sandy clay loam and yellowish-brown clay loam.

Wrightsville soils are on stream divides. These soils are nearly level, poorly drained, and slightly eroded. The surface layer is very fine sandy loam about 11

thick. The upper 5 inches is dark grayish brown, and the lower 5 inches is light yellowish brown. The next layer is 30 inches of mottled clay that is dark red in the upper part and gray in the lower part. Below this to a depth of about 95 inches is yellowish-brown clay mottled with gray.

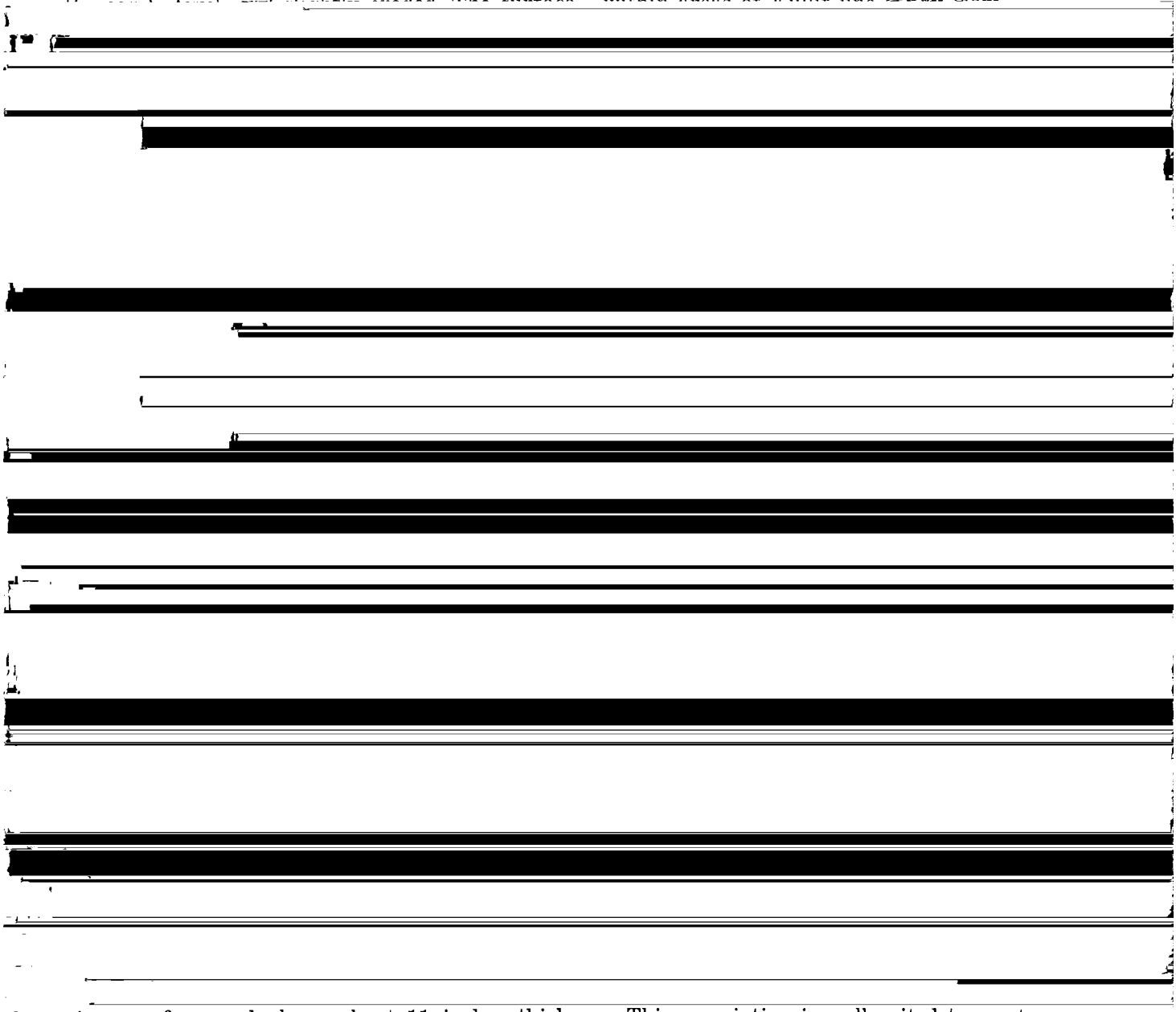
Less extensive in this association are Panola, Kullit, Freestone, Rodessa, and Addielou soils. Panola soils occupy slightly lower positions on the landscape, and the other soils occupy slightly higher positions.

This association is not well suited to most crops grown in the county, but most areas of the association are suited to pasture and hay. About 65 percent of the acreage is wooded, about 30 percent is used for pasture and hay, and about 5 percent is used for crops. The lower lying, poorly drained areas are better suited to

soils.

Wrightsville soils are poorly drained. They are

which occur on mounds within areas of Bernaldo fine sandy loam, and Addielou soils, which occur on mounds



layer is very fine sandy loam about 11 inches thick. The upper 2 inches is dark grayish brown, and the lower 9 inches is light gray and is mottled with dark yellowish brown. Below this is gray clay that extends to a depth of 51 inches. It has penetrations of loam in the upper 10 inches and is mottled with dark yellowish brown in the lower 29 inches. The underlying material to a depth of 86 inches is light-gray clay mottled with dark yellowish brown.

McKamie soils are well drained. They are gently sloping to strongly sloping and are moderately eroded

This association is well suited to most crops grown in the county. About 70 percent of the acreage is used for pasture, 20 percent is wooded, and 10 percent is used for crops.

4. *Whakana-Vesey association*

Well drained, moderately permeable, loamy soils

This association consists of nearly level to moderately steep soils on terraces.

The association makes up about 2 percent of the county. It is about 49 percent Whakana soils, 26 per-

Kullit soils are gently sloping and moderately eroded. The surface layer is brown fine sandy loam about 5 inches thick. The next layer is 9 inches of strong-brown sandy clay loam mottled with yellowish red. The next layer is 24 inches of clay loam. The upper 7 inches is strong brown and is mottled with gray and yellowish red; the lower 17 inches is light gray, has red and yellowish-brown mottles, and contains cracks and channels filled with uncoated sand. Below this to a depth of 90 inches is light-gray clay mottled with red and yellowish brown. It has a few cracks filled with uncoated sand.

Less extensive in this association are Annona and Bernaldo soils. Annona soils occupy the lower positions on the landscape, and Bernaldo soils occupy the higher positions.

This association is suited to most crops grown in the county. It is well suited to pasture and hay. The areas of steeper slopes are better suited to use as woodland and wildlife habitat. About 75 percent of the acreage is used for pasture and hay, 15 percent is wooded, and 10 percent is used for crops.

Nearly Level and Gently Sloping Prairie Soils of Uplands

This group consists of deep or moderately deep, acid and alkaline, clayey soils. About 50 percent of the acreage is used for pasture, 42 percent is used for crops, and 8 percent is wooded. Most of the soils of this group are well suited to pasture but poorly suited to woodland. They are also suited to crops and open-land wildlife habitat. Most of the soils in this group have a high shrink-swell potential that presents problems in the construction of buildings, roads, streets, and pipelines.

6. Burleson-Deport association

Less extensive in this association are Ellis, Ferris, and Mabank soils. Ellis and Ferris soils occupy the higher positions on the landscape, and Mabank soils occupy the lower positions.

This association is suited to most crops grown in the county. It is well suited to pasture and hay, but it is not suited to commercial woodland. About 45 percent of the acreage is used for crops, 45 percent is used for pasture and hay, and 10 percent is wooded.

7. Houston Black-Austin association

Moderately well drained and well drained, very slowly permeable and moderately slowly permeable, clayey soils

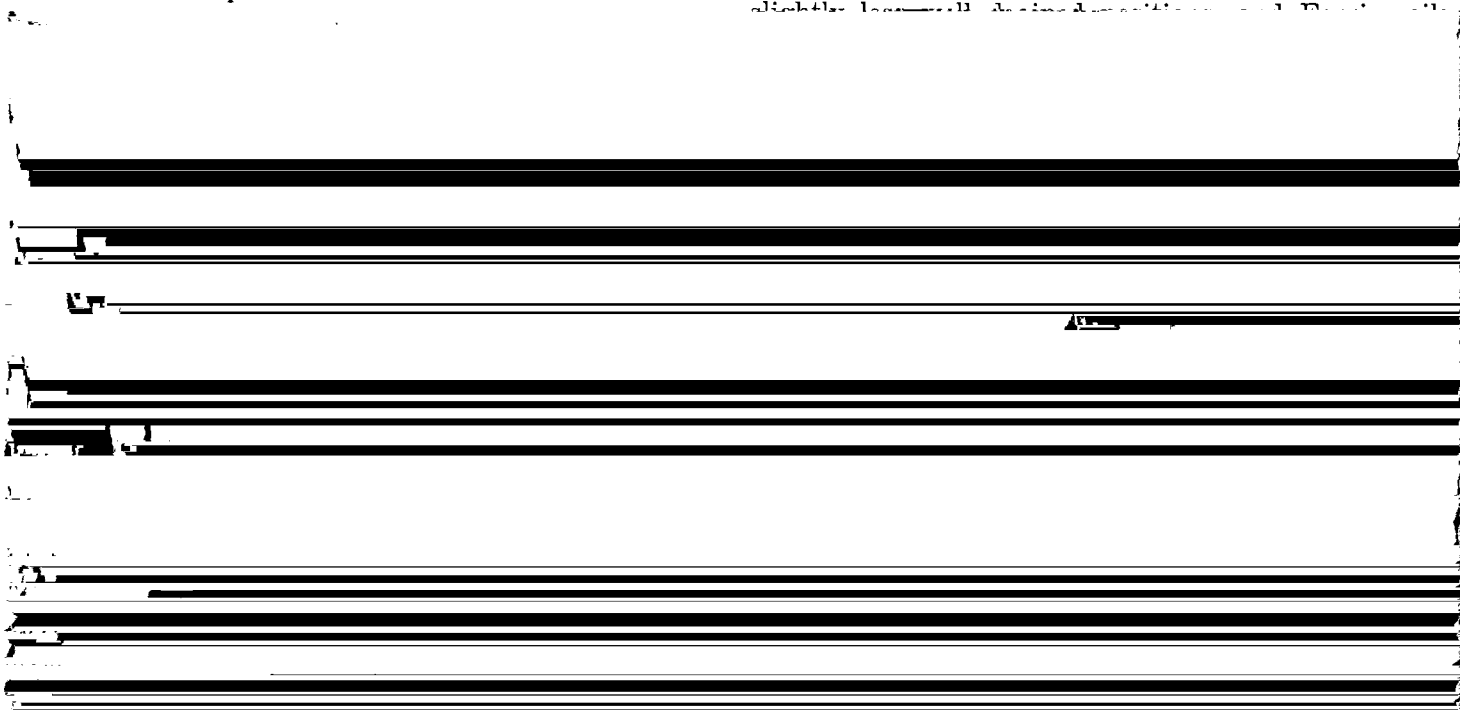
This association consists of gently sloping soils.

The association makes up about 5 percent of the county. It is about 46 percent Houston Black soils, 18 percent Austin soils, and 36 percent less extensive soils.

Houston Black soils are moderately well drained. They are gently sloping and moderately eroded. The surface layer is black clay about 20 inches thick. The next layer is 49 inches of clay. It is very dark gray in the upper 24 inches and dark gray in the lower 25 inches. The underlying material to a depth of 72 inches is shale.

Austin soils are well drained. They are gently sloping and moderately eroded. The surface layer is very dark grayish-brown silty clay about 11 inches thick. The next layer is 26 inches of grayish-brown silty clay. It is mottled with very dark grayish brown in the upper 9 inches and light olive brown in the lower 17 inches. The underlying material to a depth of 50 inches is interbedded light-gray silty clay and chalk.

Less extensive in this association are Bryarly, Burleson, and Ferris soils. Bryarly soils occupy narrow side slopes next to drainageways. Burleson soils are on



The association makes up about 9 percent of the county. It is about 50 percent Kaufman soils, 29 percent Gladewater soils, and 21 percent less extensive soils.

Kaufman soils are somewhat poorly drained. They are smooth, nearly level, and slightly eroded. The surface layer is very dark gray clay about 15 inches thick. Below this to a depth of 70 inches is dark-gray clay mottled with strong brown and light olive brown.

Gladewater soils have a surface layer of very dark gray clay about 6 inches thick. The next layer is 34 inches of clay. The upper 18 inches is light brownish gray and is mottled with yellowish brown. The lower 16 inches is gray and is mottled with yellowish brown. The underlying material to a depth of 65 inches is gray clay stratified with gray clay loam. It is mottled with yellowish brown.

Less extensive in this association are Varro and [illegible] soils. These soils occupy the higher positions

Descriptions of the Soils

This section describes the soil series and mapping units in Red River County. Each soil series is described in detail, and then each mapping unit in that series is briefly described. Unless specifically mentioned otherwise, it is to be assumed that what is stated about the soil series holds true for the mapping units in that series. Thus, to get full information about any one mapping unit, it is necessary to read both the description of the mapping unit and the description of the soil series to which it belongs.

An important part of the description of each soil series is the soil profile; that is, the sequence of layers from the surface downward to rock or other underlying material. Each series contains two descriptions of this profile. The first is brief and in terms familiar to the layman. The second is much more detailed and is for those who need to make thorough and precise stud-

TABLE 1.—*Approximate acreage and proportionate extent of soils*

Soil	Acres	Percent	Soil	Acres	Percent
Annona-Freestone complex, 1 to 3 percent slopes	46,800	7.0	Morse clay, 3 to 8 percent slopes, eroded	680	0.1
Austin silty clay, 1 to 3 percent slopes	5,970	.9	Muldrow silty clay loam	3,280	.5
Bernaldo-Elysian complex, 1 to 3 percent slopes	16,470	2.4	Muldrow-Elysian complex	1,990	.3
Bryarly clay loam, 1 to 5 percent slopes	10,960	1.7	Nahatche soils, frequently flooded	14,950	2.3
Burleson clay, 0 to 1 percent slopes	3,670	.6	Oklared fine sandy loam	10,120	1.6
Burleson clay, 1 to 3 percent slopes	24,080	3.6	Oklared silty clay loam	2,470	.4
Crockett loam, 1 to 3 percent slopes	4,810	.8	Panola silty clay	29,000	4.4
Cuthand loam, 4 to 8 percent slopes, eroded	4,230	.6	Redlake clay	2,580	.4
Deport clay, 1 to 3 percent slopes	19,400	2.9	Redlake soils	2,290	.3
Desha clay, 0 to 1 percent slopes	8,470	1.3	Roebuck clay, calcareous variant	1,860	.3
Desha clay, 1 to 3 percent slopes	1,090	.2	Rosalie loamy fine sand, 2 to 5 percent slopes	7,820	1.2
Ellis clay, 3 to 5 percent slopes	6,520	1.0	Thenas fine sandy loam, frequently flooded	18,740	2.8
Ferris clay, 3 to 8 percent slopes, eroded	10,340	1.6	Trinity clay	4,030	.6
Freestone-Addielou complex, 0 to 1 percent slopes	5,540	.8	Trinity clay, frequently flooded	6,030	1.0
Gladewater clay	3,010	.5	Varro clay loam	1,340	.2
Gladewater clay, frequently flooded	20,990	3.0	Vesey fine sandy loam, 3 to 8 percent slopes	5,330	.8
Hapludalfs, loamy, 0 to 2 percent slopes	1,960	.3	Vesey fine sandy loam, 8 to 20 percent slopes	3,790	.6
Houston Black clay, 1 to 3 percent slopes	15,650	2.4	Waskom loam	2,000	.3
Kaufman clay	4,610	.6	Whakana loam, 3 to 8 percent slopes	4,620	.7
Kaufman clay, frequently flooded	34,704	5.2	Whakana-Elysian complex, 0 to 1 percent slopes	9,040	1.4
Kenney loamy fine sand, 2 to 8 percent slopes	1,860	.3	Woodtell fine sandy loam, 1 to 5 percent slopes	61,610	9.3
Kiomatia loamy fine sand, frequently flooded	2,620	.4	Woodtell fine sandy loam, 5 to 12 percent slopes	36,560	5.5
Kullit-Addielou complex, 1 to 3 percent slopes	43,950	6.6	Wrightsville-Rodessa complex	105,830	15.9
Mabank fine sandy loam, 0 to 1 percent slopes	16,930	2.6	Water area	1,216	.2
McKamie loam, 1 to 5 percent slopes	2,900	.4			
McKamie loam, 5 to 12 percent slopes	7,690	1.2	Total	662,400	100.0

sandy clay loam mottled with yellowish red. The next layer is 12 inches of mottled yellowish-brown, gray, sandy clay loam; moderate, medium, subangular blocky structure; hard, friable; continuous clay

about 10 inches thick. The upper 5 inches is dark grayish brown, and the lower 5 inches is light yellowish brown. The next layer is 30 inches of mottled clay. It is red in the upper part and gray in the lower part. The next layer is 19 inches of yellowish-brown clay. Below this to a depth of 95 inches is mottled yellowish-brown and gray clay.

Annona soils are somewhat poorly drained. Permeability is very slow, and available water capacity is high. These soils have a high potential as pastureland and a medium potential as woodland and cropland.

Representative profile of an Annona loam in an intermound area of Annona-Freestone complex, 1 to 3 percent slopes, 10 miles north of Clarksville on Texas Highway No. 37, 3 miles west of Farm Road 2118, 2.5 miles west on International Paper Company Road No. 10 to Company Road No. 15, 100 feet northeast of road intersection, in woodland:

A1—0 to 5 inches, dark grayish-brown (10YR 4/2) loam; few, fine, distinct, yellowish-brown (10YR 5/4) mottles; weak, very fine, granular structure; slightly hard, very friable; common roots; few krotovinas; slightly acid; clear, wavy boundary.

A2—5 to 10 inches, light yellowish-brown (10YR 6/4) loam; few, fine, faint, brownish-yellow (10YR 6/6) and light brownish-gray (10YR 6/2) mottles; weak, fine, subangular blocky structure; slightly hard, very friable; strongly acid; clear, wavy boundary.

B21t—10 to 18 inches, dark-red (2.5YR 3/6) clay; many, medium, prominent, gray (10YR 6/1) mottles and few, fine, prominent, dark yellowish-brown (10YR 4/4) mottles; moderate, fine, subangular blocky structure; extremely hard, very firm; few fine roots; common pressure faces; few patchy clay films; few quartz pebbles as much as 1 inch in diameter; very strongly acid; gradual, wavy boundary.

B22t—18 to 31 inches, gray (10YR 6/1) clay; common, medium, prominent, dark-red (2.5YR 3/6) mottles and common, fine, distinct, yellowish-brown (10YR 5/4) mottles; moderate, fine, blocky structure; extremely hard, very firm; few fine roots; common pressure faces; few clay films; strongly acid; gradual, wavy boundary.

B23t—31 to 40 inches, gray (10YR 6/1) clay; common, medium, prominent, yellowish-red (5YR 4/8) mottles; dark yellowish brown, brown, yellowish brown, or light yellowish brown. The A2 horizon is pale brown, light yellowish brown, gray, or light gray.

The B21t horizon is dark red, red, yellowish red, or reddish yellow and has few to many mottles of gray, dark yellowish brown, and yellowish brown. It is clay loam or clay that is 35 to 60 percent clay. This horizon is strongly acid to very strongly acid. The B22t and B23t horizons are mottled gray, red, dark-red, yellowish-red, yellowish-brown, light olive-brown, or olive-yellow clay or clay loam. They are strongly acid to medium acid. The B24t and B25t horizons are mottled red, gray, yellowish-red, yellowish-brown, light olive-brown, and olive-yellow clay or clay loam. They are medium acid to moderately alkaline.

Annona-Freestone complex, 1 to 3 percent slopes (AfB).—This complex is about 63 percent Annona loam, 18 percent Freestone fine sandy loam, and 19 percent other soils. It is in most wooded areas in the county on broad ridgetops or along gently sloping stream divides. Areas are weakly convex, are irregular in shape, and are 75 to 300 acres.

This complex is characterized by areas of Annona soils from which circular mounds of Freestone soils protrude in a random pattern. The mounds are 35 to 60 feet in diameter, are 100 to 200 feet apart, and make up about 30 percent of a typical mapped area. The less extensive soils occur in patterns too intricate to separate at the scale used in mapping. The intermound areas of Annona loam serve as tenuous drainageways without channels.

The Freestone soil has a surface layer of fine sandy loam about 16 inches thick. It is dark grayish brown in the upper 6 inches and light yellowish brown in the lower 10 inches. The next layer is sandy clay loam 16 inches thick. It is reddish yellow mottled with red in the upper 8 inches, and it is yellowish brown and has cracks and pockets of uncoated sand in the lower 8 inches. The next layer is 24 inches of mottled gray and red clay. Below this to a depth of 65 inches is gray clay mottled with brown.

Included with this complex in mapping are Wrightsville, Rodessa, and Woodtell soils. Wrightsville soils are in poorly drained spots within areas of Annona

mottled with very dark grayish brown in the upper 9

Bernaldo Series

Bernaldo-Elysian complex, 1 to 3 percent slopes (BeB).—This complex is about 65 percent Bernaldo fine sandy loam, 25 percent Elysian loam, and 10 percent other soils. It is on interstream divides. Areas are irregular in shape, weakly dissected, and weakly convex. They are 10 to 300 acres in size but average about 40 acres.

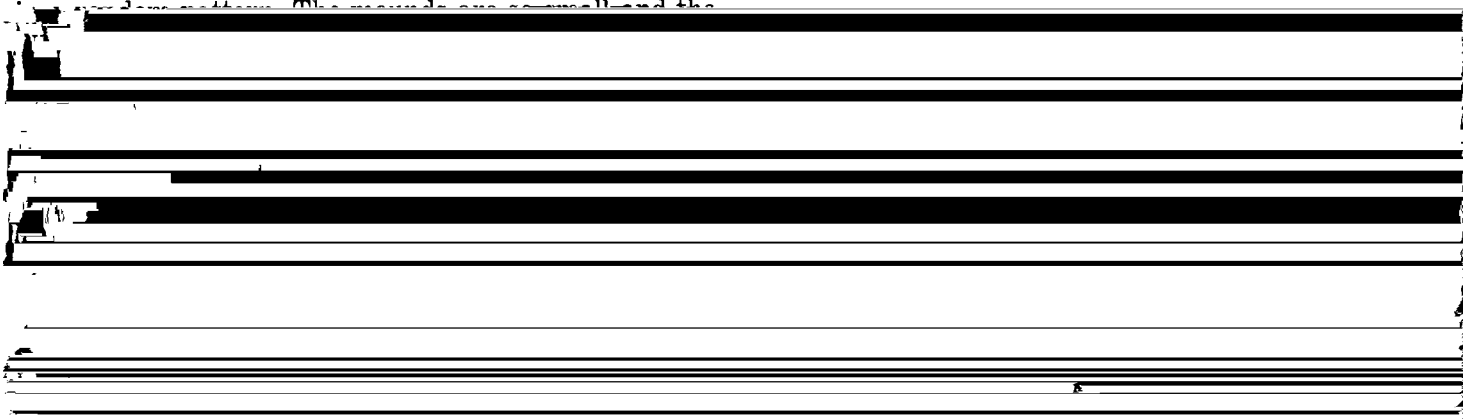
This complex is characterized by areas of Bernaldo fine sandy loam from which circular mounds protrude in a random pattern. The mounds are so small and the soil pattern so intricate that it was not practical to separate the soils at the scale used in mapping. The mounds are 40 to 60 feet in diameter, 22 to 36 inches high, and 50 to 75 feet apart.

The Elysian soil has a surface layer of brown fine sandy loam about 6 inches thick. The next layer is 16 inches of light yellowish-brown fine sandy loam. The next layer is 37 inches of strong-brown loam that contains vertical streaks and pockets of pale-brown fine sandy loam in the upper part. The next layer is 13 inches of yellowish-brown loam mottled with yellowish red. Below this to a depth of 95 inches is strong-brown clay loam mottled with yellowish red. It is 2 to 3 percent uncoated sand.

Included with this complex in mapping are areas of Kullit soils, 3 to 6 acres in size, that make up about 5 percent of mapped areas. Also included are few areas of Woodtell soils 3 to 5 acres in size. They are on short, steep slopes and make up 5 to 10 percent of some mapped areas.

Runoff is slow. The hazard of erosion is moderate.

About 65 percent of the acreage is used for pasture, 8 percent is cultivated, and 27 percent is wooded (fig. 3). Capability unit IIe–1; pasture and hayland group 8C; woodland suitability group 2o7.



Bryarly Series

The Bryarly series consists of deep, gently sloping, loamy, acid soils on uplands. These soils formed in calcareous, clayey marine sediment. They are on side slopes along drainageways.

In a representative profile the surface layer is very dark grayish-brown clay loam about 3 inches thick. The next layer is 43 inches of mottled red and gray clay. The underlying material to a depth of 81 inches is light olive-brown calcareous clay mottled with red and gray. It contains concretions of calcium carbonate.

Bryarly soils are moderately well drained. Permeability is very slow, and available water capacity is high. These soils have a medium potential as pastureland and a low potential as cropland and woodland.

Representative profile of Bryarly clay loam, 1 to 5

percent slopes, 1.2 miles south of Boxelder on county road, 0.5 mile east and 1 mile south on county road, 1.3 miles south on private road, 100 feet east of private road:

A1—0 to 3 inches, very dark grayish-brown (10YR 3/2) clay loam; moderate, very fine, granular structure; very hard, firm; few roots; medium acid; gradual, smooth boundary.

B21t—3 to 18 inches, red (2.5YR 4/6) clay; common, fine and medium, prominent, gray (10YR 6/1) mottles; moderate, fine, blocky structure; extremely hard, very firm; few roots; continuous clay films or pressure faces; very strongly acid; gradual, smooth boundary.

B22t—18 to 46 inches, gray (10YR 6/1) clay; many, fine and medium, prominent, red (2.5YR 4/6) mottles and common, fine, distinct, yellowish-brown (10YR 5/6) mottles; moderate, fine, blocky structure; extremely hard, very firm; continuous clay films or pressure faces; medium acid; gradual, smooth boundary.

B3ca—46 to 70 inches, light olive-brown (2.5Y 5/4) clay; few, fine, prominent, red and gray mottles; weak, subangular blocky structure; extremely hard, very firm; few shiny pressure faces; 5 to 10 percent soft masses and concretions of calcium carbonate; calcareous; moderately alkaline; diffuse, smooth boundary.

Cca—70 to 81 inches, light olive-brown (2.5Y 5/4) clay; few, fine and medium, distinct, gray (5Y 6/1) mottles; massive; extremely hard, very firm; few concretions and masses of calcium carbonate; calcareous; moderately alkaline.

The solum ranges from 60 inches to more than 80 inches in thickness.

The A horizon is very dark brown, dark grayish brown, very dark grayish brown, dark yellowish brown, or dark brown. It is mottled with very dark grayish brown, pale brown, dark brown, or strong brown in some profiles. It is very strongly acid to slightly acid. The boundary is clear or gradual.

The B21t horizon is red, yellowish red, or reddish brown. It is mottled with gray, yellowish brown, grayish brown,

Burleson Series

The Burleson series consists of deep, nearly level to gently sloping, clayey, acid soils on uplands, ridgetops, and gentle side slopes. These soils formed in alkaline, clayey material.

In a representative profile the surface layer is clay 56 inches thick. The upper 24 inches is very dark gray, and the lower 32 inches is dark gray. The next layer is 12 inches of dark-gray clay. Below this to a depth of 87 inches is mottled yellowish-brown, gray, and light-gray clay that contains fragments of shale.

Burleson soils are moderately well drained. Permeability is very slow, and available water capacity is high. These soils have a high potential as pastureland and cropland and a low potential as woodland.

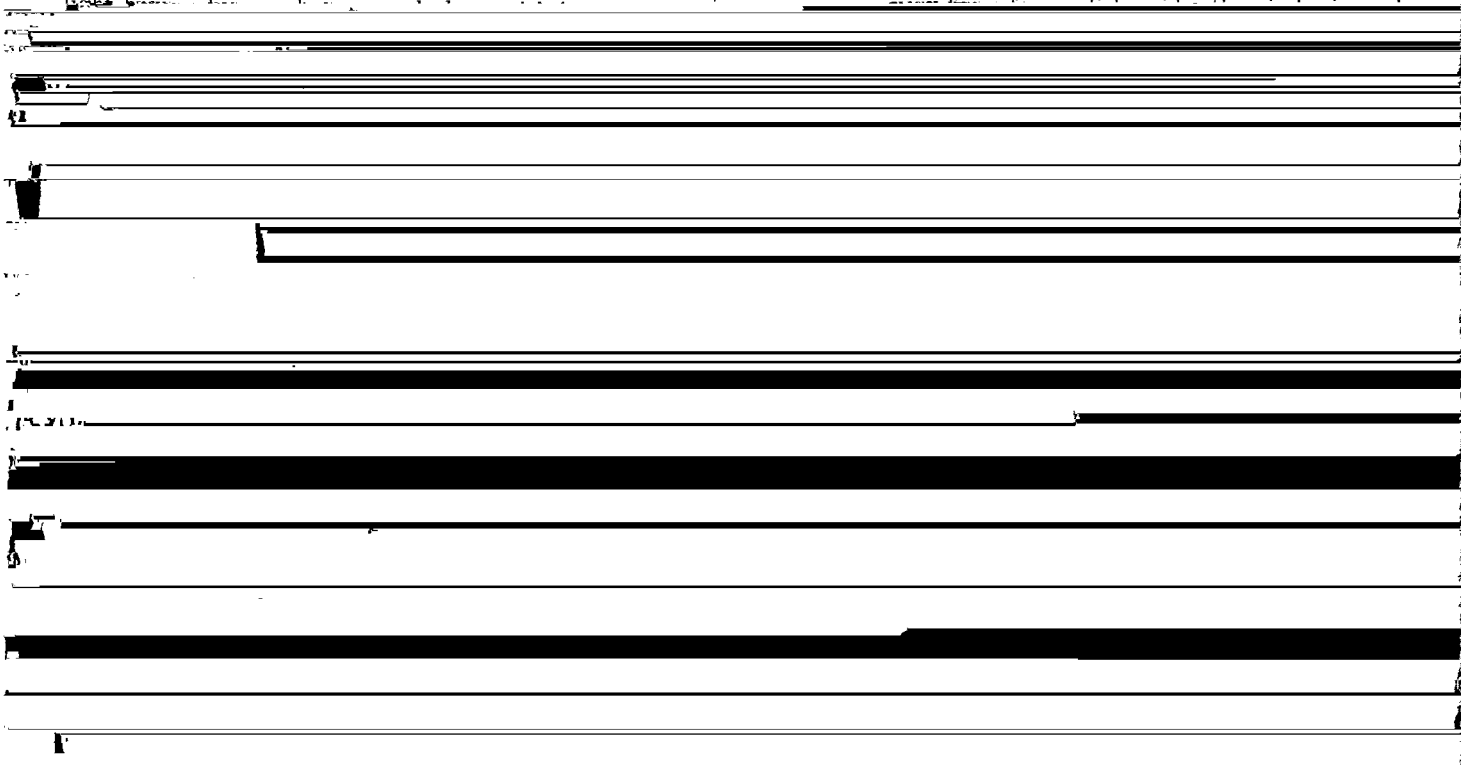
Representative profile of Burleson clay, 1 to 3 percent slopes, 12 miles south of junction, in Clarksville, of Texas Highway No. 37 and U.S. Highway No. 82, 1 mile west on county road, 1 mile north on county road, 600 feet east of road, and 200 feet east of old house:

Ap—0 to 5 inches, very dark gray (10YR 3/1) clay; few, fine, dark yellowish-brown (10YR 4/4) specks; weak, fine, subangular blocky structure and very fine, granular structure; extremely hard, very firm; medium acid; gradual, smooth boundary.

A12—5 to 24 inches, very dark gray (10YR 3/1) clay; few, fine, faint, brown (10YR 5/3) mottles; moderate, very fine, blocky structure; extremely hard, very firm; slightly acid; gradual, smooth boundary.

A13—24 to 56 inches, dark-gray (10YR 4/1) clay; moderate, very fine, blocky structure; extremely hard; intersecting slickensides about 4 inches across; few siliceous pebbles; mildly alkaline; gradual, wavy boundary.

AC1—56 to 68 inches, dark-gray (10YR 4/1) clay; common, large, distinct, olive-brown (2.5Y 4/4) mottles; moderate, coarse, blocky structure; extremely hard,



common fine distinct gray (10YR 5/1) mottles;

a low potential as cropland and woodland.

Representative profile of Cuthand loam, 4 to 8 percent slopes, eroded, 1.5 miles east of Clarksville on U.S. Highway No. 82, 7 miles east on Farm Road No. 114, 2.9 miles north on Farm Road No. 1158, 0.6 mile east on county road, and 30 feet south of road:

Ap—0 to 10 inches, dark grayish-brown (10YR 4/2) loam; moderate, fine, subangular blocky structure and moderate very fine granular structure; hard fri-

31 inches of dark-gray and gray clay mottled with dark grayish brown and yellowish brown. The next layer is 20 inches of olive-brown clay mottled with gray and yellowish brown. The underlying material to a depth of 68 inches is shale.

Deport soils are somewhat poorly drained. Permeability is very slow, and available water capacity is high. These soils have a medium to high potential as

Deport clay, 1 to 3 percent slopes (DaB).—This gently sloping soil is on convex side slopes. Areas are long and narrow. Slopes average about 2 percent. Areas are 10 to 100 acres but average about 50 acres.

Included with this soil in mapping are areas of Burleson soils, 5 to 10 acres in size. They are on gently sloping ridges and make up 10 to 20 percent of mapped areas. Also included are areas of Ellis soils 3 to 8 acres in size. They are on steeper spots and make up 5 to 10 percent of some mapped areas. There are also a few areas of Ferris soils, 5 to 10 acres in size, that make up 10 to 15 percent of some mapped areas. The included soils make up less than 25 percent of any mapped areas.

Runoff is medium. The hazard of erosion is moderate.

About 75 percent of the acreage is used for pasture, about 20 percent is wooded, and about 5 percent is cultivated. Capability unit IIIe–5; pasture and hayland group 7A; woodland suitability group not assigned.

Desha Series

The Desha series consists of deep, nearly level to [illegible] clayey, alkaline soils on bottom lands

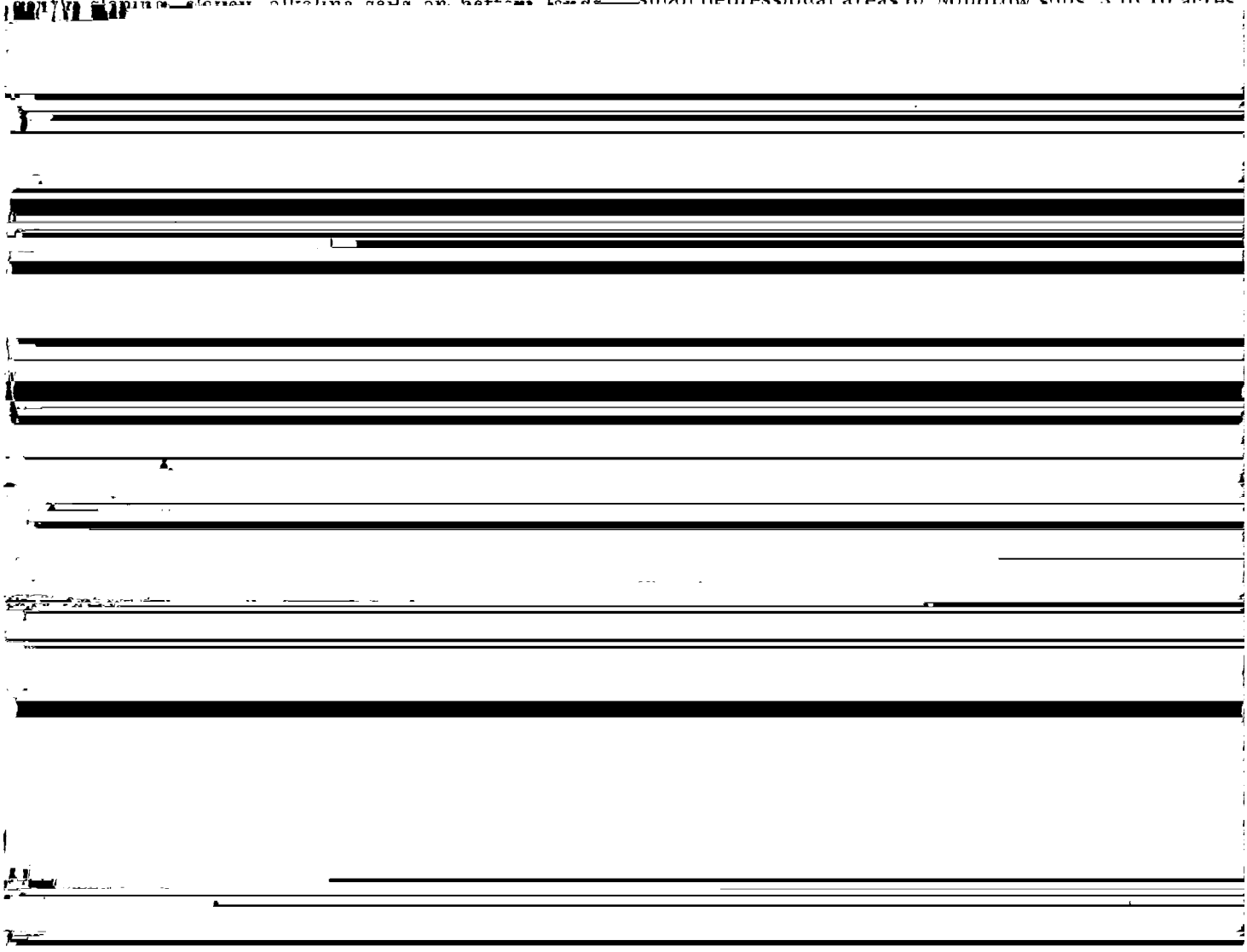
thickness. It is slightly acid to mildly alkaline throughout. Intersecting slickensides start at a depth of 36 to 45 inches.

The A horizon is 5 to 9 inches thick. It is dark brown or dark reddish brown and contains 35 to 60 percent clay.

The B1 horizon is dark brown or dark reddish brown and contains 35 to 60 percent clay. The B2 horizon is dark reddish brown, brown, very dark brown, or reddish brown and is mottled in some profiles with very dark gray, very dark brown, and black. In some profiles it has concretions of calcium carbonate. The B2 horizon is 60 to 75 percent clay. The B3 horizon, where present, contains a few concretions of calcium carbonate below a depth of 40 inches.

Desha clay, 0 to 1 percent slopes (DeA).—This nearly level soil is on flood plains. Areas are 10 acres to more than 1,000 acres but average about 75 acres. They are irregular in shape. Slopes average 0.5 percent. This soil has the profile described as representative of the series.

Included with this soil in mapping are areas of Desha clay, 1 to 3 percent slopes, that occur on the outside edge of mapped areas and make up 5 to 10 percent of some mapped areas. Also included are slightly elevated areas of Redlake soils, 5 to 15 acres in size, that make up 5 to 20 percent of some mapped areas and small depressional areas of Muldrow soils, 3 to 10 acres



Representative profile of Ellis clay, 3 to 5 percent slopes, 12 miles south of the junction of Texas Highway No. 37 and U.S. Highway No. 82 in Clarksville; 0.5 mile east on county road, 2,900 feet east on private road to pasture gate, 3,200 feet south, in pasture:

A1—0 to 3 inches, dark grayish-brown (10YR 4/2) clay; moderate, medium, subangular blocky structure; extremely hard, very firm, plastic; calcareous; moderately alkaline; gradual, smooth boundary.

B2—3 to 10 inches, dark-gray (10YR 4/1) clay; weak, medium to coarse, blocky structure; extremely hard, very firm, plastic; many shiny pressure faces; calcareous; moderately alkaline; gradual, smooth boundary.

B3—10 to 19 inches, dark-gray (10YR 4/1) clay; many, fine to coarse, distinct, olive (5Y 5/3) mottles; weak, medium, blocky structure; extremely hard, very firm, plastic; many slickensides; few fine concretions of ferromanganese; some faces coated with

In a representative profile the surface layer is brown fine sandy loam about 4 inches thick. The next layer is 16 inches of brown fine sandy loam. The next layer is 21 inches of strong-brown loam that has streaks and pockets of light yellowish-brown fine sandy loam. The next layer is 24 inches of strong-brown loam mottled with yellowish brown and yellowish red. Below this to a depth of 90 inches is yellowish-red loam.

Elysian soils are well drained. Permeability is moderate, and available water capacity is medium. These soils have a high potential as pastureland and woodland and a medium potential as cropland.

Elysian soils in Red River County are mapped only in complexes with Bernaldo, Muldrow, and Whakana soils.

Representative profile of Elysian fine sandy loam in

olive yellow and is mottled with light gray. The underlying material to a depth of 80 inches is shale (fig. 4).

Ferris soils are well drained. Permeability is very slow, and available water capacity is high. These soils have a medium potential as pastureland and a low potential as cropland and woodland.

Representative profile of Ferris clay, 3 to 8 percent slopes, eroded, 3.5 miles north of intersection of U.S. Highway No. 82 and Texas Highway No. 37, on Texas Highway No. 37, 2,500 feet east on private road, 30 feet north of road:

Ap—0 to 10 inches, olive-gray (5Y 4/2) clay; weak, fine, blocky structure; extremely hard, very firm; very plastic; few fine roots; few concretions of calcium carbonate; calcareous; moderately alkaline; gradual, smooth boundary.

AC1—10 to 21 inches, olive (5Y 4/3) clay; many, medium, faint, olive (5Y 5/3) mottles; weak, coarse, prismatic structure parting to moderate, fine, blocky; extremely hard, very firm, very plastic; few intersecting slickensides; many shiny pressure faces; worm channels and cracks filled with very dark grayish brown (2.5Y 3/2); about 5 percent concretions of calcium carbonate; calcareous; moderately alkaline; diffuse, wavy boundary.

AC2—21 to 33 inches, light yellowish-brown (2.5Y 6/4) clay; few, coarse, distinct, very dark grayish-brown (2.5Y 3/2) mottles; weak, coarse, prismatic structure parting to moderate, fine, blocky; extremely hard, very firm, very plastic; common intersecting slickensides; worm channels and cracks filled with very dark grayish brown (2.5Y 3/2); about 10 percent concretions of calcium carbonate; calcareous; moderately alkaline; gradual, wavy boundary.

AC3—33 to 49 inches, olive-yellow (2.5Y 6/6) clay; common, fine, distinct, light-gray (5Y 7/1) mottles; weak, medium, prismatic structure; extremely hard, very firm, very plastic; few concretions of calcium carbonate; calcareous; moderately alkaline; diffuse, wavy boundary.

C—49 to 80 inches, stratified, light yellowish-brown (2.5Y 6/4), pale-brown (10YR 6/3), and light-gray (5Y 7/1) shale; few fine masses and concretions of calcium carbonate; calcareous; moderately alkaline.

The solum ranges from 30 to 60 inches in thickness. The A horizon ranges from 5 to 10 inches in thickness. It is olive gray, olive brown, olive, or dark grayish brown. The AC horizon ranges from 24 to 42 inches in thickness. It is olive brown to light yellowish brown, olive yellow, or olive. The C horizon is shaly clay or slightly weathered calcareous shale.

Ferris clay, 3 to 8 percent slopes, eroded (FeD2).—This gently sloping to sloping soil is on convex side slopes. Areas are 10 to 100 acres but average about 30 acres. They are long and narrow. Areas have V-shaped gullies 3 to 5 feet deep, 20 to 30 feet across at the top, and 100 to 300 feet apart.

Included with this soil in mapping are areas of a soil on foot slopes. It is similar to Ferris clay but has a darker, thicker surface layer. Areas of this soil are 3 to 7 acres in size and make up 10 to 20 percent of a few mapped areas. Also included are areas of Houston Black soils, 5 to 10 acres in size, that make up 15 to 20 percent of mapped areas and a few areas of Ellis soils, 3 to 5 acres in size, that make up 5 to 10 percent of some mapped areas.

Runoff is rapid. The hazard of erosion is severe.

About 80 percent of the acreage is used for pasture, and 20 percent is cultivated. Capability unit VIe–2; pasture and hayland group 7B; woodland suitability group not assigned.

Freestone Series

The Freestone series consists of deep, nearly level, loamy, acid soils on high terraces and uplands. These soils formed in loamy sediment. They are on plane to slightly concave positions on the landscape.

In a representative profile the surface layer is fine sandy loam about 10 inches thick. The upper 6 inches is brown, and the lower 4 inches is pale brown. The next layer is 14 inches of yellowish-brown sandy clay loam mottled with gray and yellowish red. The next layer is 14 inches of dark-red sandy clay loam that is mottled with gray and yellowish brown and contains

[redacted]

medium potential as cropland and woodland.

Representative profile of Freestone fine sandy loam

next layer is 18 inches of yellowish-brown sandy clay loam that has gray mottles and streaks of uncoated

[redacted]

The A horizon ranges from 4 to 9 inches in thickness. It is black, very dark gray, very dark grayish brown, or dark brown. It is medium acid to neutral.

The B2g horizon is dark gray, gray, light brownish gray, or olive gray and has few to common, faint or distinct

About 30 percent of the acreage is used for pasture, 20 percent is wooded, and 50 percent is cultivated. Capability unit IIIw–2; pasture and hayland group IB; woodland suitability group 2w6.

Hapludalfs, Loamy

Hapludalfs, loamy, consists of deep, nearly level to

Houston Black Series

The Houston Black series consists of deep, gently

steep Ferris soils, 5 to 10 acres in size, that make up 5 to 10 percent of mapped areas.

Runoff is medium. The hazard of erosion is moderate.

About 60 percent of the acreage is used for pasture, and 40 percent is cultivated. Capability unit IIe–2; pasture and hayland group 7A; woodland suitability

About 25 percent of the acreage is used for pasture, 5 percent is wooded, and 70 percent is cultivated. Capability unit IIw–1; pasture and hayland group 1A; woodland suitability group 1w6.

Kaufman clay, frequently flooded (Kb).—This nearly level soil is in areas on bottom lands. Slopes are 0 to 1

reddish-brown lamellae occur in some pedons. These lamellae are about ⅛ inch thick and total 1 to 1½ inches in thickness.

The B2t horizon is yellowish red, strong brown, or red and has mottles of strong brown or brownish yellow in some profiles. The upper 20 inches is 18 to 30 percent clay.

Kenney loamy fine sand, 2 to 8 percent slopes (KeD).—This gently sloping to sloping soil is on stream divides. Slopes average about 5 percent, and the surface is convex. Areas are irregular in shape. They are 10 to 100 acres but average about 30 acres.

Included with this soil in mapping are areas of Vesey soils, 3 to 10 acres in size, that make up 5 to 10 percent of some mapped areas. Also included are a few areas of Rosalie soils, 10 to 15 acres in size, that make up 10 to 15 percent of some mapped areas.

Runoff is very slow. The hazard of erosion is slight. About 70 percent of the acreage is used for pasture, 15 percent is wooded, and 15 percent is cultivated. Capability unit IIIe–4; pasture and hayland group 9B; woodland suitability group 3s2.

Kiomatia Series

The Kiomatia series consists of deep, gently sloping, sandy, alkaline soils on bottom lands. These soils formed in Recent alluvium.

In a representative profile the surface layer is brown loamy fine sand about 4 inches thick. The underlying material extends to a depth of 60 inches. The upper part is 5 inches of light-brown fine sand, the next part is 6 inches of brown very fine sandy loam, and the lower part is 45 inches of light-brown fine sand.

Kiomatia soils are well drained. Permeability is rapid, and available water capacity is low. These soils have a medium potential as pastureland, a high potential as woodland, and a low potential as cropland.

Representative profile of Kiomatia loamy fine sand, frequently flooded, 1 mile east of Clarksville on U.S. Highway No. 82 to Farm Road No. 114, east on Farm Road No. 114 to English, north on Farm Road No. 1699 to end, north on county road to end, 3 miles north on private road, 200 yards south of Red River, in pasture:

A1—0 to 4 inches, brown (7.5YR 5/4) loamy fine sand; single-grained; slightly hard, very friable; few fine roots; few fine strata of reddish-brown (5YR 5/4) fine sandy loam; calcareous; moderately alkaline; abrupt, smooth boundary.

C1—4 to 9 inches, light-brown (7.5YR 6/4) fine sand; single-grained; loose; common fine and medium strata of reddish-brown (2.5YR 5/4) loamy fine sand and fine sandy loam; calcareous; moderately alkaline; abrupt, smooth boundary.

C2—9 to 15 inches, brown (7.5YR 5/4) very fine sandy loam; single-grained; soft, very friable; few fine and medium strata of dark grayish-brown (10YR 4/2) fine sandy loam; calcareous, moderately alkaline; abrupt, smooth boundary.

C3—15 to 60 inches, light-brown (7.5YR 6/4) fine sand; single-grained; loose; many fine and medium strata of reddish-brown (5YR 5/4) very fine sandy loam and pale-brown (10YR 6/3) loamy fine sand; calcareous; moderately alkaline.

The A horizon ranges from 2 to 10 inches in thickness. It is brown, strong brown, light brown, pink, light reddish brown, reddish brown, or dark reddish gray.

The C horizon is reddish brown, light reddish brown, pink, brown, light brown, or strong brown. It is fine sand or loamy fine sand stratified with loamy very fine sand. In some profiles it is finer-textured.

Kiomatia loamy fine sand, frequently flooded (Ki)...

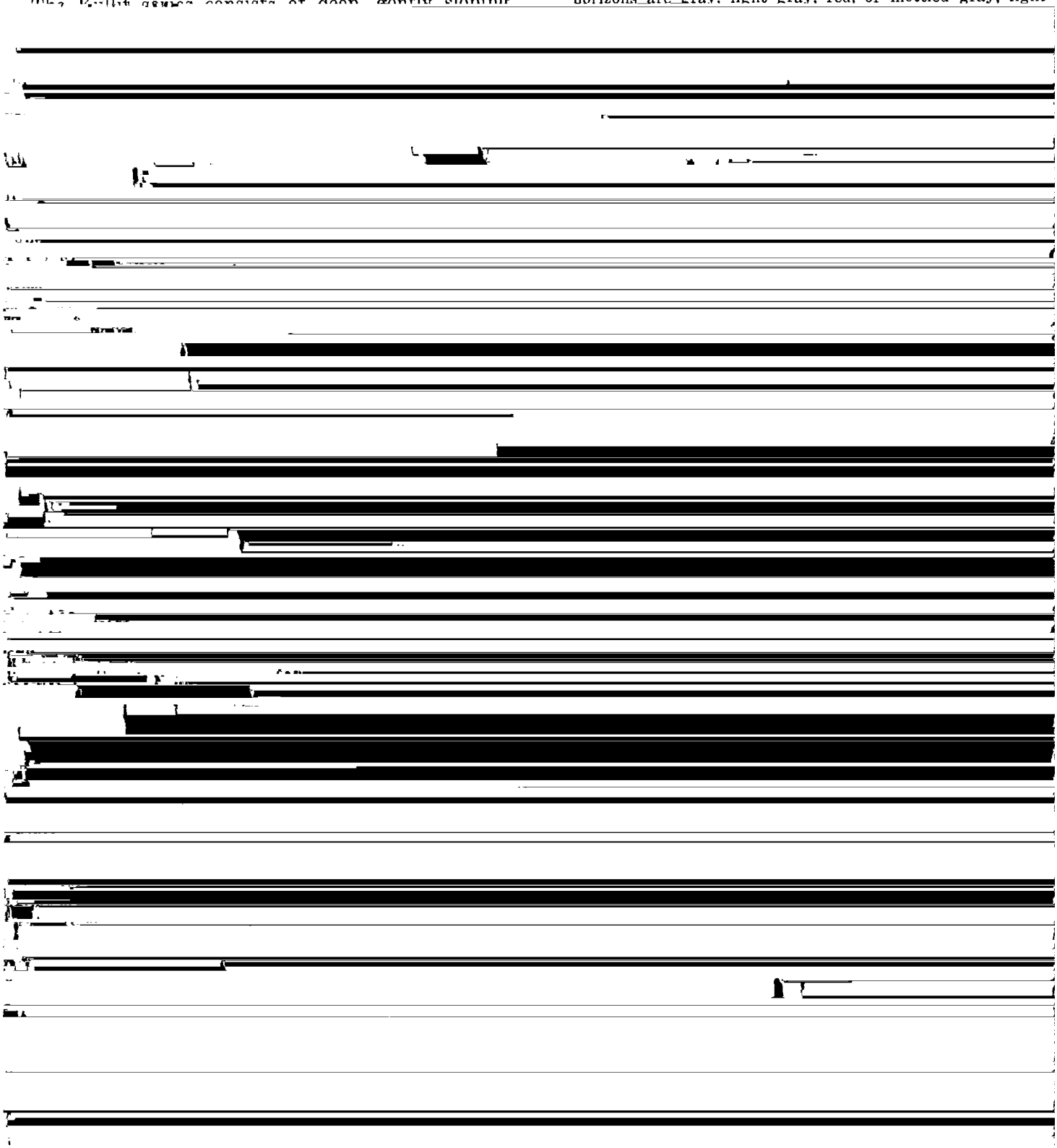
ture and hayland group 3A; woodland suitability group 2w5.

Kullit Series

The Kullit series consists of deep, gently sloping

brown, brown, yellowish brown, or light yellowish brown. It is strongly acid to medium acid.

The B21t and B22t horizons range from 14 to 36 inches in thickness. They are strong brown or yellowish red and have mottles of red, gray, or yellowish red. They are very strongly acid to strongly acid. The B23t, B24t, and B25t horizons are gray, light gray, red, or mottled gray, light



vex. Areas are 5 to 500 acres but average about 100 acres.

This complex is characterized by areas of Kullit fine sandy loam from which circular mounds of Addielou soils protrude in a random pattern. The mounds are so small and the soil pattern so intricate that it was not practical to separate the soils at the scale used in mapping.

B21tg—6 to 39 inches, very dark gray (10YR 3/1) clay; few, fine, faint, dark grayish-brown (2.5Y 4/2) and grayish-brown (10YR 5/2) mottles; moderate, fine and medium, blocky structure; extremely hard, very firm, plastic; few cracks filled with dark grayish-brown (10YR 4/2) loam; few roots; common clay films; few slickensides below a depth of 30 inches; few krotovinas filled with material from A horizon;

about 9 inches thick. It is dark brown in the upper 6 inches and brown in the lower 3 inches. The next layer is 27 inches of red clay. The underlying material to a

narrow. They are 10 to 300 acres but average about 80 acres.

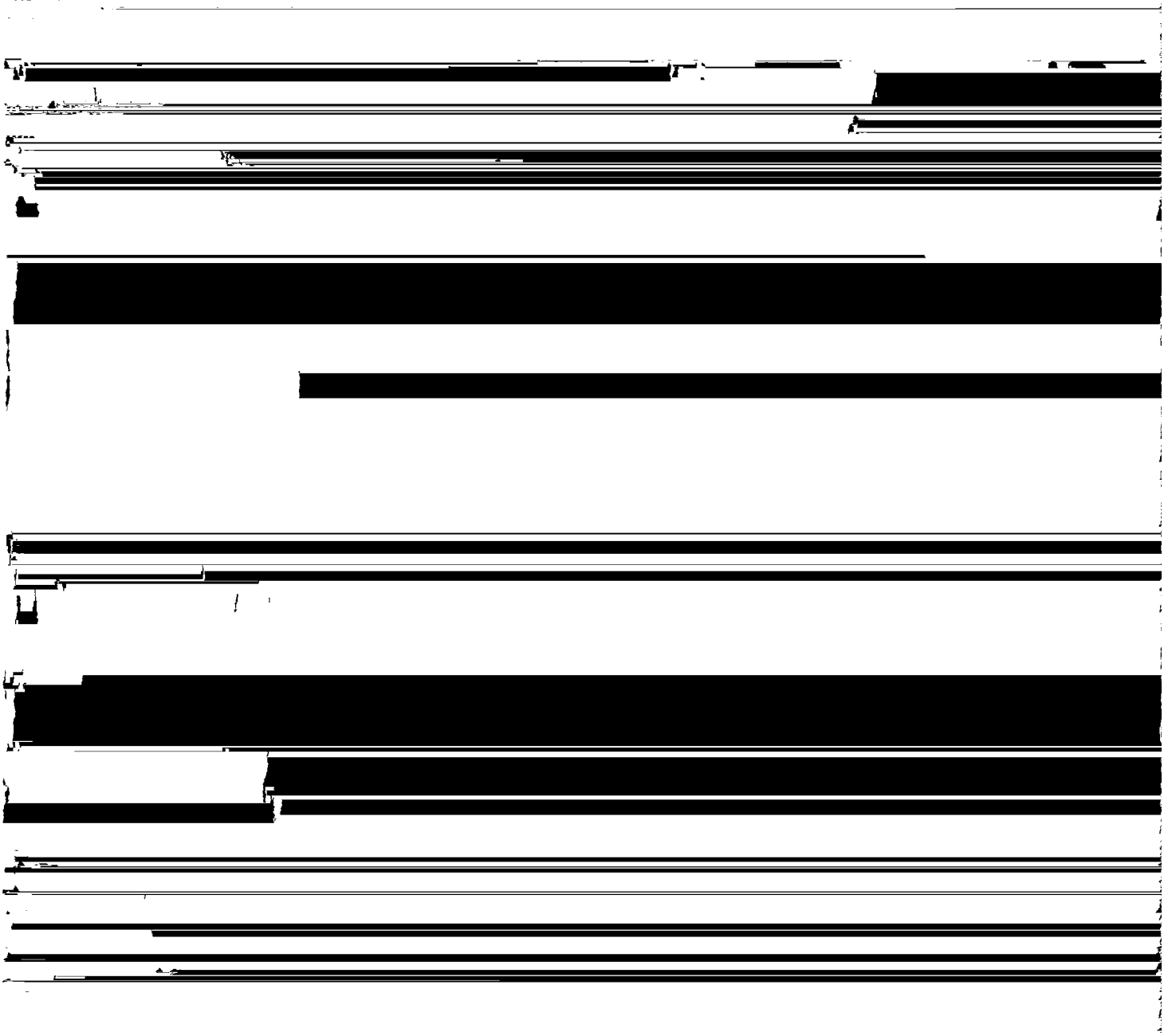
The surface layer is dark grayish-brown loam about

The A horizon ranges in thickness from 2 inches in microridges to about 12 inches in microvalleys. It is dark reddish brown, reddish brown, or dark brown.

The A horizon ranges from 10 to 15 inches in thickness. It is black, very dark gray, very dark grayish brown, very dark brown, or dark brown. It is clay loam or silty clay loam.

soils in capability unit IIw–2; Muldrow part in pasture and hayland group 1A. Elysian part in pasture and hayland group 8C; Muldrow part in woodland suita-

nearly level and is on bottom lands. Slopes are 0 to 1 percent but average 0.5 percent. The surface is plane to weakly concave. Areas are long and narrow and



group 2o7.

Nahatche Series

The Nahatche series consists of deep, nearly level, loamy, acid soils on bottom lands. These soils formed in loamy alluvial sediment.

In a representative profile the surface layer is dark grayish-brown clay loam about 6 inches thick. The next

average about 165 acres. Floods cover 80 to 90 percent of the acreage 2 or 3 times a year for periods of 1 to 3 days, mainly during the growing season.

Included with these soils in mapping are areas of Gladewater soils in depressional areas. These areas are 5 to 20 acres in size and make up 8 to 25 percent of some mapped areas. Also included are a few areas of Thenas soils, 5 to 10 acres in size, that make up 5 to 15 percent of some mapped areas.

Runoff is slow. The hazard of erosion is slight

Oklared fine sandy loam (Of).—This nearly level soil is on bottom lands. Slopes are 0 to 1 percent but average about 0.5 percent. The surface is plane to weakly convex. Areas are irregular in shape. They are 50 to 500 acres but average about 125 acres. This soil has the profile described as representative of the series.

B21g—5 to 9 inches, grayish-brown (10YR 5/2) clay; common, medium and large, distinct, dark yellowish-brown (10YR 4/4) and yellowish-brown (10YR 5/6) mottles; moderate, fine, blocky structure; very hard, firm; very strongly acid; gradual, wavy boundary.

B22tg—9 to 16 inches, grayish-brown (10YR 5/2) clay; common, medium, distinct, yellowish-brown (10YR 5/6)

brown. The next layer is 15 inches of yellowish-red clay loam mottled with very dark gray. The underlying material to a depth of 65 inches is reddish-brown loam.

Redlake soils are moderately well drained. Permeability is very slow, and available water capacity is high. These soils have a medium potential as pastureland and woodland and a high potential as cropland.

Representative profile of Redlake clay, about 22 miles north-northwest of Clarksville to Kiomatia, 1.5 miles north of Kiomatia on Farm Road No. 410, 500 feet west, in pasture:

Ap—0 to 9 inches, dark reddish-brown (5YR 3/4) clay; moderate, fine, granular and subangular blocky structure; very hard, firm, plastic; many roots; calcareous; moderately alkaline; gradual, smooth boundary.

B21—9 to 18 inches, reddish-brown (5YR 4/3) clay; moderate, fine, blocky structure; very hard, firm, plastic; shiny faces on peds; calcareous; moderately alkaline; gradual, smooth boundary.

B22—18 to 40 inches, dark reddish-brown (5YR 3/4) clay; few, fine, faint, reddish-brown (5YR 5/3) mottles; moderate, fine, blocky structure; very hard, firm, plastic; few slickensides; calcareous; moderately alkine; gradual, smooth boundary.

B23—40 to 55 inches, yellowish-red (5YR 4/6) clay loam; few, fine, distinct, very dark gray (5YR 3/1) mottles; moderate, fine, blocky structure; hard, friable; calcareous; moderately alkaline; clear, wavy boundary.

IIC—55 to 65 inches, reddish-brown (5YR 5/4) loam; massive; hard, friable; calcareous; moderately alkaline.

The solum ranges from 30 to 60 inches in thickness.

The A horizon ranges from 5 to 10 inches in thickness. It is dark reddish-gray, reddish-brown, or dark reddish-brown silty clay or very fine sandy loam.

The B2 horizon is reddish brown, yellowish red, or dark reddish brown. The upper part of the B2 horizon is 40 to 60 percent clay. Slickensides occur in most profiles, but they do not intersect.

The C horizon is similar to the B2 horizon in color. It is normally stratified with fine sandy loam, silt loam, clay loam, or clay.

Redlake clay (Rc).—This nearly level soil is on bottom lands that parallel the river and sloughs. Slopes are 0 to 1 percent but average about 0.5 percent. The surface is plane to weakly concave. Areas are long and narrow. They are 25 to 300 acres but average about 65 acres. This soil has the profile described as representative of the series.

Included with this soil in mapping are areas of Roe-

Redlake soils have a thin layer of varying texture deposited on the original clayey surface layer. The variation of thickness and texture is not uniform in size or occurrence.

The surface layer is reddish-brown very fine sandy loam about 10 inches thick. The next layer is 32 inches of dark reddish-brown clay. The underlying material to a depth of about 60 inches is reddish-brown fine sandy loam.

Included with these soils in mapping are narrow depressions of Redlake clay, less than 5 acres in size, that make up 5 to 10 percent of some mapped areas.

Runoff is slow. The hazard of erosion is slight.

About 60 percent of the acreage is used for pasture, 10 percent is wooded, and 30 percent is cultivated. Capability unit IIIw–3; pasture and hayland group 2A; woodland suitability group 3w6.

Rodessa Series

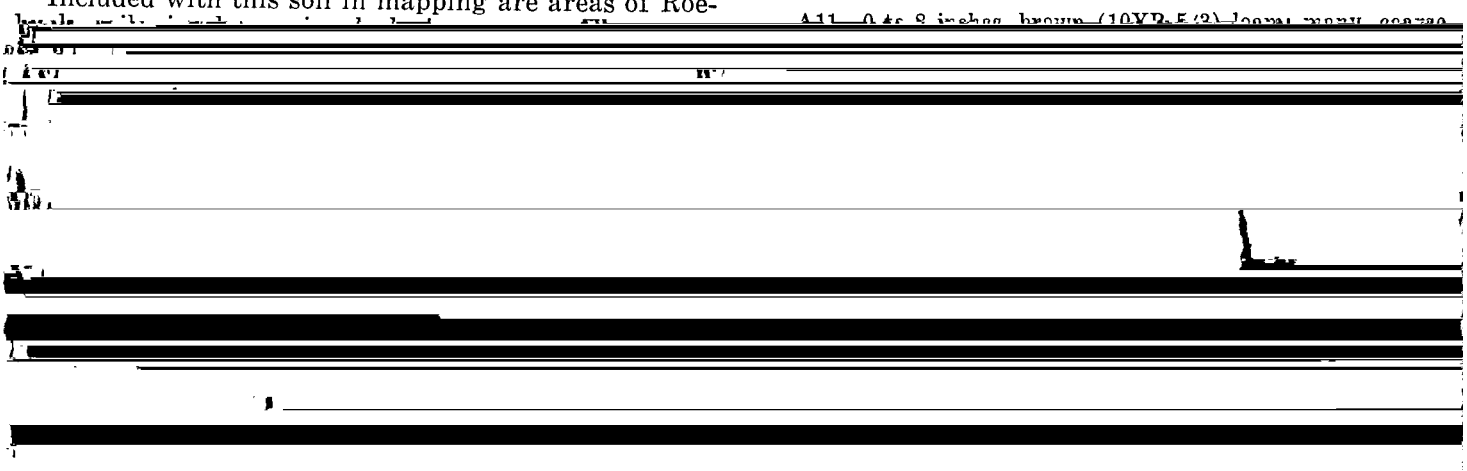
The Rodessa series consists of deep, nearly level, loamy, acid soils on uplands and terraces. These soils formed in clayey sediment.

In a representative profile the surface layer is loam about 18 inches thick. The upper 8 inches is brown, and the lower 10 inches is light yellowish brown. The next layer, in sequence from the top, is 10 inches of light yellowish-brown loam, 3 inches of pale-brown loamy material surrounded by white loam, 5 inches of gray clay that is mottled with red and brown and has white loam coats on the clay particles, and 13 inches of dark reddish-brown clay mottled with dark reddish gray and dark red. Below this to a depth of 72 inches is dark-brown clay mottled with grayish brown and yellowish brown.

Rodessa soils are somewhat poorly drained. Permeability is very slow, and available water capacity is medium. These soils have a medium potential as pastureland, cropland, and woodland.

Rodessa soils in Red River County are mapped only in a complex with Wrightsville soils.

Representative profile of Rodessa loam, in an area of Wrightsville-Rodessa complex, 12.65 miles north of the courthouse in Clarksville to International Paper Company Road No. 32; 0.25 mile west on county road, 100 feet north of road, on mound:



part); common, medium, distinct, strong-brown (7.5YR 5/6) mottles and few, medium, faint, light brownish-gray (10YR 6/2) mottles; weak, fine, and medium, subangular blocky structure; slightly hard, very friable; few woody roots; strongly acid; abrupt, wavy boundary.

B21tg&A'2—31 to 36 inches, gray (10YR 5/1) clay (Bt part) and white (10YR 8/2) loam that coats the top and sides of peds (A'2 part); many, coarse, prominent, dark-red (2.5YR 3/6) mottles and common, medium, distinct, reddish-brown (5YR 4/4) mottles; strong, coarse, blocky structure; extremely hard, very firm; few pressure faces; few vertical cracks filled with gray (10YR 6/1) loam; few fine roots; very strongly acid; gradual, smooth boundary.

B22t—36 to 49 inches, dark reddish-brown (5YR 3/4) clay; common, medium, faint, dark reddish-gray (5YR 4/2) mottles and few, fine, distinct, dark-red (2.5YR 3/6) mottles; moderate, coarse, blocky structure; extremely hard, very firm; many clay films; common slickensides; light yellowish-brown (10YR 6/4) coatings of silt on faces of peds; very strongly acid; gradual, smooth boundary.

B23t—49 to 72 inches, dark-brown (7.5YR 4/4) clay; few, medium, distinct, grayish-brown (10YR 5/2) and yellowish-brown (10YR 5/8) mottles; weak, coarse, blocky structure; extremely hard, very firm; few old cracks filled with light yellowish-brown (10YR 6/4) loam; few slickensides and pressure faces; slightly acid.

The solum ranges from 60 inches to more than 100 inches in thickness.

The A horizon is loam or fine sandy loam and is very strongly acid to slightly acid. The A11 horizon is dark grayish brown, brown, dark yellowish brown, or yellowish brown, or pale brown. The A12 and B1 horizons are light yellowish brown, very pale brown, yellowish brown, or pale brown. The A'2g&B horizon is white, light-gray, gray, light brownish-gray, or grayish brown loam or fine sandy loam. It is very strongly acid to medium acid. The horizon is 60 to 75 percent

feet west of Farm Road No. 410, in north end of depression:

Ap—0 to 12 inches, dark reddish-brown (5YR 3/2) clay that contains a few red (2.5YR 4/6) spots; weak, fine, granular and subangular blocky structure, very hard, firm, plastic; calcareous; moderately alkaline; gradual, smooth boundary.

B2—12 to 34 inches, dark-red (2.5YR 3/6) clay; few to common, fine, distinct, gray (5Y 5/1) mottles; weak, medium, blocky structure; very hard, firm, plastic; few slickensides less than 1 inch across; calcareous; moderately alkaline; gradual, smooth boundary.

C—34 to 96 inches, reddish-brown (5YR 4/4) clay; distinct gray (5Y 5/1) mottles; very hard, firm, plastic; few thin strata of yellowish-red (5YR 4/6) clay loam as much as 3 inches thick; few slickensides 0.5 inch to 1.5 inches across; calcareous; moderately alkaline; gradual boundary.

The A horizon ranges from 10 to 15 inches in thickness. It is dark reddish brown or dark brown.

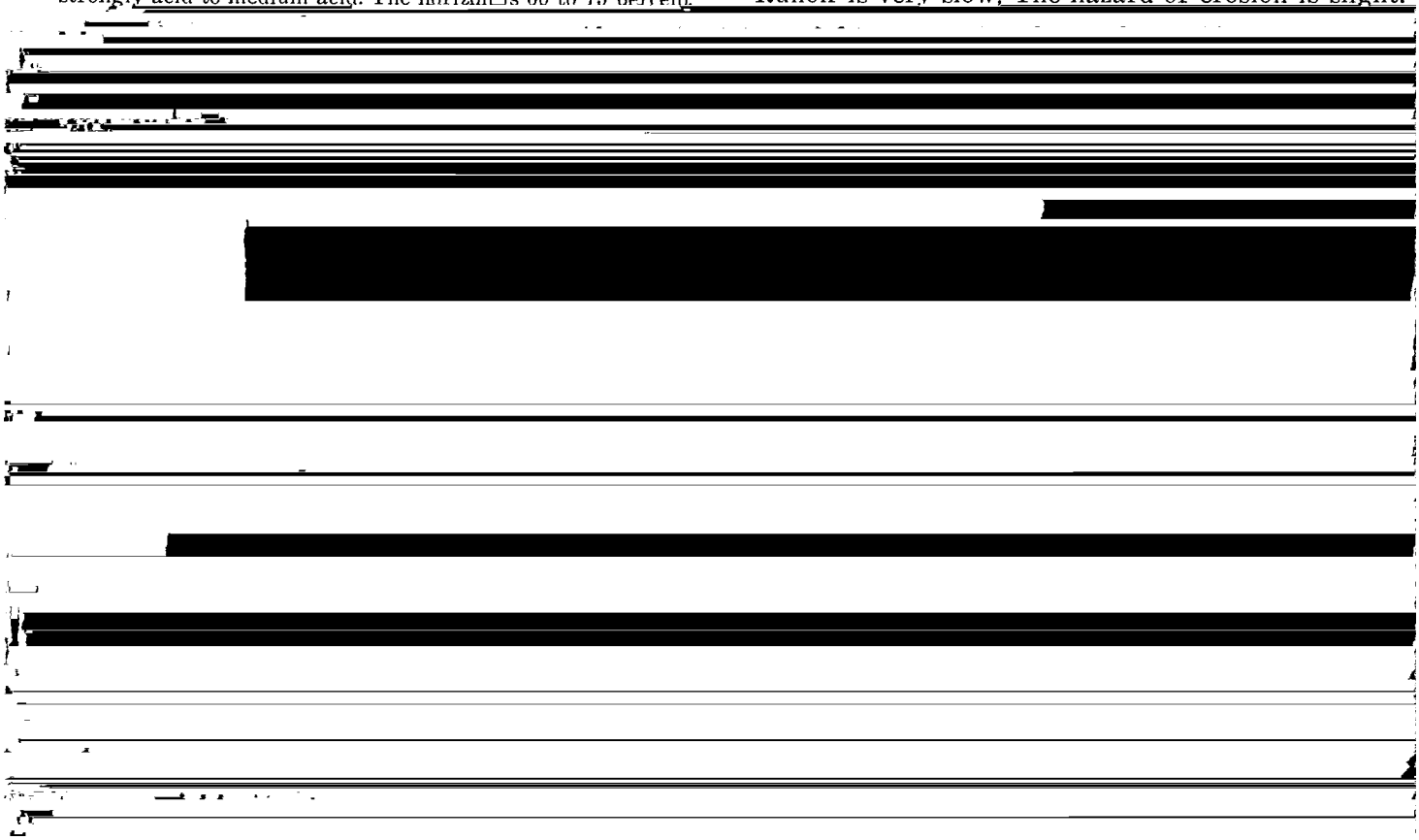
The B2 horizon ranges from 15 to 30 inches in thickness. It is dark red, dark reddish brown, or dark brown. Distinct mottles of gray are above a depth of 20 inches.

The C horizon is reddish brown and has mottles of gray. Strata of silt loam and silty clay loam are common below a depth of 40 inches.

Roebuck clay, calcareous variant (Rf).—This nearly level soil is on bottom lands. Slopes are 0 to 1 percent but average less than 0.5 percent. The surface is concave. Areas are long, narrow, winding sloughs and depressions. They are 5 to 100 acres but average about 35 acres.

Included with this soil in mapping are areas of better drained Redlake soils, 3 to 20 acres in size, that make up 10 to 30 percent of some mapped areas.

Runoff is very slow. The hazard of erosion is slight.



A21—9 to 21 inches, very pale brown (10YR 7/3) loamy fine sand; few, fine, distinct, strong-brown (7.5YR 5/6) mottles; single-grained; loose; few, fine, fibrous roots; few pebbles of quartz 2.5 to 7.5 centimeters in diameter; very strongly acid; clear, smooth boundary.

A22—21 to 31 inches, very pale brown (10YR 7/3) loamy fine sand; single-grained; loose; few, medium, distinct, yellowish-brown (10YR 5/6), brittle spots; few, medium, distinct, black (10YR 2/1) and dark yellowish-brown (10YR 4/4) segregations; few pebbles of quartz; very strongly acid; clear, irregular boundary.

B21t&A2—31 to 46 inches, yellowish-brown (10YR 5/6) sandy clay loam; few, fine, prominent, slightly brittle, red (2.5YR 5/6) mottles; weak, coarse, prismatic structure parting to weak, fine, subangular blocky; hard, friable; gray (10YR 6/1) clay films surround some peds; red (2.5YR 5/6) is in the interior of the peds and is surrounded by yellowish brown (10YR 5/4); surfaces of prisms are gray (10YR 6/1); very pale brown (10YR 7/3) uncoated grains of sand and silt (A2 material) are on some vertical faces of peds and occupy about 10 to 15 percent of the horizontal cross section; very strongly acid; gradual, wavy boundary.

B22t—46 to 74 inches, red (2.5YR 4/6) sandy clay loam; weak, coarse, prismatic structure parting to weak, fine and medium subangular blocky; very hard

Thenas Series

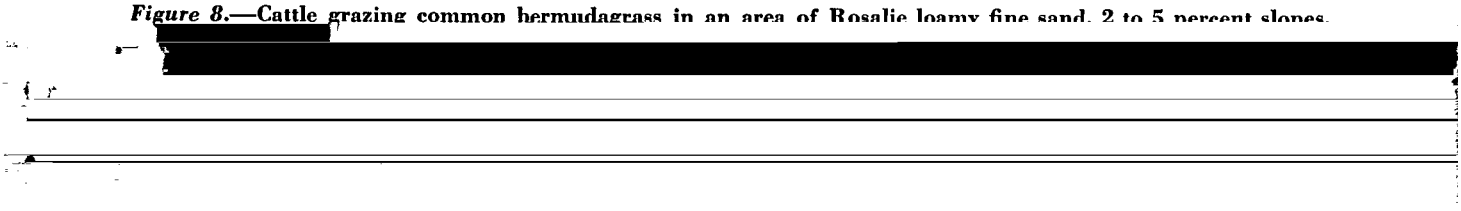
The Thenas series consists of deep, nearly level, loamy, acid soils on bottom lands. These soils formed in loamy alluvial sediment.

In a representative profile the surface layer is brown fine sandy loam about 8 inches thick. Below this is 6 inches of dark-brown very fine sandy loam mottled with light yellowish brown. The next layer is 13 inches of dark yellowish-brown loam mottled with gray. The next layer is 26 inches of pale-brown fine sandy loam mottled with dark yellowish brown and gray. The underlying material to a depth of 72 inches is light brownish-gray fine sandy loam mottled with dark yellowish brown.

Thenas soils are moderately well drained. Permeability is moderate, and available water capacity is high. These soils have a high potential as pastureland and woodland and a low potential as cropland.

Representative profile of Thenas fine sandy loam, frequently flooded, east of Clarksville on U.S. Highway No. 82 to Avery, 6.4 miles south of Avery on Farm Road No. 911, 1 mile northeast on county road, 700

Figure 8.—Cattle grazing common bermudagrass in an area of Rosalie loamy fine sand, 2 to 5 percent slopes.

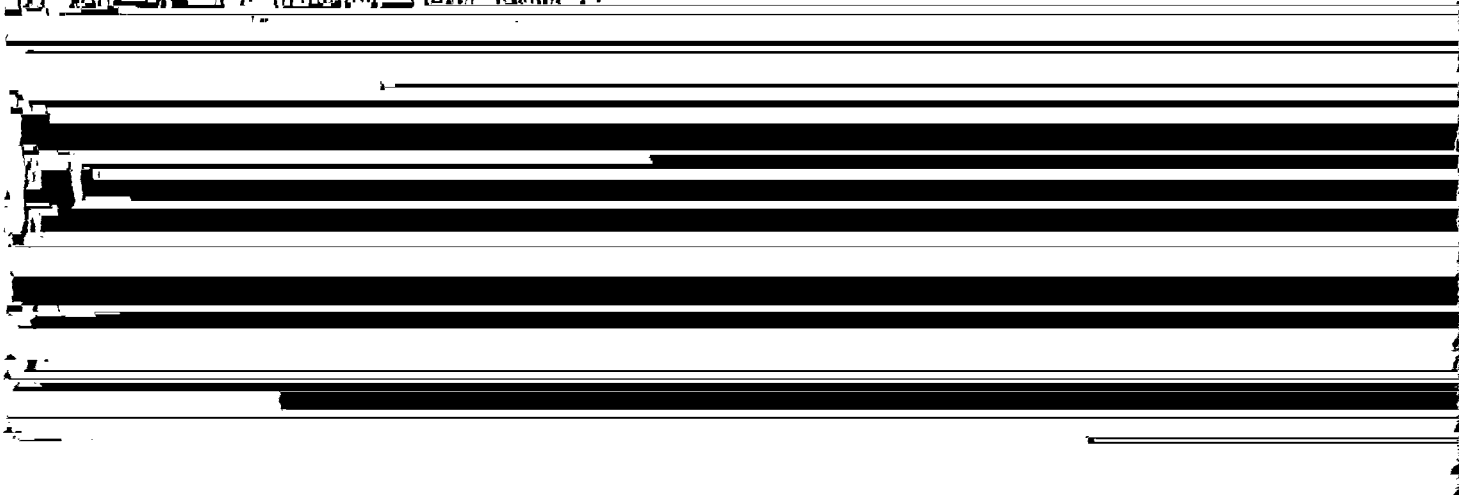


cent of this soil 2 to 4 times a year for periods of 8 to 24 hours.

Included with this soil in mapping are areas of similar soils that are browner. These areas are better

and woodland. Where the hazard of flooding can be controlled, they have a high potential as cropland.

Representative profile of Trinity clay, frequently flooded, 8.4 miles southeast of Clarksville in pasture



The surface layer is black clay about 42 inches thick. The next layer to a depth of about 65 inches is dark-gray clay.

Included with this soil in mapping are areas of Kaufman soils in areas of mixed sediment. Areas are 10 to 15 acres in size and make up 5 to 15 percent of some mapped areas. Also included are areas of Glade-

(2.5Y 4/2) loam as much as 0.25 inch thick; few thin strata of very dark gray (10YR 3/1) silty clay below a depth of 40 inches; massive; hard, friable; few fine roots; calcareous; moderately alkaline.

The solum ranges from 10 to 40 inches in thickness. It is loam, very fine sandy loam, silty clay loam, or clay loam.

The A horizon is dark grayish brown to light brownish gray, brown to pale brown, dark yellowish brown, or olive brown to light yellowish brown. Below the A horizon, bed

faces of peds; few uncoated grains of sand; few pebbles of quartz 2 to 5 millimeters in diameter; slightly acid; gradual, smooth boundary.

B23t&A'2—52 to 59 inches, reddish-yellow (7.5YR 6/6) loam; few, fine, distinct, red (2.5YR 4/6) and light-gray (10YR 7/1) mottles; common light-gray (10YR 6/1) silt coatings 0.5 to 2 millimeters thick on faces of peds; weak, fine, subangular blocky structure; hard, friable; few fine pores; patchy clay films and grains of sand bridged with clay; about 5 percent pockets of uncoated grains of sand; medium acid; gradual, smooth boundary.

B3t—59 to 68 inches, red (10R 4/8) sandy loam; many, coarse, prominent, light yellowish-brown (10YR 6/4) mottles and few, fine, distinct, reddish yellow (7.5 YR 6/6) mottles; weak, medium, subangular blocky structure; slightly hard, very friable; most grains of sand bridged and coated with clay; few to common uncoated grains of sand; few iron-enriched concretions about 5 millimeters in diameter; strongly acid.

The solum ranges from 50 inches to more than 70 inches in thickness.

The A horizon ranges from 20 to 36 inches in thickness. It is neutral to medium acid. The Ap horizon is dark brown, brown, or yellowish brown. The A2 horizon is brown, light brown, strong brown, reddish yellow, yellowish brown, or brownish yellow.

The upper 20 inches of the Bt horizon is sandy clay loam or clay loam containing 18 to 30 percent clay. The B2t horizon is dark red, red, yellowish red, brown, strong brown, or reddish yellow and has mottles of brownish yellow, strong brown, yellowish brown, yellowish red, and red in some profiles. It is strongly acid to slightly acid. The B3t horizon is red, yellowish red, or pink. It is sandy loam, loam, fine sandy loam, or loamy fine sand and is strongly acid to neutral.

Vesey fine sandy loam, 3 to 8 percent slopes (VeD).—This gently sloping to sloping soil is on terraces. Slopes average about 4 percent, and the surface is convex. Areas are irregularly shaped ridges. They are 7 to 40

Runoff is medium. The hazard of erosion is moderate.

About 35 percent of the acreage is used for pasture, and 65 percent is wooded. Capability unit VIe–3; pasture and hayland group 8D; woodland suitability group 3o1.

Waskom Series

The Waskom series consists of deep, nearly level, loamy, acid soils on terraces. These soils formed in loamy alluvial sediment.

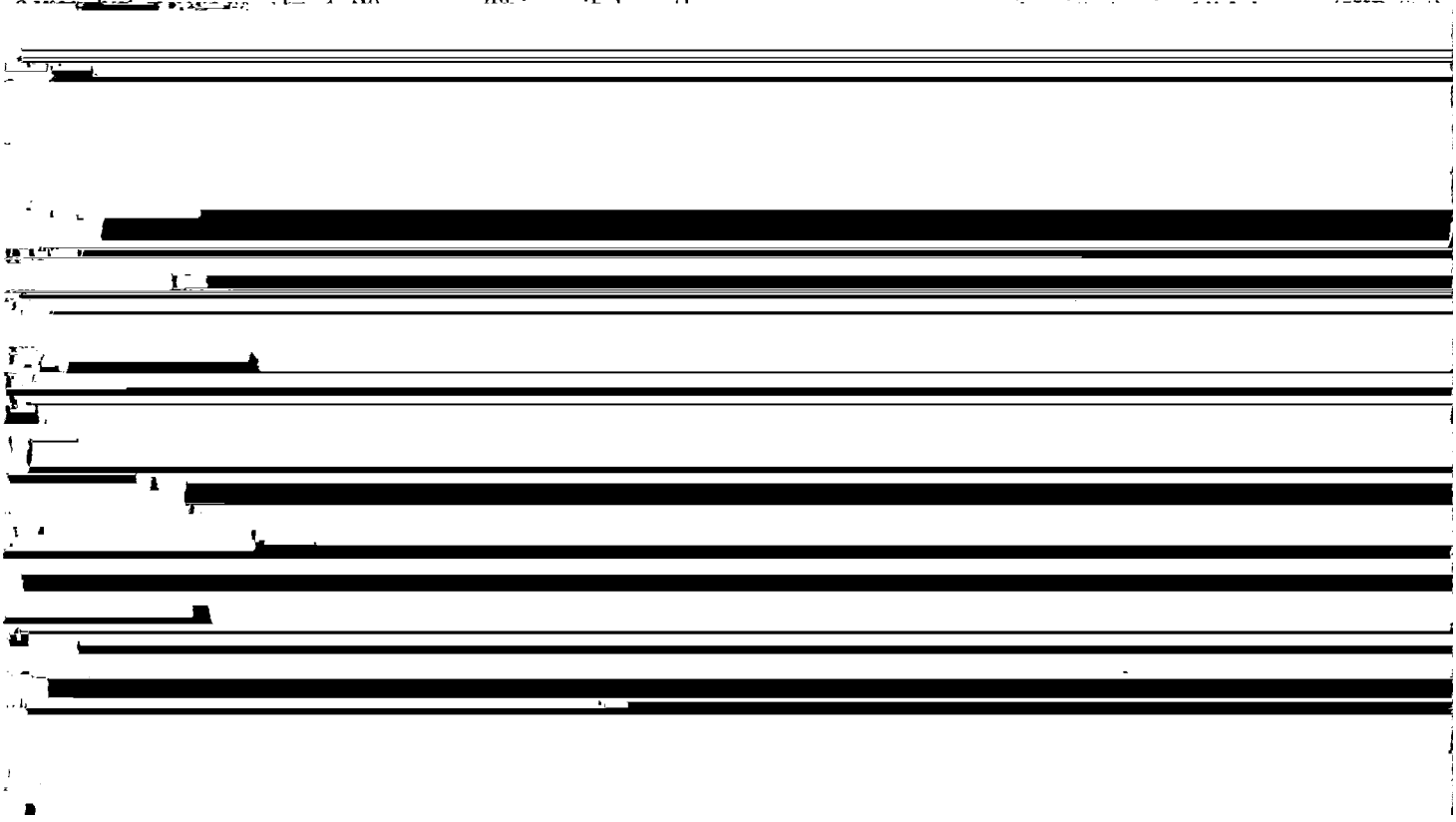
In a representative profile the surface layer is very dark grayish-brown loam about 15 inches thick. It is mottled with reddish brown in the lower 8 inches. The next layer is 17 inches of dark-brown clay loam mottled with reddish brown, dark grayish brown, and brown. The next layer is 20 inches of sandy clay loam mottled with brown, yellowish brown, strong brown, and grayish brown. Below this to a depth of 80 inches is sandy clay loam mottled with yellowish brown, grayish brown, and strong brown.

Waskom soils are moderately well drained. Permeability is moderately slow, and available water capacity is high. These soils have a high potential as pastureland, cropland, and woodland.

Representative profile of Waskom loam, 17.5 miles north of Clarksville on Texas Highway No. 37, 2 miles west on Farm Road No. 195, 11.5 miles northwest on Farm Road No. 410, 1,300 feet south of road, in field:

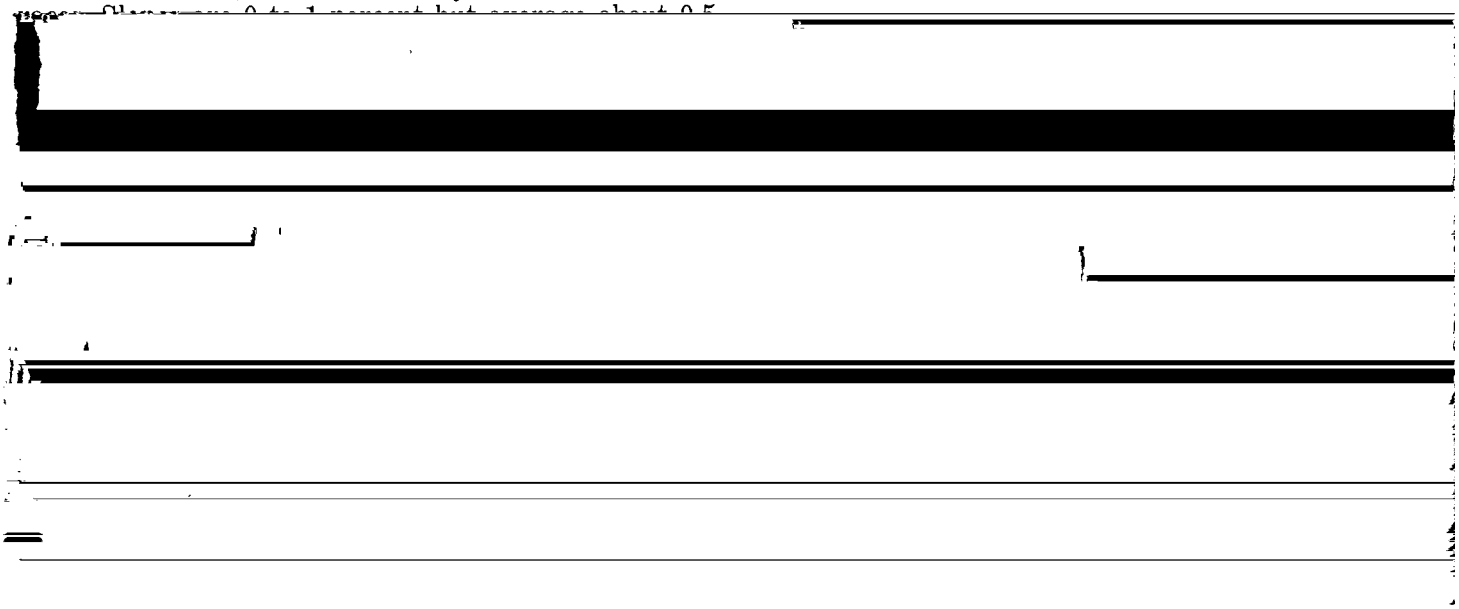
Ap—0 to 7 inches, very dark grayish-brown (10YR 3/2) loam; moderate, fine, granular structure; hard, friable; many fine roots; slightly acid; clear, smooth boundary.

A12—7 to 15 inches, very dark grayish-brown (10YR 3/2)



dark grayish brown, grayish brown, brown, dark yellowish brown, or reddish brown. It is loam, clay loam, or silty clay loam and is slightly acid to mildly alkaline. The B22t horizon typically is mottled dark yellowish brown, brown, dark grayish brown, grayish brown, reddish brown, or yellowish brown. Mottles of yellowish brown, brown, grayish brown, strong brown, or yellowish red are also common. This horizon is loam, clay loam, silty clay loam, or sandy loam and is slightly acid to mildly alkaline. The B3 horizon is mottled grayish brown to light brownish gray, brown, strong brown, yellowish brown, red, and gray. It is loam, sandy clay loam, clay loam, or silty clay loam and is neutral to moderately alkaline.

Waskom loam (Wa).—This nearly level soil is on ter-



percent. The surface is plane to weakly convex. Areas are irregular in shape. They are 15 to 100 acres but average about 40 acres.

Included with this soil in mapping are areas of Hapludalfs, loamy, 2 to 10 acres in size, that make up 5 to 15 percent of some mapped areas. Also included are areas of Muldrow soils in somewhat poorly drained positions. These areas are 2 to 8 acres in size and make up about 5 percent of some mapped areas.

Runoff is slow. The hazard of erosion is slight.

About 25 percent of the acreage is used for pasture, and 75 percent is cultivated. Capability unit IIw–2; pasture and hayland group 2A; woodland suitability group 2w5.

Whakana Series

The Whakana series consists of deep, nearly level to sloping, loamy, acid soils on terraces. These soils formed in loamy alluvial sediment.

In a representative profile the surface layer is brown loam about 9 inches thick. The next layer is brown loam 5 inches thick. The next layer is 10 inches of yellowish-red clay loam mottled with red. It has pockets of strong-brown loamy sand. The next layer is 10 inches of brown clay loam mottled with red and dark reddish brown. Below this is 12 inches of dark-red loam that has coatings of clean sand. The next layer is 17 inches of red loam that contains common streaks of uncoated sand on vertical faces. Below this to a

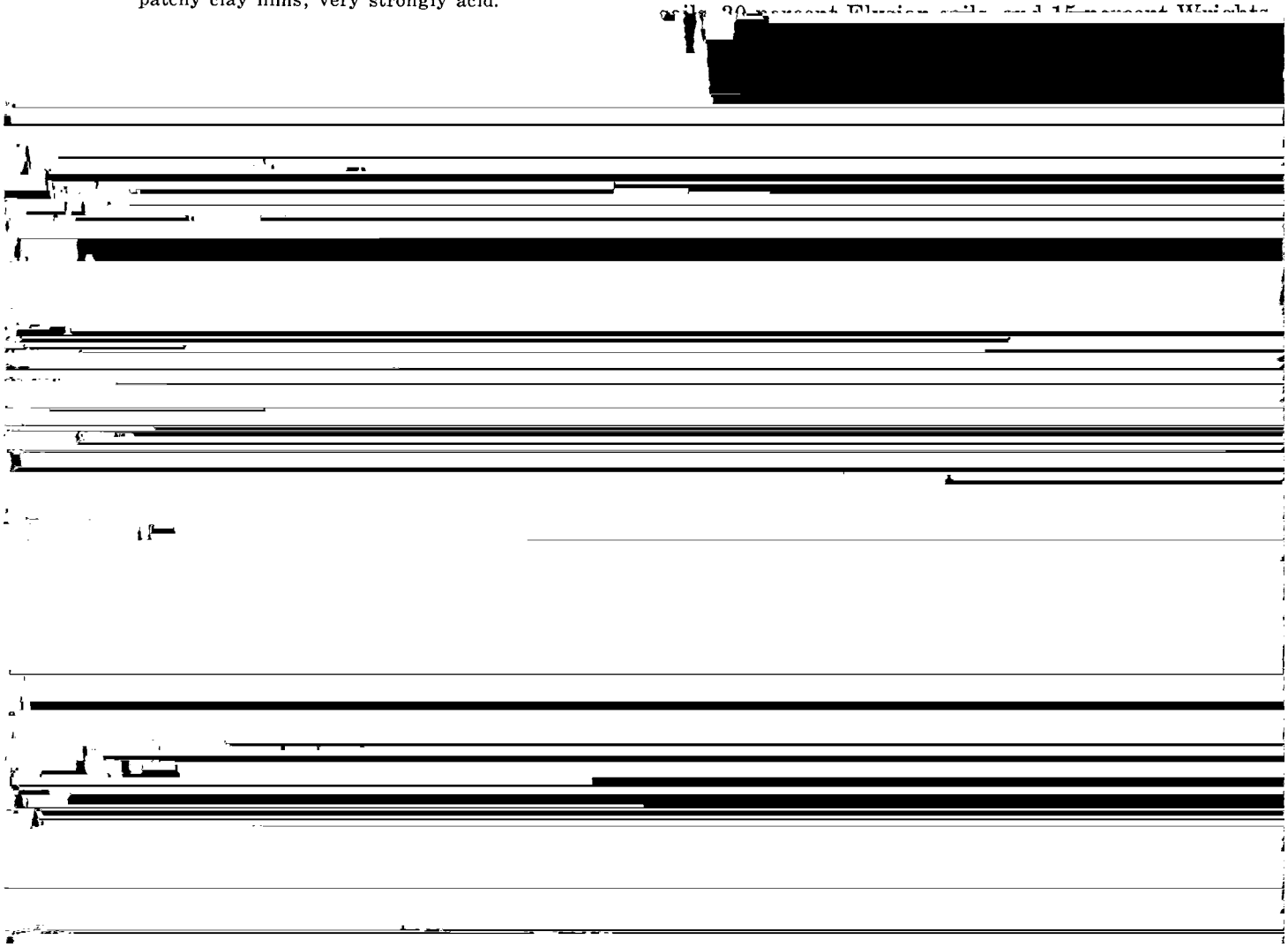
diameter, on faces of prisms; strongly acid; clear, wavy boundary.

B23t—34 to 46 inches, dark-red (2.5YR 3/6) loam; weak, coarse, prismatic structure parting to weak, medium, blocky and subangular blocky; hard, slightly brittle; few fine roots confined along the faces of peds; few fine and medium voids, some lined with clay; thick clay films on faces of some peds; some faces of peds are coated with brown (7.5YR 5/4) loamy sand 2 to 10 millimeters thick; few black (N 2/0) concretions 1 to 3 millimeters in diameter; very strongly acid; clear, irregular boundary.

B24t&A'2—46 to 63 inches, red (2.5YR 4/6) loam; weak, coarse, prismatic structure parting to weak, medium, subangular blocky; very hard, slightly brittle in 10 to 15 percent of the matrix; few fine roots in gray (10YR 6/1) zones; peds have red (2.5YR 4/6) sandy clay loam interiors and dark-red (2.5YR 3/6) clay coatings; faces of prisms coated with gray (10YR 6/1) sandy clay about 1 millimeter thick; 20 to 30 percent white (10YR 8/1) streaks and tongues of loamy sand (A'2 material), 2 to 5 centimeters and tapering to 5 to 10 millimeters; common vesicles lined with clay; very strongly acid; diffuse, irregular boundary.

B25t&A'2—63 to 80 inches, yellowish-red (5YR 4/6) sandy clay loam; many, coarse, faint, red (2.5YR 4/6) mottles; weak, medium, subangular blocky structure; very hard, friable; about 10 percent gray (10YR 6/1) loamy sand (A'2 material); common, patchy clay films; very strongly acid.

***Figure 10.*—Cattle on Pensacola bahiagrass. The soil is Whakana loam, 3 to 8 percent slopes.**



Runoff is slow. The hazard of erosion is slight.

About 61 percent of the acreage is used for pasture, 30 percent is wooded, and 9 percent is cultivated. Capability unit I–1; pasture and hayland group 8C; woodland suitability group 2o7.

Woodtell Series

The Woodtell series consists of deep, gently sloping to strongly sloping, loamy, acid soils on uplands. These soils formed in stratified loamy to clayey material and shale.

In a representative profile the surface layer is dark grayish-brown fine sandy loam about 6 inches thick. The next layer is 6 inches of yellowish-red clay mottled with light yellowish brown. The next layer is 17 inches of red clay mottled with gray and yellowish red. The next layer is 16 inches of yellowish-brown clay loam mottled with gray and red. The underlying material to a depth of 72 inches is stratified light olive-gray and gray sandy clay loam and yellowish-brown clay loam (fig. 11).

Woodtell soils are moderately well drained. Permeability is very slow, and available water capacity is high. These soils have a medium potential as pastureland and woodland and a low potential as cropland.

Representative profile of Woodtell fine sandy loam, 5 to 12 percent slopes, 8.4 miles south of intersection, in Clarksville, of U.S. Highway No. 82 and Farm Road No. 909, 1.9 miles east on private road, and 50 feet north, in pasture:

Ap—0 to 6 inches, dark grayish-brown (10YR 4/2) fine sandy loam; few, fine, distinct, strong-brown (7.5YR 5/6) mottles; weak, fine, granular structure; hard, friable; few roots; few worm casts; very strongly acid; clear, smooth boundary.

B21t—6 to 12 inches, yellowish-red (5YR 4/8) clay; few, fine, distinct, light yellowish-brown (10YR 6/4) streaks and mottles that increase in number with depth; moderate, fine, subangular blocky structure; very hard, very firm, plastic; common roots; continuous clay films; few krotovinas filled with material from A horizon; very strongly acid; gradual, wavy boundary.

B22t—12 to 29 inches, red (2.5YR 4/8) clay; many, medium, distinct, gray (10YR 6/1) mottles; few yellowish-red (5YR 4/8) streaks; weak, fine, blocky structure; very hard, very firm, plastic; continuous clay films; few slickensides; very strongly acid; gradual, smooth boundary.

B23t—29 to 45 inches, yellowish-brown (10YR 5/8) clay loam; many, medium, prominent, gray (10YR 6/1) mottles and few, coarse, prominent, red (2.5YR 4/8) mottles; weak, coarse, blocky structure; very hard, firm, plastic; few slickensides; few white (10YR 8/2) neutral salts; strongly acid; gradual, smooth boundary.

C—45 to 72 inches, stratified, light olive-gray (5Y 6/2) and gray (10YR 5/1) sandy clay loam and yellowish-brown (10YR 5/6) clay loam; medium, platy structure; hard, firm; few flattened roots; few black specks; slightly acid.

The solum ranges from 35 inches to about 65 inches in thickness.

The A horizon ranges from 4 to 9 inches in thickness. It is dark grayish brown to grayish brown, dark brown, or dark yellowish brown and has few fine mottles of strong brown. It is very strongly acid to slightly acid. The boundary between the A and Bt horizons ranges from abrupt to clear and from smooth to wavy, and the textural change is abrupt.

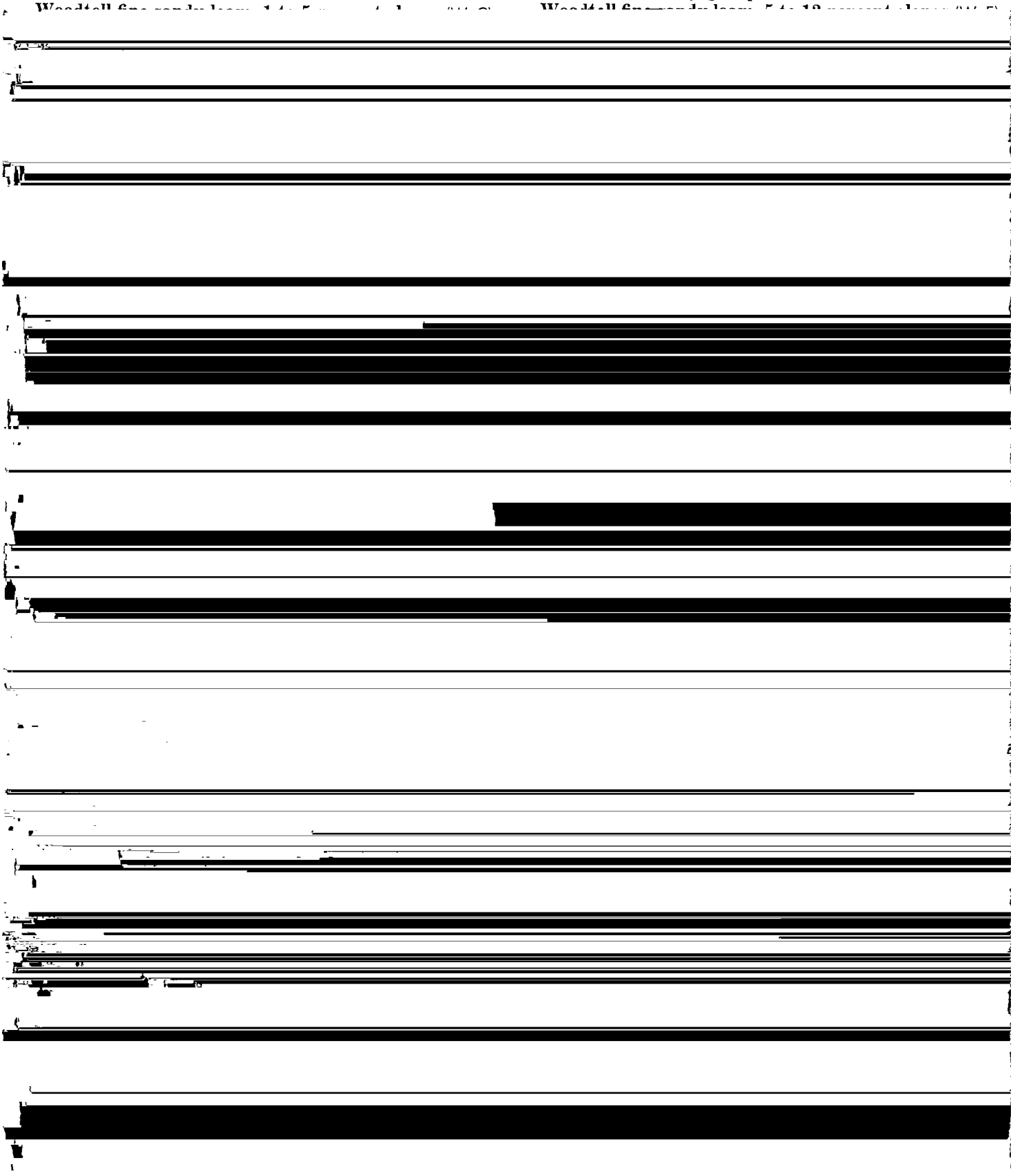
***Figure 11.*—Profile of Woodtell fine sandy loam, 1 to 5 percent slopes.**

The B2t and B22t horizons are red or yellowish red and have few to common mottles in shades of gray, brown, yellow, and red. The number of gray mottles increases with depth. The horizons are 40 to 60 percent clay. They are very strongly acid or strongly acid. The B23t horizon is clay, clay loam, sandy clay, or sandy clay loam mottled with shades of gray or yellowish brown, red, and grayish brown. The clay content decreases 20 percent within 60 inches of the surface, or the solum is less than 60 inches thick. This horizon is very strongly acid or strongly acid.

The C horizon is stratified shale, shaly clay, sandy loam, loam, sandy clay loam, or clay loam mottled in shades of

gray, yellow, brown, or olive. It is very strongly acid to slightly acid.

pability unit IIIe–1; pasture and hayland group 8A; woodland suitability group 4c2.



In a representative profile the surface layer is very fine sandy loam about 11 inches thick. The upper 2 inches is dark grayish brown, and the lower 9 inches is light gray and is mottled with dark yellowish brown. The next layer is 40 inches of gray clay mottled with

dessa soils protrude in a random pattern. The mounds are so small and the soil pattern so intricate that it was not practical to separate the soils at the scale used in mapping (fig. 13). The mounds are 1.5 to 3 feet high, 35 to 70 feet in diameter, and 100 to 200 feet

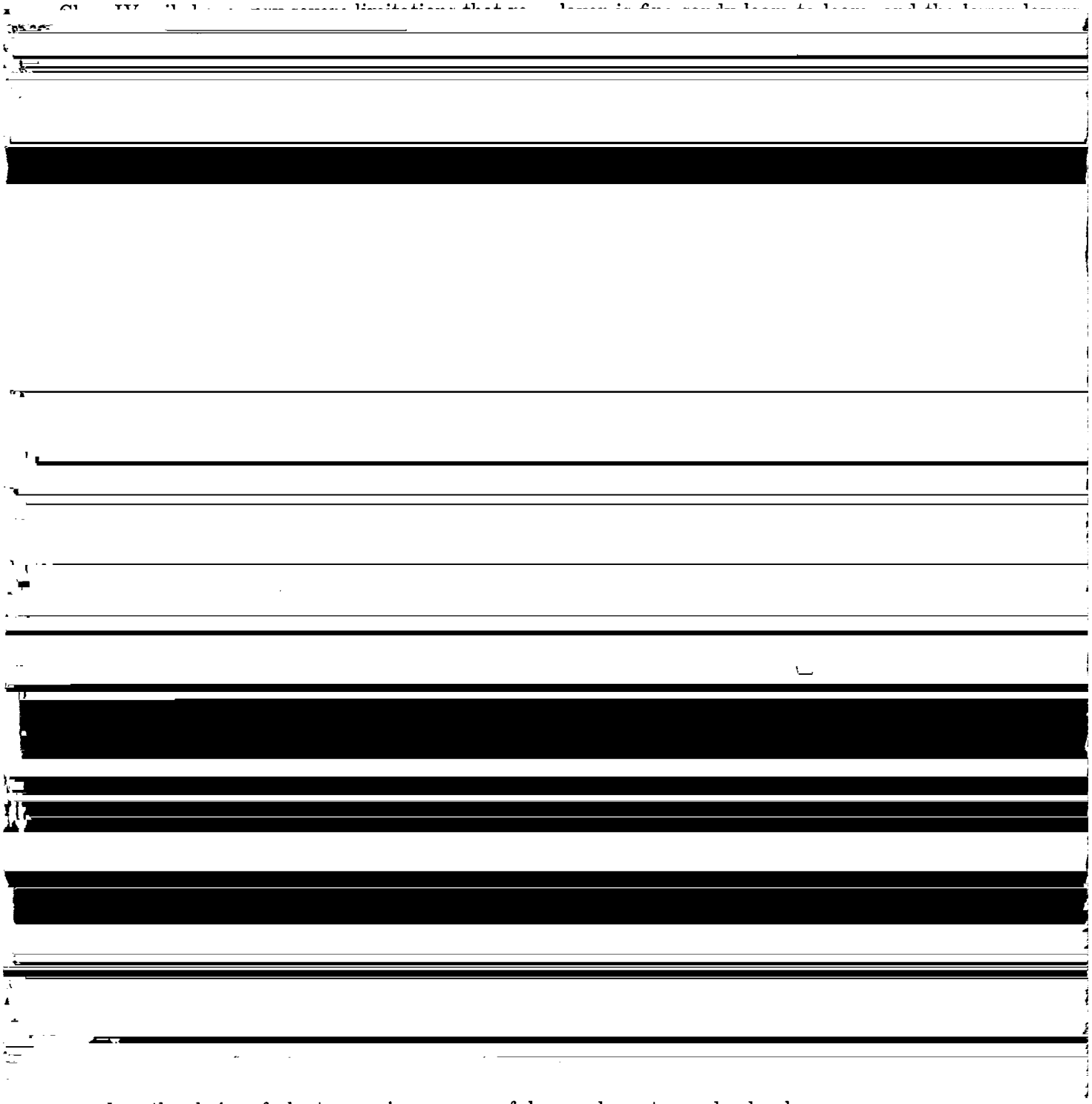
Figure 13.—**Area of Wrightsville-Rodessa complex. The mounds are Rodessa loam, and the flat areas are Wrightsville very fine sandy loam.**

Use of cover crops.—Planting crops that provide cover on the soil helps to protect against erosion between the time of harvest and the time of planting the next crop. Among crops suitable for most soils in the county are small grain, hairy vetch, crimson clover, and a mixture of annual legumes and grasses.

Maintenance of soil fertility.—In Red River County, crops respond to addition of fertilizer. Using other

take into consideration possible but unlikely major reclamation projects; and it does not apply to rice, horticultural crops, or other crops requiring special management.

Those familiar with the capability classification can infer from it much about the behavior of soils when used for other purposes, but this classification is not a substitute for interpretations designed to show suit-



duce the choice of plants, require very careful management, or both.

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use largely to pasture, woodland, or wildlife habitat.

Class VI soils have severe limitations that make them generally unsuited to cultivation and limit their use largely to pasture, woodland,

are loam to sandy clay loam.

Cotton, corn, soybeans, and grain sorghum are the main crops.

Maintaining fertility, the content of organic matter, and tilth are the main concerns in management. Returning crop residue to the soil and growing legumes and other cover crops and soil-improving crops help to meet these needs. These soils respond well to nitrogen and phosphorus fertilizers. In places lime is needed for

Controlling excess water, maintaining tilth and the content of organic matter, and improving permeability are the main concerns in management. Returning crop residue to the soil and growing deep-rooted crops help to improve permeability. A drainage system helps to remove excess water. Nitrogen and phosphorus fertilizers are needed, but lime is not.

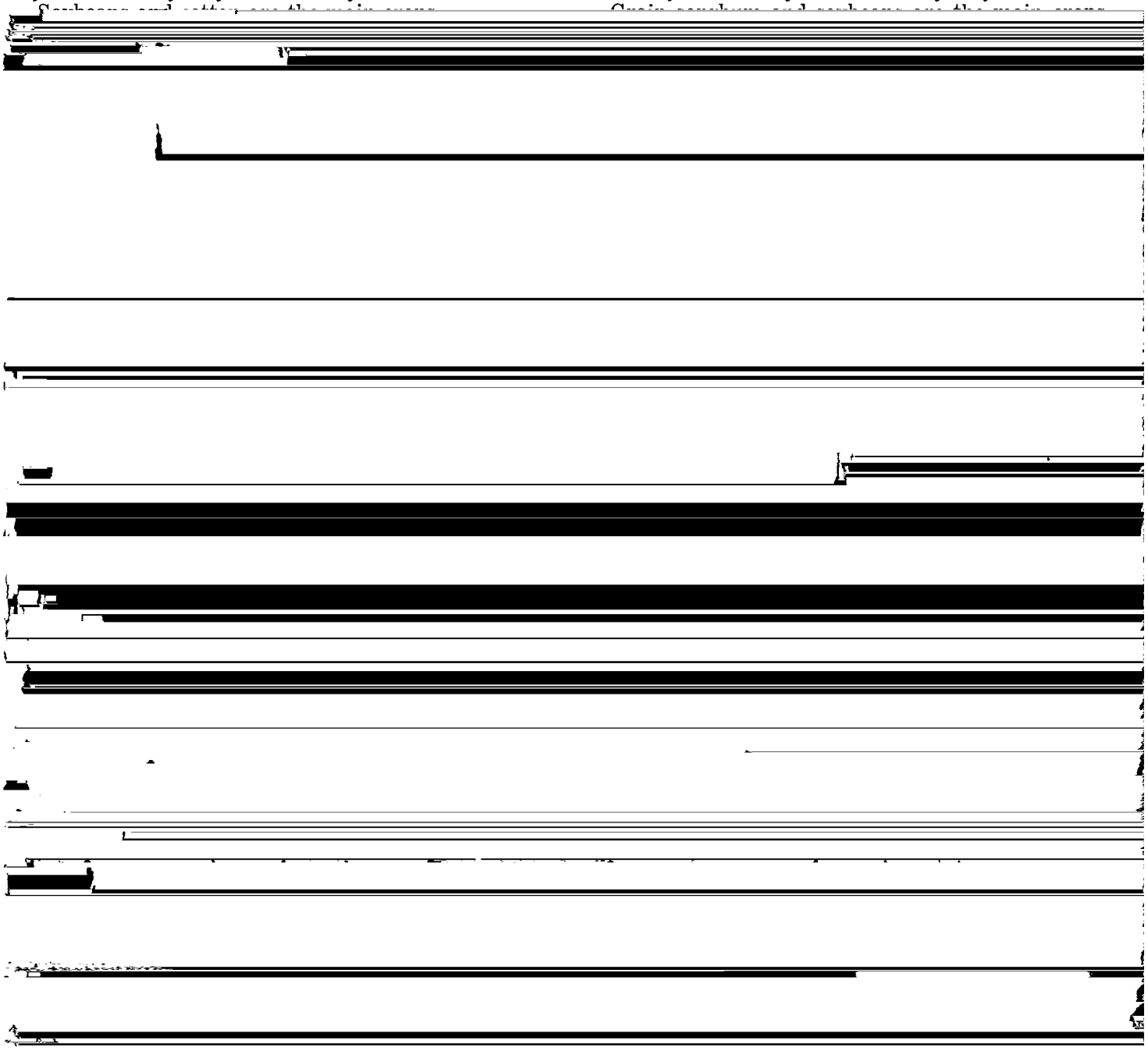
CAPABILITY UNIT IIw-2

In this unit are deep, nearly level, acid soils that are somewhat poorly drained to well drained and moderately permeable to very slowly permeable. The surface layer is fine sandy loam to silty clay loam, and the lower layers are sandy clay loam to clay.

Controlling erosion, maintaining the content of organic matter, and improving permeability are the principal concerns in management. Returning crop residue to the soil and growing cover crops and soil-improving crops help to meet these needs. Contour farming and terraces are needed, but some areas are difficult to terrace. These soils respond to commercial fertilizers. Lime is needed in places.

CAPABILITY UNIT IIIe-2

In this unit are deep, gently sloping to sloping, acid soils that are well drained and moderately permeable. The surface layer is loam to fine sandy loam, and the lower layers are clay loam to sandy clay loam.



to improve tilth and to control erosion. Terraces and contour farming are needed. This soil responds to nitrogen and phosphorus fertilizers. In places lime is needed for some crops.

CAPABILITY UNIT IIIw-1

Mabank fine sandy loam, 0 to 1 percent slopes, is the only soil in this unit. It is a deep, nearly level, acid soil that is somewhat poorly drained and very slowly permeable. The surface layer is fine sandy loam, and the lower layers are clay.

Cotton, soybeans, and corn are the main crops.

Maintaining fertility and the content of organic matter and providing drainage are the main concerns in management. Returning crop residue to the soil and growing deep-rooted crops help to open up this soil. Correct orientation of rows and use of a drainage system help to drain excess water. Nitrogen and phos-

for some crops.

CAPABILITY UNIT IIIw-2

In this unit are deep, nearly level to gently sloping, acid to alkaline soils that are moderately well drained

growing cover crops and soil-improving crops help to meet these needs. Frequent applications of complete fertilizers are needed. In places lime is needed.

CAPABILITY UNIT IVe-1

In this unit are moderately deep to deep, gently sloping, alkaline to acid soils that are well drained to moderately well drained and very slowly permeable. The surface layer is clay loam to clay, and the lower layers are clay.

Soybeans and grain sorghum are the main crops.

Controlling erosion and improving the content of organic matter, tilth, and fertility are the main concerns in management. Returning crop residue to the soil and growing deep-rooted cover crops and soil-improving crops help to meet these needs. Terraces and contour farming help to control erosion. Nitrogen and phosphorus fertilizers are needed.

CAPABILITY UNIT IVw-1

In this unit are deep, nearly level, acid soils that are poorly drained to somewhat poorly drained and very slowly permeable. The surface layer is very fine sandy loam to silty clay, and the lower layers are clay.

Figure 14.—**A drainage system being constructed on an area of Wrightsville-Rodessa complex.**

CAPABILITY UNIT VIe-1

In this unit are deep, sloping to strongly sloping, acid soils that are moderately well drained to well drained and very slowly permeable. The surface layer is fine sandy loam to loam, and the lower layers are clay.

These soils are not suited to crops but are moderately well suited to use for pasture, woodland, recreation, and wildlife habitat.

CAPABILITY UNIT VIe-2

In this unit are moderately deep to deep, gently sloping to sloping, alkaline soils that are well drained and moderately permeable to very slowly permeable. These soils are eroded. The surface layer and lower layers are loam to clay.

These soils are not suited to crops but are moderately well suited to use for pasture, woodland, recreation, and wildlife habitat.

CAPABILITY UNIT VIe-3

Vesey fine sandy loam, 8 to 20 percent slopes, is the only soil in this unit. It is a deep, strongly sloping to moderately steep, acid soil that is well drained and moderately permeable. The surface layer is fine sandy loam, and the lower layers are clay loam.

This soil is not suited to crops but is suited to use for pasture, woodland, recreation, and wildlife habitat.

Predicted yields

Table 2 shows predicted average yields per acre of the principal crops grown in the county. The predictions are based on estimates made by farmers, soil scientists, and others who have knowledge of yields in the county and on information taken from research data. The predicted yields are average yields per acre that can be expected by good commercial farmers at the level of management that tends to produce the highest economic returns.

The predicted yields are given only for dryland soils because widespread irrigation is not practical in the county. Not included in this table are soils that are used only for woodland, wildlife habitat, or recreation.

Crops other than those shown in table 2 are grown in the county, but the predicted yields are not included in the table, because the acreage is too small or reliable data on yields are not available.

TABLE 2.—*Predicted yields per acre of principal dryfarmed crops*

[Absence of data indicates crop is not suited to the soil or is not commonly grown on it]

Soil series and map symbols	Corn	Cotton (lint)	Grain sorghum	Oats	Soybeans	Common bermuda-grass	Coastal bermuda-grass	Bahia-grass	Fescue grass
	Bu	*Lb*	*Lb*	*Bu*	*Bu*	*AUM* [1]	*AUM*	*AUM*	*AUM*
Addielou:									
Mapped in a complex with Freestone soils.	65	300	4,000	60	45	6.5	8.5	7.5	----------
Mapped in a complex with Kullit soils.	60	275	3,500	55	40	6.0	8.0	7.5	----------
Annona: AfB	45	275	3,000	45	40	6.0	7.0	6.0	----------
For Freestone part, see [illegible]									

TABLE 2.—*Predicted yields per acre of principal dryfarmed crops*—Continued

Soil series and map symbols	Corn	Cotton (lint)	Grain sorghum	Oats	Soybeans	Common bermuda-grass	Coastal bermuda-grass	Bahia-grass	Fescue grass
	Bu	*Lb*	*Lb*	*Bu*	*Bu*	*AUM* [1]	*AUM*	*AUM*	*AUM*
Muldrow: Mu, Mx For Elysian part of Mx, see Elysian series.	65	475	3,500	60	35	8.5	9.0	7.0	8.0
Nahatche: Na						5.5	9.0	6.0	7.0
Oklared: Of, Ok	60	450	4,000		40	6.0	7.0		5.5
Panola: Pa	40	300	3,000		30	4.5	6.0	5.5	6.0
Redlake:									
Rc	65	500	4,500	60	35	6.0	8.0		7.5
Rd	70	500	5,000	65	45	6.5	8.0		7.5
Rodessa Mapped only in a complex with Wrightsville soils.	45	250	3,500		30	5.5	7.0	6.5	
Roebuck variant: Rf	60	500	4,500		30	6.0	7.5		7.5
Rosalie: RsC	45	250	3,000	30	30	5.5	6.5	5.5	
Thenas: Th						5.5	9.5	7.0	7.0
Trinity:									
Tr	60	450	5,500	65	40	7.0	8.0		8.0
Ts						6.5	7.5		7.5
Varro: Va						5.5	8.5	6.0	7.5
Vesey:									
VeD	60	300	3,500	40	40	6.0	7.0	6.5	
VeF						5.5	6.5	6.0	
Waskom: Wa	75	500	3,900	65	40	8.0	9.0	7.5	8.0
Whakana:									
WhD	60	350	3,500	40	40	6.0	7.0	7.0	
WkA For Elysian part, see Elysian series.	70	450	4,000	50	45	7.0	8.0	7.0	
Woodtell:									
WoC	45	250	3,500	40	40	6.5	6.5	5.5	
WoE						5.0	5.5	5.0	
Wrightsville: Wr For Rodessa part, see Rodessa series.	40	300	2,500		25	5.0	6.0	5.5	5.5

[1] Animal unit month is a term used to express the carrying capacity of pasture. It is the number of animal units carried per acre, multiplied

Figure 15.—**An area of Gladewater clay, frequently flooded.**

cool-season perennial grasses. Both common bermudagrass and Coastal bermudagrass are used on the deep, well-drained soils. Pensacola bahiagrass is used both on deep, well-drained soils and on the slightly wet to wet soils. Introduced bluestem grass, mainly King Ranch bluestem, is used on a small acreage. The most commonly used legumes are vetch, crimson clover, and

The amount of beef that can be produced on a farm is directly related to the amount of forage produced. The forage produced by a pasture can be effectively increased by fertilization, planting winter legumes, controlling weeds, and controlling grazing. Temporary pasture is often used to supplement the permanent pasture. Sudangrass, johnsongrass, and sorghum-sudan-

helps to maintain plant vigor and leaves residue that can be returned to the soil to help maintain the content of organic matter. Mowing when the soil is wet tends to pack the surface layer, causing excessive runoff and poor plant growth. Weeds can be controlled by mowing, shredding, or using herbicides.

If native haylands are seriously damaged by drought, fire, or poor management, they should not be cut but should be allowed to make a full season's growth for 1 year or more. This permits the grasses to reestablish a strong root system and regain their vigor. Weakened grasses are easily killed in winter and invaded by weeds.

Well-established native grasses generally can be kept vigorous by good management without the use of fertilizers. Commercial fertilizers improve the production of bermudagrass, bahiagrass, and johnsongrass.

Haylands on deep, fertile soils are very productive. Management is easier if the surface is relatively smooth. Soils that are low in content of organic matter or that are in poor tilth should be conditioned for 1 year or more with legumes before establishing plants for hay production.

Pasture and hayland groups

The soils of Red River County are placed in 16 pasture and hayland groups according to their suitability for forage production. The soils in each group are enough alike to be suited to the same grasses to have

PASTURE AND HAYLAND GROUP 1B

In this group are clayey, nearly level soils on bottom lands. Some of the soils are subject to overflow. These soils crack and absorb water rapidly when dry, but they swell and absorb water very slowly when wet. They are poorly drained, very slowly permeable, and acid. Plant-soil-moisture relationships are poor.

Preparing a seedbed on these soils is difficult. The soils are wet for long periods, and grazing during this time causes severe puddling. Drainage is needed for good growth of forage. Nitrogen and phosphorus fertilizers are needed for sustained forage production. In places lime is needed on the more acid soils.

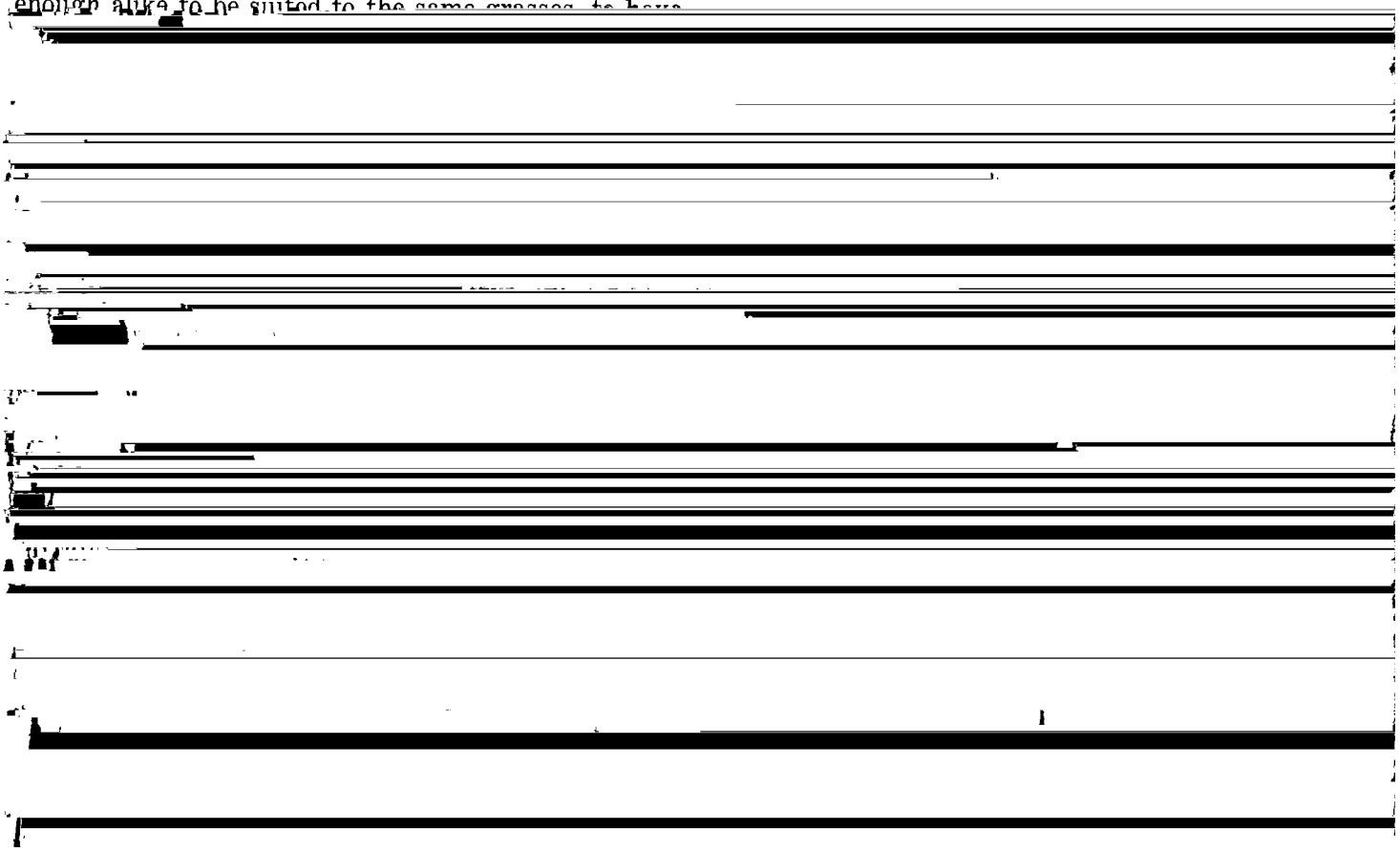
Suitable grasses and legumes are tall fescue, dallisgrass, johnsongrass, bermudagrass, white clover, burclover, vetch, and singletary peas.

PASTURE AND HAYLAND GROUP 2A

In this group are loamy, nearly level soils on bottom lands. Some of the soils are subject to overflow. These soils are moderately well drained to well drained, very slowly permeable to moderately rapidly permeable, and acid to alkaline. Plant-soil-moisture relationships are fair to good.

Preparing a seedbed on these soils is not difficult. Nitrogen and phosphorus fertilizers are needed for sustained forage production.

Suitable grasses and legumes are bermudagrass, fescue, singletary peas, and white clover.



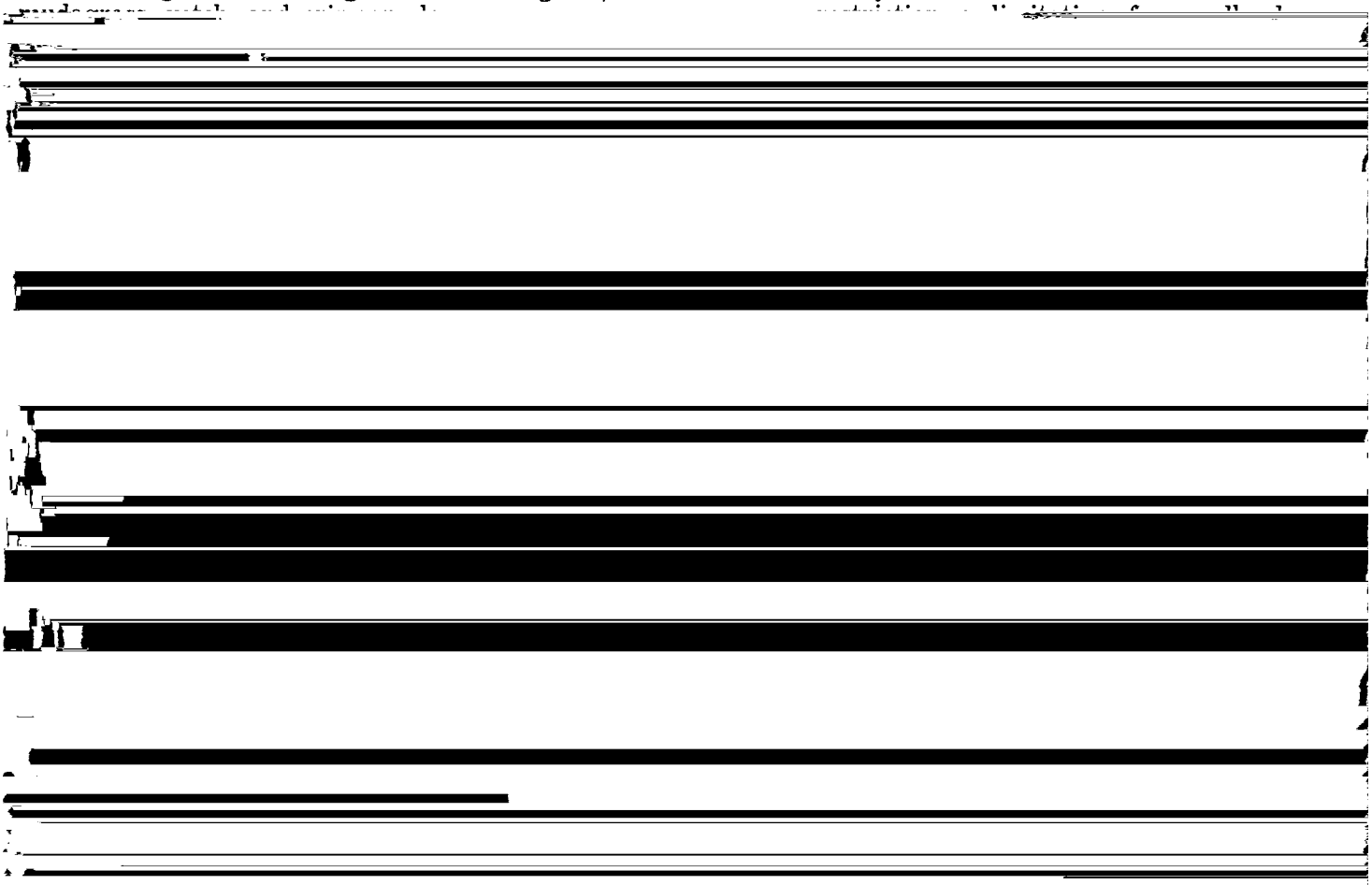
These soils are well drained to somewhat poorly drained, very slowly permeable, and acid to alkaline. Plant-soil-moisture relationships are poor.

PASTURE AND HAYLAND GROUP 8B

In this group are loamy, sloping to strongly sloping soils on uplands and terraces. The soils are well drained

duction. Fertilizers should be applied at frequent intervals.

Suitable grasses and legumes are lovegrass, ber-



PASTURE AND HAYLAND GROUP 9B

Kenney loamy fine sand, 2 to 8 percent slopes, is the only soil in this group. It is a sandy, gently sloping to sloping soil on uplands and terraces. This soil is well drained, moderately rapidly permeable, and acid. Plant-soil-moisture relationships are poor, and the soil is droughty.

Preparing a seedbed on this soil is easy, but in places soil blowing is a hazard if the surface is not protected. Nitrogen, phosphorus, and potassium fertilizers and lime are needed for sustained forage production. Fertilizers should be applied at frequent intervals.

Suitable grasses and legumes are coastal bermudagrass, crimson clover, and vetch.

Woodland [4]

Originally, Red River County was mainly woodland, but now it is about 46 percent woodland. Pine trees commonly are on uplands, and hardwoods generally predominate on bottom lands along rivers and creeks. Good stands of commercial trees are produced in the county, although stocking and growth rates are well below the potential of most soils

adversely affects either stand development or management.

s. Sandy soils that have moderate to severe

management. These soils impose equipment limitations, have low available water capacity, and are generally low in available plant nutrients.

c. Soils that have restrictions or limitations for woodland use or management because of the kind or amount of clay in the upper part of the profile.

o. Soils that have no significant restrictions or limitations for woodland use or management.

The third element in the symbol indicates the degree of hazards or limitations and the general suitability of the soils for certain kinds of trees. The four soil-related items considered are (1) hazard of erosion, (2) equipment restrictions, (3) plant competition, and (4) seedling mortality.

The *numeral 1* indicates soils that have few if any limitations to management and are suited to needleleaf trees

The *numeral 2* indicates soils that have one or more moderate limitations to management and are suited to needleleaf trees.

The *numeral 3* indicates soils that have one or more severe limitations to management and are suited to needleleaf trees.

TABLE 3.—*Suitability of*

[Soils not listed are

Soil series and map symbols	Woodland suitability group	Potential productivity			Yield
		Important tree species	Site index	Important understory vegetation (medium canopy)	
					Pounds per acre
Addielou Mapped only in complexes with Freestone and Kullit soils.	3o7	Loblolly pine	80	Little bluestem	750
		Shortleaf pine	70	Beaked panicums	500
		Southern red oak	70	Longleaf uniola	500
		Sweetgum	70	Purpletop	250
				Low panicums	250
				Other	250
				Total, favorable years	2,500
Annona: AfB For Freestone part, see Freestone series.	4c2	Loblolly pine	74	Little bluestem	500
		Shortleaf pine	65	Brownseed paspalum	200
				Indiangrass	200
				Longleaf uniola	200
				Low panicums	200
				Purpletop	100
				Sedges	200
				Other	400
				Total, favorable years	2,000
Bernaldo: BeB For Elysian part, see Elysian series.	2o7	Loblolly pine	90	Pinehill bluestem	450
		Shortleaf pine	80	Beaked panicums	450
		Sweetgum	80	Indiangrass	250
		Southern red oak	80	Longleaf uniola	700
				Purpletop	200
				Other	200

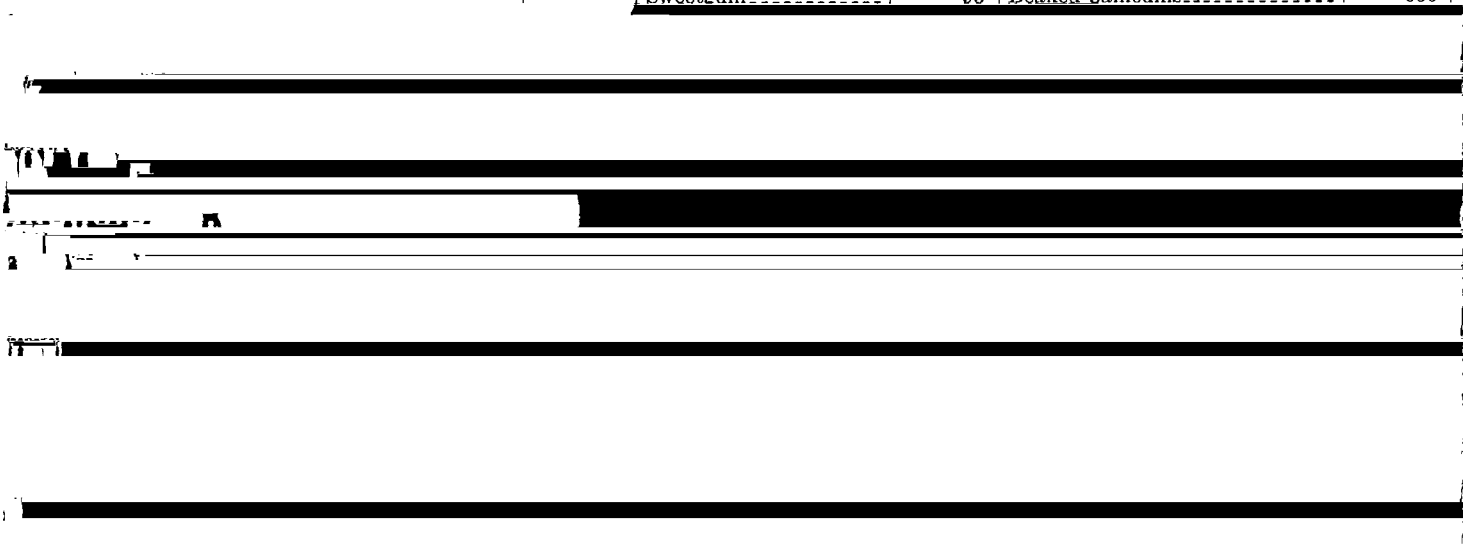
the soils for woodland

not suited to woodland]

Management concerns				Trees to plant
Erosion hazard	Equipment limitations	Plant competition	Seedling mortality	
Slight	Slight	Slight	Slight	Loblolly pine, slash pine.
Slight	Moderate	Moderate	Moderate	Loblolly pine, shortleaf pine.
Slight	Slight	Moderate	Slight	Loblolly pine, slash pine.
Slight	Moderate	Slight	Slight	Loblolly pine, slash pine.
Slight	Severe	Severe	Moderate	Cottonwood, green ash, cherrybark oak, water oak, sycamore, willow oak.
Slight	Slight	Moderate	Slight	Loblolly pine, sweetgum, cherrybark oak.
Slight	Moderate	Moderate	Slight	Loblolly pine, shortleaf pine, sweetgum, slash pine.

TABLE 3.—*Suitability of the*

Soil series and map symbols	Woodland suitability group	Potential productivity			
		Important tree species	Site index	Important understory vegetation (medium canopy)	Yield
					Pounds per acre
Gladewater: Gd, Gf	2w6	Water oak	90	Beaked panicums	500
		Willow oak	90	Rustyseed paspalum	250
		Green ash	(1)	Virginia wildrye	250
		Elm	(1)	Switchcane	500
		Sweetgum	90	Low panicums	250
				Sedges	400
				Other	200
				Total, favorable years	2,350
Hapludalfs: HaB	2o4	Cottonwood	100	Sedges	500
		Southern red oak	80	Beaked panicums	500
		Water oak	80	Switchcane	400
		Sweetgum	(1)	Virginia wildrye	200
				Longleaf uniola	200
				Perennial forbs	200
				Other	300
				Total, favorable years	2,300
Kaufman: Ka, Kb	1w6	Cottonwood	110	Virginia wildrye	400
		Sweetgum	100	Beaked panicums	300
		Water oak	100	Rustyseed paspalum	500
				Switchcane	300
				Sedges	850
				Longleaf uniola	200
				Other	200
				Total, favorable years	2,750
Kenney: KeD	3s2	Loblolly pine	80	Pinehill bluestem	700
		Shortleaf pine	70	Purpletop	500
				Longleaf uniola	300
				Brownseed paspalums	300
				Sedges	200
				Perennial forbs	600
				Other	300
				Total, favorable years	2,900
Kiomatia: Ko	2w5	Cottonwood	100	Sedges	600
		Sweetgum	95	Beaked panicums	600



soils for woodland—Continued

Management concerns				Trees to plant
Erosion hazard	Equipment limitations	Plant competition	Seedling mortality	
Slight	Severe	Severe	Moderate	Water oak, sweetgum.
Slight	Slight	Slight	Slight	Cottonwood, red oak, water oak, black walnut.
Slight	Severe	Severe	Moderate	Cottonwood.
Slight	Moderate	Moderate	Moderate	Loblolly pine, slash pine.
Slight	Moderate	Moderate	Moderate	Cottonwood, sweetgum, black walnut, sycamore.
Slight	Moderate	Moderate	Slight	Loblolly pine, sweetgum.
Slight	Moderate	Moderate	Moderate	Loblolly pine.

TABLE 3.—*Suitability of the*

Soil series and map symbols	Woodland suitability group	Potential productivity			
		Important tree species	Site index	Important understory vegetation (medium canopy)	Yield
					Pounds per acre
Muldrow: Mu, Mx For Elysian part of Mx, see Elysian series.	2w5	Sweetgum	90	Virginia wildrye	200
		Green ash	90	Canada wildrye	200
		Hackberry	(1)	Sedges	400
		Pecan	(1)	Switchcane	300
		Willow oak	(1)	Beaked panicums	300
		Water oak	(1)	Longleaf uniola	250
				Perennial forbs	250
				Other	250
				Total, favorable years	2,150
Nahatche: Na	1w6	Water oak	100	Switchcane	300
		Willow oak	100	Beaked panicums	300
		Cottonwood	100	Longleaf uniola	200
				Virginia wildrye	200
				Sedges	400
				Greenbriar	300
				Other	300
				Total, favorable years	2,000
Oklared: Of, Ok	2o4	Cottonwood	100	Sedges	400
		Southern red oak	80	Beaked panicums	300
		Water oak	90	Switchcane	300
				Virginia wildrye	200
				Longleaf uniola	300
				Greenbriar	300
				Other	400
				Total, favorable years	2,200
Redlake: Rc, Rd	3w6	Cottonwood	90	Virginia wildrye	200
		Southern red oak	70	Canada wildrye	200
		Sweetgum	80	Sedges	500
				Beaked panicums	300
				Switchcane	300
				Longleaf uniola	200
				Greenbriar	300
				Other	400
				Total, favorable years	2,400
Rodessa Mapped only in a complex with Wrightsville soils.	3w8	Loblolly pine	80	Little bluestem	600
		Shortleaf pine	70	Beaked panicums	600
		Water oak	(1)	Longleaf uniola	300
		Willow oak	(1)	Purpletop	300
		Post oak	(1)	Other	200
		Southern red oak	(1)	Total, favorable years	2,000
Roebuck variant: Rf	2w6	Water oak	90	Virginia wildrye	200
		Pecan	(1)	Sedges	500
		Sycamore	(1)	Beaked panicums	500
		Sweetgum	(1)	Longleaf uniola	300
				Switchcane	200
				Greenbriar	300
				Other	200
				Total, favorable years	2,200
Rosalie: RsC	3s2	Loblolly pine	80	Longleaf uniola	350
		Shortleaf pine	70	Purpletop	150
				Pinehill bluestem	560
				Low panicums	125
				Low paspalums	125
				Indiangrass	150
				Other	250
				Total, favorable years	1,710

soils for woodland—Continued

Management concerns				Trees to plant
Erosion hazard	Equipment limitations	Plant competition	Seedling mortality	
Slight	Moderate	Moderate	Moderate	Cottonwood, sweetgum, green ash, sycamore.
Slight	Severe	Severe	Moderate	Cottonwood, water oak.
Slight	Slight	Slight	Slight	Cottonwood, southern red oak, water oak.
Slight	Severe	Moderate	Moderate	Water oak, cottonwood, sweetgum, green ash.
Slight	Moderate	Moderate	Slight	Loblolly pine, shortleaf pine, southern red oak.
Slight	Moderate	Severe	Severe	Water oak, green ash, sweetgum.
Slight	Moderate	Moderate	Moderate	Loblolly pine, shortleaf pine.

TABLE 3.—*Suitability of the*

Soil series and map symbols	Woodland suitability group	Potential productivity			
		Important tree species	Site index	Important understory vegetation (medium canopy)	Yield
					Pounds per acre

soils for woodland—Continued

Management concerns				Trees to plant
Erosion hazard	Equipment limitations	Plant competition	Seedling mortality	
Slight	Moderate	Moderate	Moderate	Loblolly pine, slash pine, sycamore, southern red oak, sweetgum, pecan, black walnut, cottonwood.
Slight	Severe	Severe	Moderate	Cottonwood, green ash, water oak.
Slight	Moderate	Moderate	Moderate	Cottonwood, water oak.
Slight	Slight	Slight	Slight	Loblolly pine, shortleaf pine, slash pine.
Slight	Moderate	Moderate	Moderate	Cottonwood, pecan.
Slight	Slight	Slight	Slight	Loblolly pine, slash pine, sweetgum, southern red oak.
Slight	Moderate	Slight	Moderate	Slash pine, loblolly pine.
Slight	Severe	Slight	Moderate to severe	Loblolly pine, sweetgum, southern red oak.

decisions during the establishment and development of his woodlands.

The hazard of erosion is *slight* if erosion control is unimportant. A rating of *moderate* indicates the need for some attention to prevent unnecessary soil erosion. A rating of *severe* indicates that intensive treatment or special equipment or techniques of operation are needed to prevent excessive soil losses.

Equipment limitations reflect limitations in the use of equipment for managing or harvesting the tree crop. A *slight* rating indicates that use of equipment is seldom limited in kind or time of year. A *moderate* rating indicates a need for modified equipment or sea-

shrubs, and vines. When openings are made in the canopy, weeding is needed to release seedlings for normal growth.

WOODLAND SUITABILITY GROUP 1w6

In this group are clayey to loamy, somewhat poorly drained soils on bottom lands. Most of the soils are subject to overflow. Permeability is moderate to very slow, and available water capacity is medium to high. Slopes are nearly level.

Hardwoods and a few pines are the principal trees that grow on these soils. The supply of moisture is sufficient to cause severe plant competition from un-

WOODLAND SUITABILITY GROUP 2w6

In this group are clayey, poorly drained to somewhat poorly drained soils on bottom lands. Some of the soils are subject to overflow. Permeability is slow to

vines and shrubs. Weeding is necessary to release young seedlings for normal growth.

WOODLAND SUITABILITY GROUP 3o1

In this group are loamy, well-drained soils on up-

WOODLAND SUITABILITY GROUP 3c2

In this group are loamy, well-drained soils on uplands. Permeability is very slow, and available water capacity is high. Slopes are nearly level to strongly sloping.

Pines are the principal trees that grow on these soils. The supply of moisture is sufficient to cause slight to moderate plant competition.

WOODLAND SUITABILITY GROUP 5c2

Bryarly clay loam, 1 to 5 percent slopes, is the only soil in this group. It is a loamy, moderately well

The density of the understory affects its availability to livestock and wildlife. Where the canopy is open, about 90 percent of the understory is available; where the canopy is medium, about 75 percent is available; and where the canopy is dense, about 60 percent is available. The rest of the understory consists of woody vegetation that is not suited to grazing.

moderately rapid to very slow, and available water capacity is medium to high.

Primary species grazed by cattle include Florida paspalums, switchgrass, sedges, beaked panicums, longleaf uniola, switchcane, Virginia wildrye, lespedeza, and tickclover.

If these soils are heavily and continuously grazed,

rattan, greenbriar, osage-orange, eastern hornbean, and hawthorn.

The potential annual acre yield of air-dry herbage ranges from about 1,500 pounds where canopy cover is dense to as much as 6,000 pounds where canopy cover is open. The mean annual production is about 2,000 pounds where canopy cover is medium.

elements that make up wildlife habitat. The ratings take into account mainly the characteristics of the soils and closely related natural factors of the environment. They do not take into account climate, present use of soils, or present distribution of wildlife and people. For this reason, selection of a site for development as a habitat for wildlife requires inspection at

[redacted]

TIGHT SANDY LOAM WOODLAND GRAZING GROUP

In this group are loamy, well-drained to somewhat poorly drained soils on uplands. Permeability is very slow, and available water capacity is high.

Primary species grazed by cattle include little bluestem, beaked panicums, low paspalums, low panicums, purpletop, longleaf uniola, Florida paspalum, and

4 are briefly described in the following paragraphs.

Grain and seed crops.—These crops are annual grain-producing plants such as corn, sorghum, millet, and soybeans.

Grasses and legumes.—This group consists of domestic grasses and legumes that are established by planting. They provide food and cover for wildlife. Grasses

[redacted]

TABLE 4.—*Suitability of soils for elements of wildlife habitat and kinds of wildlife*

Soil series and map symbols	Elements of wildlife habitat						Kinds of wildlife		
	Grain and seed crops	Grasses and legumes	Wild herbaceous upland plants	Hardwood trees, shrubs, and vines	Wetland food and cover plants	Shallow-water developments	Open-land	Woodland	Wetland
Addielou Mapped only in complexes with Freestone and Kullit soils.	Good	Good	Good	Good	Poor	Very poor	Good	Good	Very poor.
Annona: AfB For Freestone part, see Freestone series.	Fair	Good	Good	Good	Fair	Poor	Good	Good	Poor.
Austin: AuB	Fair	Fair	Fair	Poor	Poor	Very poor	Fair	Poor	Very poor.
Bernaldo: BeB For Elysian part, see Elysian series.	Good	Good	Good	Good	Poor	Very poor	Good	Good	Very poor.
Bryarly: BrC	Fair	Good	Good	Good	Poor	Poor	Good	Good	Poor.
Burleson: BuA, BuB	Fair	Fair	Fair	Poor	Poor	Poor	Fair	Poor	Poor.
Crockett: CrB	Fair	Good	Good	Fair	Poor	Poor	Good	Fair	Poor.
Cuthand: CuD2	Poor	Fair	Good	Fair	Poor	Very poor	Fair	Fair	Very poor.
Deport: DaB	Fair	Fair	Fair	Poor	Poor	Poor	Fair	Poor	Poor.
Desha: DeA, DeB	Fair	Fair	Fair	Good	Poor	Fair	Fair	Good	Poor.
Ellis: EsC	Fair	Fair	Fair	Poor	Poor	Very poor	Fair	Poor	Very poor.
Elysian Mapped only in complexes with Bernaldo, Muldrow, and Whakana soils.	Good	Good	Good	Good	Poor	Very poor	Good	Good	Very poor.
Ferris: FeD2	Poor	Fair	Fair	Poor	Poor	Very poor	Fair	Poor	Very poor.
Freestone: FrA For Addielou part, see Addielou series.	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
Gladewater: Gd, Gf	Poor	Fair	Fair	Fair	Poor	Good	Fair	Fair	Fair.
Hapludalfs: HaB	Good	Good	Good	Good	Poor	Very poor	Good	Good	Very poor.
Houston Black: HoB	Fair	Fair	Fair	Poor	Poor	Very poor	Fair	Poor	Very poor.
Kaufman:									
Ka	Fair	Fair	Fair	Good	Poor	Fair	Fair	Good	Poor.
Kb	Very poor	Poor	Fair	Good	Poor	Fair	Poor	Fair	Poor.
Kenney: KeD	Poor	Fair	Fair	Poor	Poor	Very poor	Fair	Poor	Very poor.
Kiomatia: Ko	Very poor	Poor	Poor	Poor	Poor	Very poor	Poor	Poor	Very poor.
Kullit: KuB For Addielou part, see Addielou series.	Good	Good	Good	Good	Poor	Very poor	Good	Good	Poor.
Mabank: MaA	Fair	Fair	Good	Good	Fair	Fair	Fair	Good	Fair

TABLE 4.—*Suitability of soils for elements of wildlife habitat and kinds of wildlife*—Continued

Soil series and map symbols	Elements of wildlife habitat						Kinds of wildlife		
	Grain and seed crops	Grasses and legumes	Wild herbaceous upland plants	Hardwood trees, shrubs, and vines	Wetland food and cover plants	Shallow-water developments	Open-land	Woodland	Wetland
Muldrow: Mu, Mx For Elysian part of Mx, see Elysian series.	Fair	Good	Good	Good	Fair	Fair	Good	Good	Fair.
Nahatche: Na	Very poor.	Poor	Fair	Good	Fair	Fair	Poor	Fair	Fair.
Oklared: Of, Ok	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
Panola: Pa	Poor	Fair	Fair	Good	Poor	Fair	Fair	Good	Poor.
Redlake: Rc	Fair	Fair	Fair	Good	Poor	Poor	Fair	Good	Poor.
Rd	Fair	Fair	Good	Good	Poor	Poor	Fair	Good	Poor.

Woodland wildlife.—This group consists of birds and mammals that normally live in wooded areas of hardwood trees, coniferous trees, and shrubs. Woodcocks, thrushes, wild turkeys, vireos, deer, squirrels, and raccoons are typical examples of woodland wildlife.

Wetland wildlife.—This group consists of birds and mammals that normally live in wet areas, marshes, and swamps. Ducks, geese, rails, shore birds, herons, minks, and muskrats are typical examples of wetland wildlife.

Recreational Development

Knowledge of soils is necessary in planning, developing, and maintaining areas used for recreation. In table 5 the soils of Red River County are rated according to limitations that affect their suitability for camp areas, playgrounds, picnic areas, and paths and trails.

In table 5 the soils are rated as having slight, moderate, or severe limitations for the specified uses. For all of these ratings, it is assumed that a good cover of vegetation can be established and maintained. A *slight* limitation means that soil properties are generally than once during the season of use, have slopes of less than 15 percent, and have few or no rocks or stones on the surface.

Engineering Uses of the Soils [5]

This section is useful to those who need information about soils used as structural material or as foundation upon which structures are built. Among those who can benefit from this section are planning commissions, town and city managers, land developers, engineers, contractors, and farmers.

Among the soil properties that are highly important in engineering are permeability, strength, compaction characteristics, drainage condition, shrink-swell potential, grain size, plasticity, and reaction. Also important are depth to the water table, depth to bedrock, and slope. These properties, in various degrees and combinations, affect construction and maintenance of roads, airports, pipelines, foundations for small buildings, irrigation systems, ponds and small dams, and systems for disposal of sewage and refuse.

Information in this section of the soil survey can be helpful to those who

TABLE 5.—*Degree of limitation and major factors affecting recreational uses*

Soil series and map symbols	Camp areas	Picnic areas	Playgrounds	Paths and trails
Addielou Mapped only in complexes with Freestone and Kullit soils.	Slight	Slight	Slight	Slight.
Annona: AfB For Freestone part, see Freestone series.	Severe: percs slowly.	Moderate: wetness	Severe: percs slowly.	Moderate: wetness.
Austin: AuB	Severe: too clayev	Severe: too clayev	Severe: too clayev	Severe: too clayev.

TABLE 5.—*Degree of limitation and major factors affecting recreational uses*—Continued

Soil series and map symbols	Camp areas	Picnic areas	Playgrounds	Paths and trails
Panola: Pa	Severe: wetness; too clayey.	Severe: wetness; too clayey.	Severe: wetness; too clayey.	Severe: wetness; too clayey.
Redlake:				
Rc	Severe: too clayey; percs slowly.	Severe: too clayey	Severe: too clayey	Severe: too clayey.
Rd	Severe: percs slowly.	Slight	Severe: percs slowly.	Slight.
Rodessa Mapped only in a complex with Wrightsville soils.	Severe: percs slowly; wetness.	Moderate: wetness	Severe: percs slowly; wetness.	Moderate: wetness.
Roebuck variant: Rf	Severe: percs slowly; wetness.	Severe: wetness	Severe: percs slowly; wetness.	Severe: wetness.
Rosalie: RsC	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.
Thenas: Th	Severe: floods	Severe: floods	Severe: floods	Moderate: floods.
Trinity:				
Tr	Severe: too clayey	Severe: too clayey	Severe: too clayey	Severe: too clayey.
Ts	Severe: floods; too clayey.	Severe: floods; too clayey.	Severe: floods; too clayey.	Severe: floods; too clayey.
Varro: Va	Severe: floods	Severe: floods	Severe: floods	Severe: floods.
Vesey:				
VeD	Slight	Slight	Moderate: slope	Slight.
VeF	Moderate: slope	Moderate: slope	Severe: slope	Slight.
Waskom: Wa	Moderate: wetness	Moderate: wetness	Moderate: wetness	Slight.
Whakana:				
WhD	Slight	Slight	Moderate: slope	Slight.
WkA For Elysian part, see Elysian series.	Slight	Slight	Slight	Slight.
Woodtell:				
WoC	Severe: percs slowly.	Slight	Severe: percs slowly.	Slight.
WoE	Severe: percs slowly.	Moderate: slope	Severe: slope; percs slowly.	Slight.
Wrightsville: Wr For Rodessa part, see Rodessa series.	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness.

TABLE 6.—*Estimates of soil*

[An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or more kinds of soil. The instructions for referring to other series that appear in the first column of

Soil series and map symbols	Hydrologic group	Depth to—		Depth from surface	Dominant USDA texture	Classification	
		Bedrock	Seasonal high water table			Unified	AASHTO
		Inches	*Inches*	*Inches*			
Addielou Mapped only in complexes with Freestone and Kullit soils.	B	>60	40–60	0–28	Fine sandy loam	SM, SM-SC, ML or CL-ML	A–4
				28–60	Sandy clay loam	SC or CL	A–6
				60–90	Clay	CH	A–7–6
*Annona: AfB For Freestone part, see [illegible] series	D	>60	24–40	0–10	Loam	ML or SM	A–4
				10–40	Clay	CH	A–7–6
				40–95	Clay	CH, CL	A–7–6

[redacted]

properties significant in engineering

soils in such mapping units may have different properties and limitations, and for this reason it is necessary to follow carefully the this table. The symbol > means greater than; the symbol < means less than]

Percentage less than 3 inches passing sieve—				Liquid limit	Plasticity index	Permeability	Available water capacity	Reaction	Shrink-swell potential	Corrosivity to—	
No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)							Uncoated steel	Concrete
				Pct		*Inches per hour*	*Inches per inch of soil*	*pH*			
95–100	95–100	70–85	40–55	<25	[1]NP–5	0.6–2.0	0.10–0.15	5.6–7.3	Low	Low	Moderate.
95–100	95–100	80–90	45–65	20–35	11–20	0.2–0.6	0.15–0.16	4.5–6.0	Low	Moderate	Moderate.
100	95–100	90–100	75–95	51–60	25–35	0.06–0.2	0.15–0.20	4.5–5.5	High	High	High.
95–100	95–100	75–95	45–70	<25	NP–3	0.6–2.0	0.13–0.15	4.5–6.5	Low	Low	High.
95–100	95–100	90–100	75–95	51–70	30–45	<0.06	0.15–0.18	4.5–6.0	High	High	High.
95–100	95–100	90–100	75–95	41–55	25–35	<0.06	0.15–0.18	5.6–8.4	High	High	Moderate.
95–100	95–100	80–100	75–95	51–65	25–40	0.2–0.6	0.15–0.20	7.9–8.4	High	High	Low.
100	95–100	90–100	45–65	<25	NP–5	2.0–6.0	0.10–0.15	5.6–6.5	Low	Low	Moderate.
100	100	90–100	51–75	26–40	12–24	0.6–2.0	0.15–0.20	4.5–6.5	Low	Moderate	Moderate.
100	100	90–100	45–65	30–40	12–24	0.6–2.0	0.15–0.20	4.5–6.5	Low	Moderate	Moderate.
100	100	90–100	70–80	40–45	20–30	0.6–2.0	0.15–0.18	4.5–6.5	Moderate	Moderate	Moderate.
100	100	90–100	75–96	60–75	35–48	<0.06	0.15–0.18	4.5–5.5	High	High	Moderate.
98–100	95–100	90–100	75–95	51–76	25–45	<0.06	0.15–0.18	7.4–8.4	High	High	Moderate.
95–100	90–100	80–100	80–97	51–75	30–55	<0.06	0.15–0.18	5.6–8.4	High	High	Low.
95–100	95–100	95–100	51–70	<35	NP–15	0.6–2.0	0.11–0.15	5.6–7.3	Low	Low	Moderate.
95–100	95–100	80–100	65–90	40–55	25–35	<0.06	0.15–0.18	6.1–7.8	High	High	Low.
100	95–100	90–100	80–90	20–35	5–15	0.6–2.0	0.10–0.15	7.9–8.4	Low	Moderate	Low.
95–100	95–100	95–100	90–100	51–75	30–50	<0.06	0.12–0.18	5.6–8.4	High	High	Low.
100	100	95–100	95–100	60–85	40–70	<0.06	0.17–0.20	6.1–7.8	High	High	Low.
95–100	95–100	90–100	90–100	51–70	25–40	<0.06	0.12–0.18	6.6–8.4	High	High	Low.
100	100	50–70	30–60	<26	NP–12	0.6–2.0	0.10–0.13	5.6–6.5	Low	Low	Moderate

TABLE 6.—*Estimates of soil properties*

Soil series and map symbols	Hydrologic group	Depth to—		Depth from surface	Dominant USDA texture	Classification	
		Bedrock	Seasonal high water table			Unified	AASHTO
		Inches	*Inches*	*Inches*			
Hapludalfs: HaB	C	>60	>60	0–7	Fine sandy loam	SM-SC, ML, SM, SC, CL-ML, or CL	A–4
				7–15	Loam	CL-ML, CL	A–4 or A–6
				15–38	Sandy clay loam	CL	A–6 or A–7–6
				38–50	Clay loam	CL	A–6 or A–7–6
				50–60	Stratified fine sandy loam and sandy clay loam.	SC, ML, SM, CL-ML, CL, or SM-SC	A–4
Houston Black: HoB	D	>60	>60	0–69	Clay	CH	A–7–6
				69–72	Shale.		
Kaufman: Ka, Kb	D	>60	10–40	0–70	Clay	CH	A–7–6
Kenney: KeD	A	>60	>60	0–52	Loamy fine sand	SM or SP-SM	A–2
				52–84	Sandy clay loam	SC or CL	A–6
Kiomatia: Ko	A	>60	30–60	0–4	Loamy fine sand	SM	A–4 or A–2–4
				4–60	Stratified fine sand, very fine sandy loam.	SM or SP-SM	A–2–4
*Kullit: KuB For Addielou part, see Addielou series.	B	>60	20–60	0–5	Fine sandy loam	ML or SM	A–2–4, A–4
				5–14	Sandy clay loam	SC or CL	A–4 or A–6
				14–38	Clay loam	SC or CL	A–6
				38–90	Clay	CL	A–7–6
Mabank: MaA	D	>60	6–20	0–6	Fine sandy loam	SC, CL, CL-ML, SM-SC	A–4
				6–90	Clay	CH	A–7–6
McKamie: McC, McE	D	>60	>60	0–9	Loam	ML or CL-ML	A–4
				9–36	Clay	CH or CL	A–7–6
				36–65	Silty clay loam, clay.	CL	A–7–6 or A–6
Morse: MoD2	D	>60	>60	0–84	Clay	CH or MH	A–7–6
*Muldrow: Mu, Mx For Elysian part, see Elysian series.	D	>60	24–72	0–10	Silty clay loam	CL or ML	A–4 or A–6
				10–85	Clay	CL or CH	A–6 or A–7–6
Nahatche: Na	C	>60	10–20	0–50	Clay loam	CL	A–6 or A–7–6
				50–72	Sandy clay loam	CL	A–6 or A–4, A–7–6
Oklared: Of	B	>60	>60	0–15	Fine sandy loam	ML, CL-ML, SM, or SM-SC	A–2–4 or A–4
				15–25	Very fine sandy	ML, SM, CL, SC.	A–4

significant in engineering—Continued

Percentage less than 3 inches passing sieve—				Liquid limit	Plasticity index	Permeability	Available water capacity	Reaction	Shrink-swell potential	Corrosivity to—	
No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)							Uncoated steel	Concrete
				Pct		*Inches per hour*	*Inches per inch of soil*	*pH*			
95–100	95–100	90–100	36–60	20–26	2–8	2.0–6.0	0.10–0.15	5.6–6.5	Low	Low	Moderate.
100	100	85–95	60–75	20–30	4–20	0.6–2.0	0.10–0.15	5.6–6.5	Low	Low	Moderate.
95–100	95–100	90–100	51–85	28–46	15–23	0.2–0.6	0.10–0.15	5.6–6.5	Moderate	Moderate	Moderate.
95–100	95–100	90–100	51–85	28–46	15–23	0.2–0.6	0.10–0.15	5.6–6.5	Moderate	Moderate	Moderate.

TABLE 6.—*Estimates of soil properties*

Soil series and map symbols	Hydrologic group	Depth to—		Depth from surface	Dominant USDA texture	Classification	
		Bedrock	Seasonal high water table			Unified	AASHTO
		Inches	*Inches*	*Inches*			
Redlake—Cont.							
Rd	D	>60	>60	0–10	Fine sandy loam	ML, SM, CL-ML, or SM-SC	A–4 or A–2–4
				10–42	Clay	CL or CH	A–7–6

significant in engineering—Continued

Percentage less than 3 inches passing sieve—				Liquid limit	Plasticity index	Permeability	Available water capacity	Reaction	Shrink-swell potential	Corrosivity to—	
No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)							Uncoated steel	Concrete
				Pct		*Inches per hour*	*Inches per inch of soil*	*pH*			
100	100	90–100	30–60	<26	NP–6	2.0–6.0	0.10–0.15	7.9–8.4	Low	Low	Low

TABLE 7.—*Engineering*

[An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or more kinds of soil. The instructions for referring to other series

Soil series and map symbols	Degree and kind of limitation for—				
	Septic tank absorption fields	Sewage lagoons	Shallow excavations	Dwellings without basements	Sanitary landfill [1]
Addielou Mapped only in complexes with Freestone and Kullit soils.	Moderate: percs slowly; wetness.	Moderate: slope; wetness.	Moderate: wetness.	Slight	Severe: wetness.
*Annona: AfB For Freestone part, see Freestone series.	Severe: percs slowly; wetness.	Severe: wetness.	Severe: wetness.	Severe: shrink-swell.	Severe: too clayey.
Austin: AuB	Severe: depth to rock.	Severe: depth to rock.	Moderate: depth to rock.	Severe: shrink-swell.	Severe: depth to rock.
*Bernaldo: BeB For Elysian part, see Elysian series.	Moderate: wetness.	Moderate: slope; seepage.	Moderate: wetness.	Moderate: low strength.	Slight
Bryarly: BrC	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Severe: shrink-swell.	Severe: too clayey.
Burleson:					
BuA	Severe: percs slowly.	Slight	Severe: too clayey.	Severe: shrink-swell.	Severe: too clayey.
BuB	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Severe: shrink-swell.	Severe: too clayey.
Crockett: CrB	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Severe: shrink-swell.	Severe: too clayey.
Cuthand: CuD2	Severe: depth to rock.	Severe: depth to rock.	Moderate: depth to rock.	Slight	Severe: depth to rock.
Deport: DaB	Severe: percs slowly; wetness.	Severe: wetness.	Severe: too clayey.	Severe: shrink-swell.	Severe: too clayey.
Desha:					
DeA	Severe: percs slowly; wetness.	Severe: wetness.	Severe: too clayey.	Severe: shrink-swell.	Severe: too clayey.
DeB	Severe: percs slowly; wetness.	Severe: slope; wetness.	Severe: too clayey.	Severe: shrink-swell.	Severe: too clayey.
Ellis: EsC	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Severe: shrink-swell.	Severe: too clayey.
Elysian Mapped only in complexes with Bernaldo, Muldrow, and Whakana.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
Ferris: FeD2	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Severe: shrink-swell.	Severe: too clayey.
*Freestone: FrA For Addielou part, see Addielou series.	Severe: percs	Severe:	Severe:	Moderate:	Severe:

interpretations

soils in such mapping units may have different properties and limitations, and for this reason it is necessary to follow carefully the that appear in the first column of this table]

Degree and kind of limitation for—(cont.)			Suitability as source of—		Soil features affecting—		
Local roads and streets	Pond reservoir areas	Dikes, levees, and other embankments	Road fill	Topsoil	Drainage for crops and pasture	Waterways	Terraces and diversions
Moderate: low strength.	Moderate: seepage.	Moderate: piping.	Fair: low strength.	Good	Not needed	Slope	Complex slope.
Severe: shrink-swell.	Slight	Moderate: low strength.	Poor: shrink-swell.	Fair: thin layer.	Favorable	Slope	Complex slope.
Severe: shrink-swell.	Severe: depth to rock.	Moderate: low strength.	Poor: shrink-swell.	Poor: too clayey.	Not needed	Favorable	Favorable.
Moderate: low strength.	Moderate: seepage.	Moderate: piping; erosion.	Fair: low strength.	Fair: thin layer.	Not needed	Slope	Complex slope.
Severe: shrink-swell.	Slight	Moderate: low strength.	Poor: shrink-swell.	Poor: too clayey.	Not needed	Percs slowly	Percs slowly.
Severe: shrink-swell.	Slight	Moderate: low strength.	Poor: shrink-swell.	Poor: too clayey.	Not needed	Favorable	Favorable.
Severe: shrink-swell.	Slight	Moderate: low strength.	Poor: shrink-swell.	Poor: too clayey.	Not needed	Favorable	Favorable.
Severe: shrink-swell.	Slight	Moderate: unstable fill.	Poor: shrink-swell.	Poor: too clayey.	Not needed	Percs slowly	Percs slowly.
Moderate: low strength.	Severe: depth to bedrock.	Moderate: piping; low strength.	Fair: low strength.	Poor: excess lime.	Not needed	Erodes easily	Depth to rock.

TABLE 7.—*Engineering*

Soil series and map symbols	Degree and kind of limitation for—				
	Septic tank absorption fields	Sewage lagoons	Shallow excavations	Dwellings without basements	Sanitary landfill[1]
Gladewater: Gd	Severe: percs slowly.	Severe: wetness.	Severe: too clayey; wetness.	Severe: shrink-swell; wetness.	Severe: wetness.
Gf	Severe: percs slowly; floods.	Severe: wetness; floods.	Severe: wetness; floods.	Severe: shrink-swell; floods.	Severe: wetness; floods.
Hapludalfs: HaB	Slight	Moderate: seepage.	Slight	Moderate: shrink-swell.	Slight
Houston Black: HoB	Severe: percs slowly.	Slight	Severe: too clayey.	Severe: shrink-swell.	Severe: too clayey.
Kaufman: Ka	Severe: wetness.	Severe: wetness.	Severe: too clayey; wetness.	Severe: shrink-swell; wetness.	Severe: too clayey.
Kb	Severe: wetness; floods.	Severe: floods; wetness.	Severe: wetness; floods; too clayey.	Severe: shrink-swell; wetness; floods.	Severe: wetness; floods; too clayey.
Kenney: KeD	Slight	Severe: seepage.	Severe: cut-banks cave.	Slight	Moderate: too sandy.

interpretations—Continued

Degree and kind of limitation for—(cont.)			Suitability as source of—		Soil features affecting—		
Local roads and streets	Pond reservoir areas	Dikes, levees, and other embankments	Road fill	Topsoil	Drainage for crops and pasture	Waterways	Terraces and diversions
Severe: shrink-swell; wetness.	Slight	Moderate: compressible.	Poor: shrink-swell; wetness.	Poor: too clayey; wetness.	Percs slowly	Wetness	Not needed.
Severe: shrink-swell; wetness.	Slight	Moderate: compressible.	Poor: shrink-swell; wetness.	Poor: too clayey; wetness.	Floods	Floods	Not needed.

TABLE 7.—*Engineering*

Soil series and map symbols	Degree and kind of limitation for—				
	Septic tank absorption fields	Sewage lagoons	Shallow excavations	Dwellings without basements	Sanitary landfill[1]
Rodessa Mapped only in a complex with Wrightsville series.	Severe: percs slowly; wetness.	Severe: wetness.	Severe: wetness; too clayey.	Moderate: shrink-swell.	Severe: wetness; too clayey.
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

interpretations—Continued

Degree and kind of limitation for—(cont.)			Suitability as source of—		Soil features affecting—		
Local roads and streets	Pond reservoir areas	Dikes, levees, and other embankments	Road fill	Topsoil	Drainage for crops and pasture	Waterways	Terraces and diversions
Severe: shrink-swell.	Slight	Moderate: piping; shrink-swell.	Poor: shrink-swell.	Good	Percs slowly	Slope	Not needed.
Severe: shrink-swell; wetness.	Slight	Moderate: compressible; shrink-swell.	Poor: shrink-swell; wetness.	Poor: too clayey; wetness.	Percs slowly; wetness.	Wetness	Not needed.
Moderate: low strength.	Moderate: seepage.	Moderate: piping.	Fair: low strength.	Poor: too sandy.	Not needed	Droughty	Too sandy.
Severe: floods	Moderate: seepage.	Moderate: piping.	Good	Good	Floods	Wetness	Not needed.
Severe: shrink-swell.	Slight	Moderate: compressible; shrink-swell.	Poor: shrink-swell.	Poor: too clayey.	Percs slowly	Favorable	Not needed.
Severe: floods, shrink-swell.	Slight	Moderate: compressible; shrink-swell.	Poor: shrink-swell.	Poor: too clayey.	Floods	Floods	Not needed.
Severe: floods	Moderate: seepage.	Moderate: piping.	Fair: low strength.	Fair: too clayey.	Floods	Floods	Not needed.
Slight	Severe: seepage.	Moderate: piping.	Fair: low strength.	Good	Not needed	Slope	Slope.
Moderate: slope.	Severe: seepage.	Moderate: piping.	Fair: low strength; slope.	Good	Not needed	Slope	Slope.
Severe: low strength.	Moderate: seepage.	Moderate: piping.	Poor: low strength.	Fair: thin layer.	Favorable	Favorable	Not needed.
Severe: low strength.	Moderate: seepage.	Moderate: piping.	Poor: low strength.	Fair: thin layer.	Not needed	Slope	Slope.
Severe: shrink-swell.	Slight	Moderate: low strength.	Poor: shrink-swell.	Poor: too clayey.	Not needed	Slope	Not needed.
Severe: shrink-swell.	Slight	Moderate: low strength.	Poor: shrink-swell.	Poor: too clayey.	Not needed	Slope	Not needed.
Severe: shrink-swell; wetness.	Slight	Severe: compressible; shrink-swell.	Poor: wetness.	Poor: wetness.	Percs slowly	Wetness	Not needed.

TABLE 8.—*Engineering*

[Tests performed by the Texas Highway Department in accordance with standard

Soil name and location	Parent material	Report no.	Depth	Shrinkage		
				Limit	Lineal	Ratio
			In	*Pct*	*Pct*	
Bernaldo:	Alluvial sediment.	70–48–R	0–7	19	1.8	1.71
3 miles east of Annona on U.S. Highway 82, 2.5 miles		70–49–R	24–37	17	5.6	1.79

test data

procedures of American Association of State Highway and Transportation Officials (AASHTO)]

Mechanical analysis[1]								Liquid limit	Plasticity index	Classification[2]	
Percentage passing sieve—					Percentage smaller than—						
⅜ in	No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)	0.05 mm	0.005 mm	0.002 mm			AASHTO[3]	Unified[4]
								Pct			
			100	46	28	6	2	23	4	A–4	SM-SC
			100	54	40	19	18	28	13	A–6	CL
			100	64	48	29	27	37	23	A–6	CL
			98	96	94	75	66	75	46	A–7–6	CH
99	98	98	97	95	91	70	56	76	45	A–7–6	CH
				97	94	66	57	72	48	A–7–6	CH
			100	78	63	28	22	30	15	A–6	CL
				87	79	47	40	48	33	A–7–6	CL

[2] Classification made by Soil Conservation Service personnel.
[3] Based on AASHTO Designation M 145–49.
[4] Based on the Unified soil classification system (See footnote 6, p. 82).

erties and different suitabilities or limitations for soil engineering.

Some of the terms used in this soil survey have different meanings in soil science than in engineering. The Glossary defines many of these terms as they are commonly used in soil science.

Engineering soil classification systems

The two systems most commonly used in classifying samples of soils for engineering are the Unified system[6] used by SCS engineers, the Department of Defense, and others, and the AASHTO system[7] adopted by the American Association of State Highway and Transportation Officials.

In the Unified system soils are classified according to particle-size distribution, plasticity, liquid limit, and content of organic matter. Soils are grouped in 15 classes. There are eight classes of coarse-grained soils, identified as GW, GP, GM, GC, SW, SP, SM, and SC;

end of long-duration storms, occurring after the soil has had prior wetting and opportunity for swelling and when the soil has been without the protection of vegetation. The four major soil groups currently recognized range from group A, which consists of soils having the lowest runoff potential, to group D, which consists of soils having the highest runoff potential.

Soils in group A have a high rate of infiltration when thoroughly wet. These soils are deep and well drained to excessively drained and consist mainly of sand or gravel, or both. They have a high rate of water transmission and a low runoff potential.

Soils in group B have a moderate rate of infiltration when thoroughly wet. These soils are moderately deep to deep, and moderately well drained to well drained. They are moderately fine textured to moderately coarse textured. These soils have a moderate rate of water transmission.

Soils in group C have a slow rate of infiltration when

Permeability is the quality of a soil that enables it to transmit water or air. It is estimated on the basis of characteristics of the soil observed in the field, par-

Corrosivity, as used in table 6, pertains to potential soil-induced chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of

that the embankment is compacted to medium density and the pond is protected from flooding. Properties are considered that affect the pond floor and the embankment. Those that affect the pond floor are permeability, content of organic matter, and slope, and if the floor needs to be leveled, depth to bedrock is important. The soil properties that affect the embankment are engineering properties of the embankment material as interpreted from the Unified soil classification system and the number of stones, if any, that influence the ease of excavation and compaction of the embankment material.

Shallow excavations are those that require digging or trenching to a depth of less than 6 feet, as for example, excavations for pipelines, sewerlines, telephone and power transmission lines, basements, open ditches, and cemeteries. Desirable soil properties are good workability, moderate resistance to sloughing, gentle slopes, absence of rock outcrops or big stones, and freedom from flooding or a high water table.

Dwellings without basements, as rated in table 7, are not more than three stories high, and are supported by foundation footings placed in undisturbed soil. The features that affect the rating of a soil for dwellings are those that relate to capacity to support load and resist settlement under load and those that relate to ease of excavation. Soil properties that affect capacity to support load are wetness, susceptibility to flooding, density, plasticity, texture, and shrink-swell potential. Those that affect excavation are wetness, slope, depth to bedrock, and content of stones and rocks.

[redacted]

bility of the material. Slope, depth to hard rock, content of stones and rocks, and wetness affect ease of excavation and amount of cut and fill needed to reach an even grade.

Pond reservoir areas hold water behind a dam or embankment. Soils suitable for pond reservoir areas have low seepage, which is related to their permeability and depth to fractured or permeable bedrock or other permeable material.

Dikes, levees, and other embankments require soil material resistant to seepage and piping and of favorable stability, shrink-swell potential, shear strength, and compactibility. Presence of stones or organic material in a soil are among factors that are unfavorable.

Road fill is soil material used in embankments for roads. The suitability ratings reflect (1) the predicted performance of soil after it has been placed in an embankment that has been properly compacted and provided with adequate drainage and (2) the relative ease of excavating the material at borrow areas.

Topsoil is used for topdressing an area where vegetation is to be established and maintained. Suitability is affected mainly by ease of working and spreading the soil material, as for preparing a seedbed; by natural fertility of the material or the response of plants when fertilizer is applied; and by absence of substances toxic to plants. Texture of the soil material and its content of stone fragments are characteristics that affect suitability, but also considered in the rating is damage that will result at the area from which topsoil is taken.

Drainage for crops and pasture is affected by such

tests to determine liquid limits and plastic limits. The mechanical analyses were made by combined sieve and hydrometer methods.

Shrinkage limit is the percentage of moisture at which shrinkage of the soil material stops.

Shrinkage ratio is the relation of change in volume of the soil material to the water content of the soil material when at the shrinkage limit. The change in volume is expressed as a percentage of the air-dry volume of the soil material, and the water content is expressed as a percentage of the weight of the soil material when ovendry.

Linear shrinkage is the decrease in one dimension, expressed as a percentage of the original dimension, of the soil mass when the moisture content is reduced from the given value to the shrinkage limit.

Tests to determine liquid limit and plastic limit measure the effect of water on the consistence of soil material, as has been explained for table 6.

Formation and Classification of the Soils

This section explains how soils form and discusses the factors that affect the formation of the soils in Red River County. It also discusses the processes by which various soil layers are formed.

Factors of Soil Formation

The factors that determine the kind of soil that [redacted]

Smaller streams that have watersheds consisting mostly of soils that have an acid, loamy surface layer deposited loamy sediment on their flood plains. Nahatche and Thenas soils formed in these deposits.

Climate

The climate of Red River County is warm and humid. Climate features that existed during the time when the soils formed influenced the soil formation.

Temperature, high humidity, and adequate rainfall have encouraged deep penetration of water. Moisture and warm temperature have also favored the development of plant roots, chemical activity, and microorganisms. As a result many deep soils have formed in the county. Calcium and other chemicals have been removed from many of the soils by leaching. This resulted in the formation of soils low in some essential plant nutrients.

Plant and animal life

Vegetation, micro-organisms, earthworms, other organisms, and recently man live on and in the soil and contribute to its development. The kind and amount of vegetation, controlled by climate and parent material, have a great influence on soil formation.

The forest that grows over much of the county contributes organic matter to the top few inches of the soil. This is quickly destroyed when the soils are cultivated, as has happened in the Bernaldo and Elysian soils. Grass, however, favors the accumulation of organic matter to lower depths and contributes to the

[redacted]

layer, and if they have been cleared, they are more eroded than nearly level or gently sloping soils.

Some of the effects of relief such as shallow soil formation are not pronounced in Red River County. Abundant rainfall and long warm periods overcome most of its effects, and nearly all soils are deeply formed.

Pimple mounds, a form of microrelief, are common in the county. These turn the intermound areas into tenuous drainageways that have small, slightly depressional spots. Kullit-Addielou complex, 1 to 3 percent slopes, is characteristic of this condition. Cultivation of soils that have mounds is delayed a few days in spring.

in most places occurred many years ago, but deposition still occurs on some flood plains.

Classification of Soils

Soils are classified so that we can more easily remember their significant characteristics. Classification enables us to assemble knowledge about the soils, to see their relationship to one another and to the whole environment, and to develop principles that help us to understand their behavior and their response to manipulation. First through classification, and then through use of soil maps, we can apply our knowledge of soils to specific fields and other tracts of land.

[redacted]

Time

The length of time that climate, living organisms, and relief have acted upon the parent material affects the kind of soil that has formed. However, the effects of time are modified by the other four factors of soil formation. Differences in age are apparent in the soil profiles.

Rosalie and Kullit soils formed in older sediment, and they show the development of well-expressed soil horizons, are deep, and are leached in nearly all of the profile. Oklared soils, which formed in recent sediment, show only faint horizonation, higher lime content, and stratification of sediment at a shallow depth.

Processes of Soil Horizon Differentiation

Each soil horizon receives its characteristics from

used in detailed soil surveys, allow us to organize and apply knowledge about soils in managing farms, fields, and woodlands; in developing rural areas; in engineering work; and in many other ways. Soils are placed in broad classes to facilitate study and comparision in large areas such as countries and continents.

The system of soil classification currently used was adopted by the National Cooperative Soil Survey in 1965. Because this system is under continual study, readers interested in developments of the current system should search the latest literature available.[9]

The current system of classification has six categories. Beginning with the broadest, these categories are order, suborder, great group, subgroup, family, and series. In this system the criteria used as a basis for classification are soil properties that are observable and measurable. The properties are chosen, however, so that the soils of similar genesis, or mode of origin,

[redacted]

TABLE 9.—*Classification of soil series*

Series	Family	Subgroup	Order
Addielou	Fine-loamy, siliceous, thermic	Typic Paleudults	Ultisols.
Annona	Fine, montmorillonitic, thermic	Vertic Paleudalfs	Alfisols.
Austin	Fine-silty, carbonatic, thermic	Typic Haplustolls (Calciustols)	Mollisols.
Bernaldo	Fine-loamy, siliceous, thermic	Glossic Paleudalfs	Alfisols.
Bryarly	Fine, montmorillonitic, thermic	Vertic Paleudalfs	Alfisols.
Burleson	Fine, montmorillonitic, thermic	Udic Pellusterts	Vertisols.
Crockett	Fine, montmorillonitic, thermic	Udertic Paleustalfs	Alfisols.
Cuthand	Coarse-silty, carbonatic, thermic	Typic Ustochrepts	Inceptisols.
Deport	Fine, montmorillonitic, thermic	Udorthentic Pellusterts	Vertisols.
Desha	Very fine, mixed, thermic	Vertic Hapludolls	Mollisols.
Ellis	Fine, mixed, thermic	Vertic Ustochrepts	Inceptisols.
Elysian	Coarse-loamy, siliceous, thermic	Haplic Glossudalfs	Alfisols.
Ferris	Fine, montmorillonitic, thermic	Udorthentic Chromusterts	Vertisols.
Freestone	Fine-loamy, siliceous, thermic	Glossaquic Paleudalfs	Alfisols.
Gladewater	Fine, montmorillonitic, nonacid, thermic	Vertic Haplaquepts	Inceptisols.
Hapludalfs	Not classified	Not classified	Alfisols.
Houston Black	Fine, montmorillonitic, thermic	Udic Pellusterts	Vertisols.
Kaufman [1]	Fine, montmorillonitic, thermic	Vertic Haplaquolls	Mollisols.
Kenney	Loamy, mixed, thermic, (siliceous)	Grossarenic Paleudalfs	Alfisols.
Kiomatia	Sandy, mixed, thermic	Typic Udifluvents	Entisols.
Kullit	Fine-loamy, siliceous, thermic	Aquic Paleudults	Ultisols.
Mabank	Fine, montmorillonitic, thermic	Vertic Albaqualfs	Alfisols.
McKamie	Fine, mixed, thermic	Vertic Hapludalfs	Alfisols.
Morse	Fine, mixed, thermic	Entic Chromuderts	Vertisols.
Muldrow	Fine, mixed, thermic	Typic Argiaquolls	Mollisols.
[redacted]	[redacted]	[redacted]	[redacted]

Families.—Soil families are separated within a subgroup primarily on the basis of properties important to the growth of plants or on the basis of the behavior of soils when used for engineering. Among the properties considered are texture, mineralogy, reaction, temperature, permeability, thickness of horizons, and

Winter temperatures are mild, and there are only about 3 days each year when the daily maximum fails to go above freezing. Infrequent arctic airmasses, moving southward out of Canada, bring sharp drops in temperature. These cold spells are usually of short duration. Typically, the weather turns cold one day,

Average annual relative humidity is 85 percent at 6:00 a.m. and 55 to 60 percent at noon and at 6:00 p.m. The area receives about 68 percent of the total possible sunshine annually. Mean annual lake evaporation is between 50 and 52 inches. Average hourly windspeeds are among the lowest in Texas, annually averaging about 8 miles per hour.

Severe local storms occur infrequently in the Clarksville area. Only eight tornadoes are known to have touched ground in Red River County during the period 1896–1966. Two of these occurred in 1961.

Geology

The geologic strata in which the soils of the county developed consist mostly of clay, marl, shale, and sand deposited during Cretaceous, Eocene, Pleistocene, and Recent times.[11]

Surface exposures of Cretaceous System rocks predominate in the county. Exceptions include alluvium (Recent Series) and terrace deposits (Pleistocene Series) along the Red River and the Sulphur River and their tributaries. Erosional remnants of terrace deposits are present near Avery. An outcrop of the Midway Group (Eocene Series) occurs in the extreme southeastern part of the county.

Immediately before the Cretaceous Period, continental North America was practically all dryland. Upon this dryland Cretaceous seas encroached, covered the land, and left their record in the form of many deposits. The Cretaceous Period marked the last great epicontinental marine invasion of North America.[12]

Strata of the Cretaceous System are represented by the Woodbine Group, Eagle Ford Formation, Austin Group, Taylor Group, and Navarro Group in the county.

The rocks of the Woodbine Group (undivided) are the oldest surface exposures and are largely made up of ferruginous, argillaceous sand, characterized by intense discoloration in places, and lesser occurrences of sandy laminated clay. Soils such as Kullit and Bernaldo are dominant, but there are small areas of Woodtell soils.

The Woodbine Group is overlain by the Eagle Ford Formation and consists chiefly of dark-gray to nearly black shale that is commonly gypsiferous and bituminous. In places, crystals of selenite weather from the shale in great numbers. Woodtell and Kullit are typical soils.

The Austin Group overlies the Eagle Ford Formation and underlies the Taylor Group. The Austin is represented by the Bonham Formation and the Blossom Sand Formation. The Bonham consists of a greenish-gray, waxy marl and clay. The Blossom Sand is a calcareous quartz sand with thin clay interbeds. Soils such as Wrightsville, Woodtell, and Annona are dominant in this area.

The Taylor Group is represented, in ascending order, by the Brownstown Marl, Ozan, Annona Chalk, Pecan Gap Chalk, and Marlbrook Marl Formations. The Brownstown Marl is composed of dark-gray marl and clay that are, in part, sandy. The Ozan Formation is a bluish-gray, calcareous clay and has some fine sand. The Annona Chalk consists of a thickly bedded to massive, hard chalk that is, in part, argillaceous and sandy. The Pecan Gap Chalk is a slightly bituminous chalk that is, in part, argillaceous and sandy. The Marlbrook Marl is composed of a strikingly uniform marl that is highly plastic when wet. This formation forms a smooth, rolling topography. The dominant soils on the clayey members of this group are Burleson, Ferris, Houston Black, Deport, and Ellis. The more chalky members give rise to Austin and Cuthand soils.

[11] UNIVERSITY OF TEXAS. Geologic Atlas of Texas, Texarkana, Sheet Map With Text, 1966.

[12] SELLARDS, E. M., ADKINS, W. S., and PLUMMER, F. B. The Geology of Texas. v. 1, Stratigraphy. University of Texas, Bull. 3232. 1007 pp., illus. 1932.

and precipitation data [1]

station at Clarksville]

Precipitation								
Probability, in percent, of receiving selected amounts during month						Average number of days with—		
1.00 inch or more	2.00 inches or more	3.00 inches or more	4.00 inches or more	5.00 inches or more	6.00 inches or more	0.10 inch or more	0.50 inch or more	1.00 inch or more
90	70	50	36	25	10	5	2	1
92	73	52	38	25	15	7	2	1
96	82	60	45	26	17	7	3	1
97	90	74	60	44	34	8	3	2
98	90	75	60	46	31	6	3	2
90	71	52	40	30	20	6	3	2
80	60	47	34	25	15	5	2	1
77	51	38	25	15	10	4	2	1
80	60	40	30	20	12	4	3	2
95	60	41	25	20	10	4	2	1
80	65	48	38	30	23	4	2	1
92	73	55	40	28	20	5	2	1
						65	29	16

[1] Greater than 99 percent.

The Navarro Group (undivided) consists of fine- of the county are moderately well drained to somewhat

All but the very thinly populated areas of the county are served by rural water supply corporations. The thinly populated sections of the wooded part of the county ordinarily get enough water for home use from wells. Most parts of the prairie section of the county not served by water supply corporations depend on cisterns for household water.

Nearly all water for livestock is secured from constructed ponds or lakes. Satisfactory sites for stock ponds can be found on most farms. However, in places the high terraces in the north part of the county have permeable layers in the substratum at depths that are too shallow for satisfactory ponds.

Site 1—Langford Creek Watershed—is being developed

Sticky.—When wet, adheres to other material, and tends to stretch somewhat and pull apart, rather than to pull free from other material.

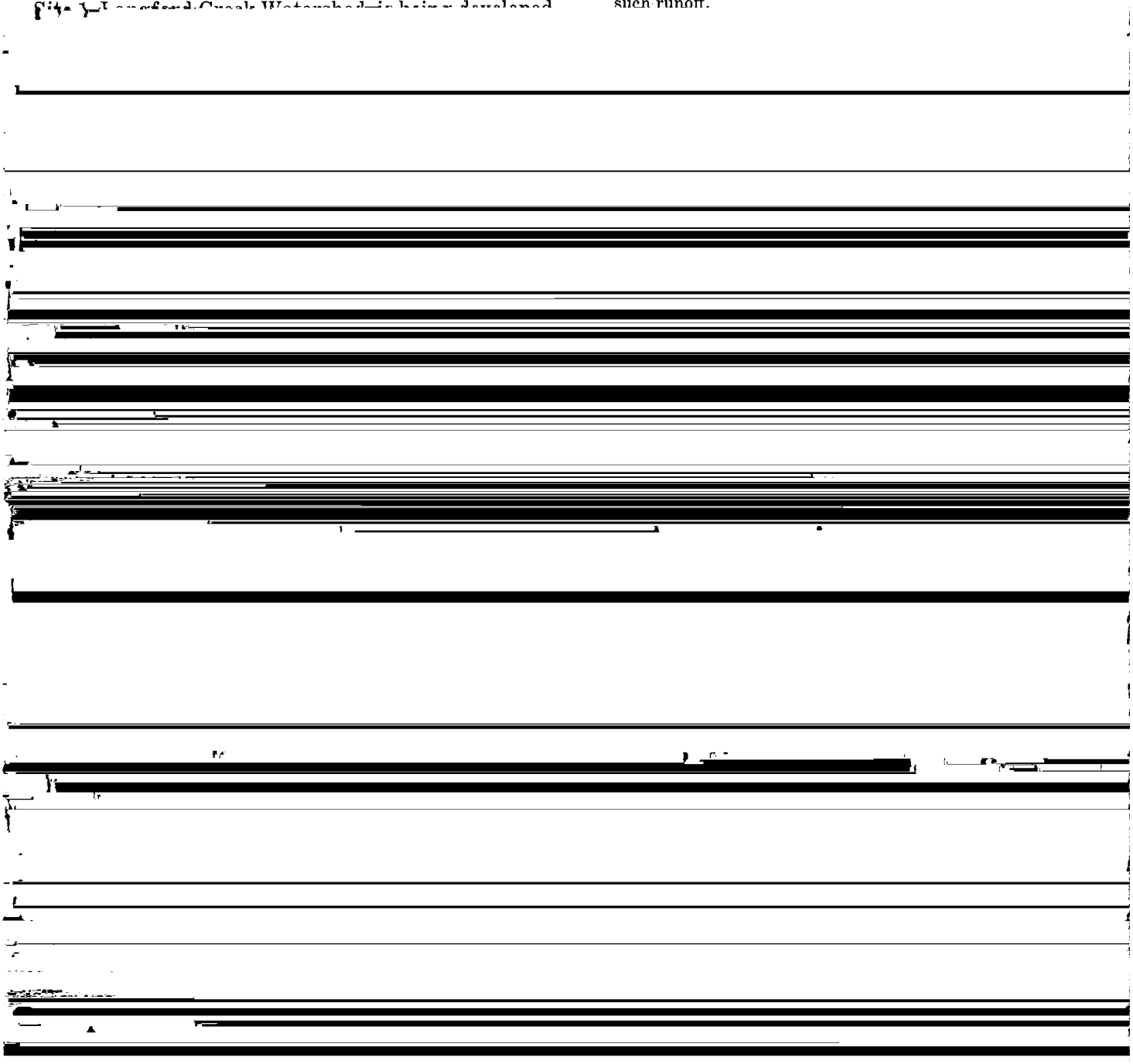
Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard and brittle; little affected by moistening.

Deferred grazing. The practice of delaying grazing until range plants have reached a definite stage of growth, in order to increase the vigor of the forage and to allow the desirable plants to produce seed. Contrasts with continuous grazing and rotation grazing.

Diversion, or diversion terrace. A ridge of earth, generally a terrace, that is built to divert runoff from its natural course and, thus, to protect areas downslope from the effects of such runoff.



example, a notation of 10YR 6/4 is a color with a hue of 10YR, a value of 6, and a chroma of 4.

Ped. An individual natural soil aggregate, such as a crumb, a prism, or a block, in contrast to a clod.

Permeability. The quality that enables the soil to transmit water or air. Terms used to describe permeability are as follows: *very slow, slow, moderately slow, moderate, moderately rapid, rapid,* and *very rapid.*

Phase, soil. A subdivision of a soil series or other unit in the soil [illegible]

meter); *coarse sand* (1.0 to 0.5 millimeter); *medium sand* (0.5 to 0.25 millimeter); *fine sand* (0.25 to 0.10 millimeter); *very fine sand* (0.10 to 0.05 millimeter); *silt* (0.05 to 0.002 millimeter); and *clay* (less than 0.002 millimeter). The separates recognized by the International Society of Soil Science are as follows: I (2.0 to 0.2 millimeter); II (0.2 to 0.02 millimeter); III (0.02 to 0.002 millimeter); IV (less than 0.002 millimeter).

Solum. The upper part of a soil profile, above the parent material, [illegible]

[redacted]

that affect its management but do not affect its classification in the natural landscape. A soil series, for example, may be divided into phases because of differences in slope, stoniness, thickness, or some other characteristic that affects its management but not its behavior in the natural landscape.

pH value. A numerical means for designating acidity and alkalinity in soils. A pH value of 7.0 indicates precise neutrality; a higher value, alkalinity; and a lower value, acidity.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisure content within which the soil remains plastic.

Plastic limit. The moisture content at which a soil changes from a semisolid to a plastic state.

Profile, soil. A vertical section of the soil through all its horizons and extending into the parent material.

Reaction, soil. The degree of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is precisely neutral in reaction because it is neither acid nor alkaline. [illegible]

in mature soil includes the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and other plant and animal life characteristic of the soil are largely confined to the solum.

Structure, soil. The arrangement of primary soil particles into compound particles or clusters that are separated from adjoining aggregates and have properties unlike those of an equal mass of unaggregated primary soil particles. 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 together without any regular cleavage, as in many claypans and hardpans).

Substratum. Technically, the part of the soil below the solum.

Surface soil. The soil ordinarily moved in tillage, or its equivalent [illegible]

[redacted]

GUIDE TO MAPPING UNITS

For a full description of a mapping unit, read both the description of the mapping unit and that of the soil series to which the mapping unit belongs. In referring to a capability unit or other land use interpretative group, read the introduction to the section it is in for general information about its management. Dashes indicate that the soil was not placed in a particular grouping. Other information is given in tables as follows:

Acreage and extent, table 1, page 7.
Predicted yields, table 2, page 44.
Suitability of soils for woodland, table 3, page 50.
Suitability of soils for elements of wildlife habitat and for kinds of wildlife, table 4, page 63.
Degree of limitation and major factors affecting recreational uses, table 5, page 66.
Use of soils in engineering, tables 6, 7, and 8, pages 68 through 81.

Map symbol	Mapping unit	Page	Capability unit		Pasture and hayland group		Woodland suitability group		Woodland grazing group
			Symbol	Page	Symbol	Page	Symbol	Page	Name
AfB	Annona-Freestone complex, 1 to 3 percent slopes	8	IIIe-1	41	--	--	---	--	----------
	Annona part	--	------	--	8A	48	4c2	60	Tight Sandy Loam
	Freestone part	--	------	--	8C	48	3w8	60	Sandy Loam
AuB	Austin silty clay, 1 to 3 percent slopes	9	IIIe-3	41	7C	48	---	--	----------
BeB	Bernaldo-Elysian complex, 1 to 3 percent slopes	10	IIe-1	40	8C	48	2o7	58	Sandy Loam
BrC	Bryarly clay loam, 1 to 5 percent slopes	11	IVe-1	42	8A	48	5c2	60	Tight Sandy Loam
BuA	Burleson clay, 0 to 1 percent slopes	11	IIw-3	41	7A	47	---	--	----------
BuB	Burleson clay, 1 to 3 percent slopes	12	IIe-3	40	7A	47	---	--	----------
CrB	Crockett loam, 1 to 3 percent slopes	12	IIIe-1	41	8A	48	---	--	----------
CuD2	Cuthand loam, 4 to 8 percent slopes, eroded	13	VIe-2	43	7D	48	---	--	----------
DaB	Deport clay, 1 to 3 percent slopes	14	IIIe-5	41	7A	47	---	--	----------
DeA	Desha clay, 0 to 1 percent slopes	14	IIIw-2	42	1A	47	2w6	59	Clayey Bottomland
DeB	Desha clay, 1 to 3 percent slopes	14	IIIw-2	42	1A	47	2w6	59	Clayey Bottomland
EsC	Ellis clay, 3 to 5 percent slopes	15	IVe-1	42	7A	47	---	--	----------
FeD2	Ferris clay, 3 to 8 percent slopes, eroded	16	VIe-2	43	7B	48	---	--	----------
FrA	Freestone-Addielou complex, 0 to 1 percent slopes	17	IIw-2	41	8C	48	---	--	Sandy Loam
	Freestone part	--	------	--	--	--	3w8	60	----------
	Addielou part	--	------	--	--	--	3o7	59	----------
Gd	Gladewater clay	18	IIIw-2	42	1B	47	2w6	59	Clayey Bottomland
Gf	Gladewater clay, frequently flooded	18	Vw-3	42	1B	47	2w6	59	Clayey Bottomland
HaB	Hapludalfs, loamy, 0 to 2 percent slopes	19	I-1	40	2A	47	2o4	58	Loamy Bottomland
HoB	Houston Black clay, 1 to 3 percent slopes	19	IIe-2	40	7A	47	---	--	----------
Ka	Kaufman clay	20	IIw-1	40	1A	47	1w6	58	Clayey Bottomland
Kb	Kaufman clay, frequently flooded	20	Vw-3	42	1A	47	1w6	58	Clayey Bottomland
KeD	Kenney loamy fine sand, 2 to 8 percent slopes	21	IIIe-4	41	9B	49	3s2	60	Sandy
Ko	Kiomatia loamy fine sand, frequently flooded	21	Vw-2	42	3A	47	2w5	58	Sandy Bottomland
KuB	Kullit-Addielou complex, 1 to 3 percent slopes	22	IIe-1	40	8C	48	---	--	Sandy Loam
	Kullit part	--	------	--	--	--	2w8	59	----------
	Addielou part	--	------	--	--	--	3o7	59	----------
MaA	Mabank fine sandy loam, 0 to 1 percent slopes	23	IIIw-1	42	8A	48	---	--	----------
McC	McKamie loam, 1 to 5 percent slopes	24	IVe-1	42	8A	48	3c2	60	Tight Sandy Loam
McE	McKamie loam, 5 to 12 percent slopes	24	VIe-1	43	8B	48	3c2	60	Tight Sandy Loam
MoD2	Morse clay, 3 to 8 percent slopes, eroded	25	VIe-2	43	7B	48	---	--	----------

Map symbol	Mapping unit	Page	Capability unit		Pasture and hayland group		Woodland suitability group		Woodland grazing group
			Symbol	Page	Symbol	Page	Symbol	Page	Name
Mu	Muldrow silty clay loam	25	IIw-2	41	1A	47	2w5	58	Clayey Bottomland
Mx	Muldrow-Elysian complex	25	IIw-2	41	--	--	---	--	----------
	Muldrow part	--	------	--	1A	47	2w5	58	Clayey Bottomland
	Elysian part	--	------	--	8C	48	2o7	58	Sandy Loam
Na	Nahatche soils, frequently flooded	26	Vw-1	42	2C	47	1w6	58	Loamy Bottomland
Of	Oklared fine sandy loam	27	IIw-4	41	2A	47	2o4	58	Loamy Bottomland
Ok	Oklared silty clay loam	27	IIw-4	41	2A	47	2o4	58	Loamy Bottomland
Pa	Panola silty clay	27	IVw-1	42	8E	48	---	--	Flatwoods
Rc	Redlake clay	28	IIIw-2	42	1A	47	3w6	60	Clayey Bottomland
Rd	Redlake soils	28	IIIw-3	42	2A	47	3w6	60	Loamy Bottomland
Rf	Roebuck clay, calcareous variant	29	IIIw-2	42	1A	47	2w6	59	Clayey Bottomland
RsC	Rosalie loamy fine sand, 2 to 5 percent slopes	30	IIIs-1	42	9A	48	3s2	60	Sandy
Th	Thenas fine sandy loam, frequently flooded	30	Vw-1	42	2A	47	1w8	58	Loamy Bottomland
Tr	Trinity clay	31	IIw-1	40	1A	47	1w6	58	Clayey Bottomland
Ts	Trinity clay, frequently flooded	32	Vw-3	42	1A	47	1w6	58	Clayey Bottomland
Va	Varro clay loam	32	Vw-1	42	2A	47	1w5	58	Loamy Bottomland
VeD	Vesey fine sandy loam, 3 to 8 percent slopes	33	IIIe-2	41	8C	48	3o1	59	Sandy Loam
VeF	Vesey fine sandy loam, 8 to 20 percent slopes	33	VIe-3	43	8D	48	3o1	59	Sandy Loam
Wa	Waskom loam	34	IIw-2	41	2A	47	2w5	58	Loamy Bottomland
WhD	Whakana loam, 3 to 8 percent slopes	35	IIIe-2	41	8C	48	2o7	58	Sandy Loam
WkA	Whakana-Elysian complex, 0 to 1 percent slopes	35	I-1	40	8C	48	2o7	58	Sandy Loam
WoC	Woodtell fine sandy loam, 1 to 5 percent slopes	37	IIIe-1	41	8A	48	4c2	60	Tight Sandy Loam
WoE	Woodtell fine sandy loam, 5 to 12 percent slopes	37	VIe-1	43	8B	48	4c2	60	Tight Sandy Loam
Wr	Wrightsville-Rodessa complex	38	IVw-1	42	--	--	---	--	----------
	Wrightsville part	--	------	--	8E	48	3w9	60	Flatwoods

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