Number 21 Series 1923

UNITED STATES DEPARTMENT OF AGRICULTURE
BUREAU OF CHEMISTRY AND SOILS
In cooperation with the Iowa Agricultural Experiment Station

SOIL SURVEY
APPANOOSE COUNTY, IOWA

BY

C. L. ORRBEN, Iowa Agricultural Experiment Station, in Charge, and
W. W. STRIKE, U. S. Department of Agriculture

Beginning with the 1923 Series, Soil Survey Reports will be issued separately. These reports of the individual areas will be sent to libraries as soon as they are available and should be filed, preserved, and ultimately bound to take the place of the bound volumes of the Field Operations which have previously been supplied by the department. The reports for each year will be consecutively numbered, the last report for a particular year bearing the conspicuous notice: "This number is the final and last Soil Survey Report for the Year 192-."

UNITED STATES
GOVERNMENT PRINTING OFFICE
WASHINGTON
1928

BUREAU OF SOILS

MILTON WHITNEY, *Chief*
WILBERT W. WEIR, *Acting Editor*

SOIL SURVEY

CURTIS F. MARBUT, *Chief*
T. D. RICE, *Inspector District 3*

COOPERATION

IOWA AGRICULTURAL EXPERIMENT STATION

C. F. CURTISS, *Director*
W. H. STEVENSON, *in Charge Soil Survey*
P. E. BROWN, *Associate in Charge*

CONTENTS

	Page
County surveyed	683
Climate	685
Agriculture	686
Soils	692
Grundy silt loam	696
Grundy silty clay loam	697
Putnam silt loam	698
Shelby loam	699
Edina silt loam	701
Marion silt loam	702
Clinton silt loam	703
Lindley loam	704
Crawford loam	705
Calhoun silt loam	705
Waukesha loam	706
Bremer silt loam	707
Wabash silty clay loam	708
Wabash silt loam	709
Wabash loam	709
Summary	710

SOIL SURVEY OF APPANOOSE COUNTY, IOWA

By C. L. ORRBEN, Iowa Agricultural Experiment Station, in Charge, and W. W. STRIKE, U. S. Department of Agriculture

COUNTY SURVEYED

Appanoose County, in southeastern Iowa, has an area of 513 square miles, or 328,320 acres. The county comprises 12 congressional townships and parts of 4 others, and is divided into 17 civil townships.

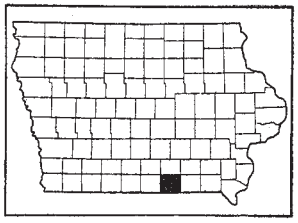


FIG. 24.—Sketch map showing location of Appanoose County, Iowa

The outstanding topographic feature of the county is a broad, even plain which is extensively dissected by stream channels. Chariton River has cut a deep, wide valley through the level country. The irregularity of the surface relief, apparent in the contrast between the level plain on the wide divides and the hilly and broken lands adjacent to streams, has been caused by erosion. The flat prairie land lies at a considerable distance from the master stream, where the naturally level surface has so far been unaffected by erosion. Immediately adjacent to and on the north side of Chariton River which enters the county from the northwest the slopes are very steep, whereas those facing south as well as those formed by the smaller tributaries are long and gentle, with rounded ridges. Soap Creek, North Soap Creek, and their numerous tributaries in the northeastern part of the county have cut deep gorges, leaving steep rugged slopes with narrow sharp ridges of upland and V-shaped valleys. Stream beds are from 50 to 150 feet below the original plain. Similar channels have resulted in the western part of the county from the erosion caused by South Chariton River and Walnut, Cooper, and Shoal Creeks.

In the southern part of the county the effect of erosion upon what was once a flat prairie region is evident in the narrow channels and sharp ridges formed by the branching tributaries of the creeks. Flat areas at some distance from the principal streams and high on the divides where the tributaries have not yet cut show the land in its original level condition. This same condition is seen in the northern half of the county at some distance from the Chariton River Valley. Here the topography is much less rugged, the valleys are U-shaped, and the slopes long and gentle, although drainage is fairly well developed. Serious damage from excessive erosion is not so marked in this section and there are many extensive areas of level or rolling country, some of them being several miles in width.

Chariton River winds in a tortuous course over its broad flood plain, the first bottoms narrowing to barely one-fourth of a mile in width about 4 miles north of Centerville and broadening out above

and below that point, in some places being 2½ miles wide. Remnants of narrow terraces from 8 to 20 feet above the first-bottom level and adjacent to the bluffs may be seen where smaller tributaries empty into the master stream. First bottoms bordering creeks occur as narrow strips rarely exceeding one-fourth of a mile in width.

Appanoose County is on the divide between Missouri River and Mississippi River, consequently the drainage ways of the county belong in part to the Mississippi River system and in part to the Missouri River system. In general the county slopes south and east, as indicated by the course of the Chariton River and some of its principal tributaries. Soap Creek and North Soap Creek which drain the northeastern corner and Fox River which drains the east-central part of the county, belong to the Mississippi River system, whereas Chariton River and its tributaries which drain the remainder of the county, are a part of the Missouri River system. The divide separating the two systems extends across the northeastern part of the county from Moravia to Moulton and the Wabash Railway follows the crest of this divide.

Altitudes[1] in the county range from 831 feet above sea level at Sedan in the bottom land of Chariton River, to 1,042 feet at Jerome on an upland divide between Walnut and Cooper Creeks. Centerville, in the center of the county, has an elevation of 1,017 feet, Brazil 955 feet, Moravia 1,001 feet, Plano 1,030 feet, Numa 1,037 feet, Exline 1,013 feet, Dean 834 feet, Moulton 987 feet, and Udell 996 feet. The lower elevations are along Chariton River.

Appanoose County was organized in 1846, although the first settlement was made several years prior to that date. In the summer of 1832, a company of cavalry from Davenport established a trail westward which passed through the county north of the present sites of Moulton and Cincinnati and continued into Wayne County. Hunters from Missouri, in search of game and bee trees, also blazed a trail northward through the county. In 1839, a few families from Missouri settled in wooded country along Chariton River, but not until 1841 did the territory show any marked increase in population. The rich prairie lands were the last to be settled.

As early as 1848 a post office was established in Washington Township at Beetrace, and the first claim to proprietorship of land was made in 1847 in Union Township, the first deed being recorded in 1850. In 1839, the Governor of Missouri laid claim to a piece of territory within the State of Iowa and extending into Appanoose County. The boundary dispute resulting from this claim was finally settled in 1850 by the board of commissioners.

The greater proportion of early settlers were native-born Americans from Kentucky, Tennessee, Virginia, Indiana, and Missouri, expert hunters and trappers, who obtained their living through the sale and barter of hides and furs. Some foreigners from southern Europe have been brought in more recently to work in the coal mines. The population of the county in 1920, according to the census, was 30,535, 19,253 of whom were classed as rural and 11,282 as urban. The rural population is well distributed over the

[1] GANNETT, H. (COMP.) A DICTIONARY OF ALTITUDES IN THE UNITED STATES. Ed. 4, 1072 p. Washington, D. C. 1906. (U. S. Geol. Survey Bul. 274.)

county with an average of 37.5 persons to the square mile, the hilly sections being somewhat more thickly settled.

Centerville, the county seat, is the largest town, with a population of 8,486 in 1920. Coal mining is the principal industry there. Mystic, with a population of 2,796, is the second largest town, and it has several large coal mines and serves as an important shipping point on the Chicago, Milwaukee & St. Paul Railway. Moulton in the southeastern part of the county has a population of 1,387, and it is a terminal for the Wabash Railway.

Almost all of Appanoose County is well supplied with railroad facilities. Public roads follow section lines wherever possible, but in the more hilly regions they are built along narrow ridges, regardless of section lines, in order to avoid steep and dangerous grades. Parts of the main roads have been brought to permanent grade, but owing to the nature of the soil, the roads are rarely smooth. The township roads are easily passable in dry weather.

Telephone lines reach all sections of the county and practically every farmhouse is equipped with this convenience.

Chicago, Kansas City, St. Louis, Omaha, and Minneapolis furnish ready markets for livestock and farm products. Centerville is the market for most of the garden and truck crops. Much of the coal mined is used locally and any surplus is shipped to points in Iowa, South Dakota, and Nebraska.

CLIMATE

Temperatures in Appanoose County range from —21° F., recorded during January and February, to 109° recorded in July and August. The mean annual temperature as recorded by the Weather Bureau station at Centerville is 51.8°. The summers are pleasant except for short but intense heat waves during July and August, often followed by thunderstorms. Winters are frequently severe, with periods of intense cold, accompanied by high winds, during January and February. From 10 to 25 inches of snow falls. Although there is a wide range in temperature, the climate of Appanoose County is healthful and favorable for growing staple crops.

The mean annual precipitation is 32.86 inches. During the wettest year on record (1915) 41.78 inches of rain fell, and during the driest year (1912) 18.83 inches. Precipitation is well distributed throughout the year, with the greatest fall during May and June, when the growing crops are in need of moisture, and the least in January. Droughts are uncommon and rarely last more than three to five weeks. More than one-half of the yearly precipitation occurs during the growing season, furnishing the crops with abundant moisture and promoting vigorous and rapid growth.

The average date of the last killing frost in the spring is April 20, with the latest frost recorded on May 13; the average date of the first killing frost in the fall is October 4, and the earliest recorded frost occurred on September 13. The average frost-free season is 166 days and the grazing season from four to six weeks longer.

In the following table the more important climatic data, as recorded at the Weather Bureau station at Centerville, are given.

Normal monthly, seasonal, and annual temperature and precipitation at Centerville

(Elevation, 1,013 feet)

Month	Temperature			Precipitation		
	Mean	Absolute maximum	Absolute minimum	Mean	Total amount for the driest year (1912)	Total amount for the wettest year (1915)
	°F.	°F.	°F.	Inches	Inches	Inches
December	27.4	66	−18	1.29	0.17	1.28
January	25.1	64	−21	.99	.14	2.48
February	28.4	67	−21	1.59	2.63	3.18
Winter	27.0	67	−21	3.87	2.94	6.94
March	40.4	79	−12	2.32	1.62	1.24
April	51.1	88	18	3.30	2.84	1.64
May	62.4	93	30	5.06	3.56	8.35
Spring	51.3	93	−12	10.68	8.02	11.23
June	72.6	101	39	4.18	1.41	5.90
July	76.3	109	47	2.90	1.22	6.02
August	74.2	109	39	2.86	1.84	4.43
Summer	74.4	109	39	9.94	4.47	16.35
September	67.0	106	28	4.25	.28	4.81
October	55.4	89	16	2.52	2.17	.86
November	42.2	78	3	1.60	.95	1.59
Fall	54.9	106	3	8.37	3.40	7.26
Year	51.8	109	−21	32.86	18.83	41.78

AGRICULTURE

Agriculture in Appanoose County dates back to 1841, when the first white settlers established themselves along the wooded slopes of Chariton River. The forested land along this stream was selected in preference to the level plains because of the abundance of material for building homes, the ready fuel and water supply, and the nearness to hunting grounds. Only small patches of land were cleared and broken, and enough grain and garden products were raised to supply the needs of the household.

Trapping, hunting, and fishing were the chief occupations of the pioneers, and not until 1850, when a group of immigrants from the south settled in the county, was agricultural development really begun. With the slow but steady increase in population the acreage devoted to grain production enlarged, and the rich, level prairie lands were finally settled. Enough cattle and hogs were raised to supply fresh meat throughout the year. Livestock roamed the woods and prairies, the cattle feeding on the luxuriant grasses and the hogs fattening on the acorns and nuts of the forest.

Settlers from Kentucky and Tennessee introduced the practice of breeding and raising fast horses, so that until very recent years Appanoose County was noted for its fast saddle and road horses.

Improvement of farm machinery and the establishment of railroads and good public highways have brought about gradual changes in farming methods. With modern farm equipment one man can

easily do the work which formerly required six or eight men. With the cultivation of extensive prairie lands the acreage of corn and small grains increased, and as early as 1867 surplus grain and other farm products were shipped from the county. Improved farm machinery was an important factor in increasing the average size of the farms from 80 acres in 1860 to 136 acres in 1880. Since that time the average size has not changed materially. In 1919, according to the United States census report, the average farm comprised 135.4 acres.

Agricultural activities at the present time (1923) consist chiefly of the production of corn, small grains, and hay, some fruit, potatoes, sweet corn, and truck crops for the local markets, and the raising of cattle, hogs, sheep, horses, and poultry. Since the earliest settlement of the county the acreage of corn has exceeded that of other grain crops.

The following table shows the acreage and yields of the principal crops from 1879 to 1924:

Acreage and yields of principal crops in 1879, 1889, 1899, 1909, 1919, and 1924

Year	Corn		Oats		Wheat		Hay	
	Acres	*Bushels*	*Acres*	*Bushels*	*Acres*	*Bushels*	*Acres*	*Tons*
1879	63,232	2,410,620	18,598	643,704	6,759	65,793	39,714	42,883
1889	44,133	1,619,655	19,223	593,693	2,171	22,672	66,199	79,695
1899	60,725	1,870,930	8,416	220,440	376	2,410	65,158	70,800
1909	55,995	1,464,540	13,651	341,451	3,209	38,791	57,631	65,157
1919	48,289	1,618,648	22,662	549,175	20,605	267,640	37,117	38,552
1924	48,283	1,140,980	18,256	486,675	1,923	24,862	57,386	46,590

In 1879 in addition to the principal crops $75,905 worth of orchard, garden, and forest products were sold or consumed. Of the miscellaneous crops potatoes were the most important, yielding 75,712 bushels. In 1889 the production of all crops, with the exception of hay, which almost doubled in acreage and yield, decreased materially. Yields of other crops did not differ materially from those of the previous 10-year period; 79,977 bushels of potatoes were raised and small quantities of flaxseed, broomcorn, and cane sorghum.

The acreage of corn in 1899 increased by 16,000 acres, but the average yield was less than in 1889. The acreage of oats and wheat greatly decreased in 1899 owing to the destructive ravages of the chinch bug, Hessian fly, and the rusts. In that year only 376 acres of wheat were planted. By 1909 practically all the crops were back to a normal acreage and there was but little fluctuation between 1909 and 1916. During the period from 1916 to 1919 every available acre was placed under cultivation and planted to corn or wheat. Prices were very high, since the demand for grain was greater than the supply. But at the end of the World War the acreage planted to corn decreased somewhat, remaining at about 48,000 acres for the last five years. With the Hessian fly and the chinch bug under control, winter wheat has been established as a profitable cash crop. A small acreage is devoted to rye, barley, buckwheat, millet, potatoes, flax, sorghum, alfalfa, and sweet clover. Apples, pears, plums, cherries, grapes, and the small bush fruits serve as a source of income on farms convenient to local markets.

Livestock raising and fattening is an important activity on all farms in the county. Several large hog farms are located near Centerville, and one on which several hundred head are raised and fed annually, is the largest farm in the United States devoted exclusively to hog raising. Hogs are raised on every farm, the number depending on the selling price the previous year, the size of the farm, and the quantity of feed produced. From 25 to 125 hogs are raised each year on the farm of average size. The brood sows are selected from the previous year's herd and bred to farrow in March or April. Some farmers breed the same sows to farrow again in the early fall, thus obtaining two litters of pigs each year. This practice is gaining favor among farmers in the county. During the summer months the young pigs are allowed to run in the pasture and fed only sufficient grain to keep them in good condition. In the fall, when the corn crop matures, they are placed in the fattening pens, fed heavily on corn and tankage until December or January, when they are marketed as fat hogs. The practice of "hogging down" corn, adopted in recent years by many farmers, is considered a very good method of feeding. When the corn crop is to be fed in this manner it is customary to plant soy beans with the corn, thus furnishing a more balanced ration for the hogs. Duroc-Jersey hogs are the favorite breed throughout the county, although Hampshire, Chester White, and Poland-China hogs are also raised in large numbers.

Beef cattle are usually purchased in carload lots from livestock markets, good western cattle being preferred. These are fed from two to six months and placed on the market as finished fat cattle. Corn, cottonseed or flaxseed meal, roughage such as clover, timothy, or alfalfa hay, and silage, constitute the ration for fattening cattle. On some of the larger farms several hundred head are pastured and fed annually, but the average farmer does not attempt to feed more than 1 or 2 carloads each year. Herefords are preferred by most farmers, but small herds of purebred Shorthorns and Angus are also fed. Both cattle and hogs are marketed at Ottumwa, Chicago, Omaha, Kansas City, or St. Louis.

In Appanoose County the rough hilly lands which prohibit the production of cultivated crops without serious damage by erosion, but support a good bluegrass pasture throughout the year, are well adapted to dairy farming. Fields on ridges supply sufficient corn, oats, silage, and hay for winter feeding, and numerous towns and mining camps provide a ready market for milk and other dairy products. Practically all farms in the rougher regions have from 5 to 20 cows, the number depending upon the nearness to towns and the pasture available. The larger dairy herds are in the vicinity of Centerville. Creameries, milk stations, and cheese factories located at convenient points, collect the dairy products and transfer them to the central stations from which they are sold wholesale or retail.

Cattle and hogs are the more important farm animals. Horses and mules are kept mainly as work animals, and small flocks of sheep and goats for the purpose of cleaning up hilly brush land. Poultry raising, although practiced throughout the county, is of minor agricultural importance.

The following table shows the number and kind of livestock on farms from 1880 to 1925 as reported by the Bureau of the Census:

Number and kind of livestock on farms, 1880 to 1925

Year	Swine	Cattle	Sheep	Horses	Mules
1880	47,557	27,937	11,018	7,800	675
1890	36,667	45,621	9,911	13,477	445
1900	41,557	48,069	9,510	12,120	794
1910	24,864	34,457	18,551	11,946	1,137
1920	36,627	31,285	29,775	10,695	1,219
1925	33,186	29,808	22,362	8,517	1,380

Agriculture is the most important industry of the county. General farming practices are followed, including the growing of corn and small grains, combined with the raising of livestock. Specialized farming is practiced only on farms located near large towns, where the products find a ready market. The general farm income is derived from the sale of corn, small grains, livestock, dairy products, eggs, and poultry. Small quantities of tree fruits, honey, and cane sorghum are sold locally.

Topography has been an important factor in determining the type of farming followed in different parts of the county. In hilly regions, where erosion is a serious factor, the land is kept in meadow or pasture as long as possible. Corn is grown on slopes after they have been enriched by meadow grasses. It is planted for two years only, and then is followed by winter wheat or some other small grain, which serves as a nurse crop for the clover and timothy planted on the same land with it in the spring. This system of rotation is advantageous to dairy farming and the pasturing of beef cattle through the grazing season.

The undulating or rolling land characteristic of the plains or ridges is adapted to the production of corn and small grains and to hog raising and cattle feeding. The grain produced is generally fed to livestock. In recent years, owing to the high prices paid, a large quantity of grain has been sold to the local elevators, but since the more recent drop in price for all farm products, livestock feeding is again becoming profitable.

Corn as the chief grain crop grown follows oats or wheat on those farms where no meadow or legume crop is grown, but on the better-planned farms it follows clover and timothy pasture. This sod land is carefully plowed in the fall and thoroughly disked and dragged in the spring, thereby insuring a compact though mellow seed bed. Corn is commonly planted in checkrows, usually about May 5, the date depending upon seasonal conditions, but when the crop is to be used for silage or soiling purposes it is often drilled in rows. As many as five cultivations may be given, depending upon the growth of weeds and the frequency of rain. Single or two row cultivators drawn by horses are used for this purpose. Some of the crop is cut green for silage and early fall feeding and some when the grain is mature. When mature it is shocked in the field, to be husked later, and the stalks are fed to livestock as roughage. The greater part of the crop, however, is husked by hand, stored in cribs to be used for

feeding, or shelled and sold. Reid Yellow Dent and Boone County White are the principal varieties grown, and Silver King, Iowa Silvermine, Bloody Butcher, and strains or mixtures of these varieties are also raised.

Small grains are planted following the corn crop. Since the loose stalks interfere with drill seeding, it is the common practice to broadcast the seed. Where winter wheat is the small-grain crop, the land is plowed in late summer, then thoroughly disked and dragged. It is well not to seed until danger from the Hessian fly is past. All the small grains mature during July and are cut with binders and shocked in the field to properly cure and dry before being threshed or stacked. Most of the grain is threshed directly from the shock.

Wheat is an important cash crop. It is marketed at the local elevators and from there shipped to the terminals. The principal wheat varieties are Turkey and Kanred. Oats are used as feed for the work animals or ground and used as part of the ration in the feeding of cattle, hogs, and sheep. The principal varieties grown are Albion (Iowa 103), Richland (Iowa 105), Green Russian, Iowar, Iogren, and Early Champion. Clover and timothy, separately or in mixture, are sown in the spring with some small grain to afford protection for the young plants until they have become hardy enough to withstand the strong rays of the sun. After the nurse crop is removed from the field the young clover plants grow more rapidly. Some farmers cut one crop of clover the year it is planted, whereas others use the first year's growth for pasturage. Clover makes a vigorous growth the second year and is ready to cut by the latter part of June. The second crop is cut either for hay or for seed. When cut for seed the whole plant is left on the field until mature enough so that the seed shatters from the head easily. Hulling machines are used to separate the seed from the chaff and stems. Timothy makes its best growth the second year. After one or two cuttings of hay have been made, timothy fields are used for pasture as long as the grass flourishes.

Topographical conditions are more important than the soil types in determining the kinds of crops to be grown. The level or rolling upland plains, the terraces, and the wide bottoms are the best cornlands, whereas the slopes of the rougher areas are utilized as hay and pasture land.

Farm buildings in Appanoose County are kept in good repair. Modern homes, barns, hog houses, and poultry houses are rapidly replacing the older buildings. Silos are used on the better farms, particularly in the dairying districts, thereby insuring a supply of succulent feed during the winter months.

Modern labor-saving machinery, including tractors, plows, disks, drags, corn planters, seeders, cultivators, grain and corn binders, hayracks, hay tedders and loaders, and manure spreaders are in general use. Grain threshers and clover hullers are owned cooperatively by groups of neighboring farmers. However, horses and mules furnish the greater part of the farm power. Tractors are used in plowing and pulling hedge from the fence rows.

Many of the farms are inclosed by hog-tight fences. Osage orange hedgerows which were planted along section lines and between fields in the early days when fencing material was expensive,

served as excellent barriers to the livestock, but these hedges are now considered impractical and are being replaced by woven-wire fences.

The water supply is obtained from shallow wells, either bored, drilled, or dug, and from ponds made by damming shallow swales. Windmills are used on most farms to pump water into supply tanks from which it may be piped to barns and feed lots.

Systematic crop rotations are practiced by some of the better farmers of Appanoose County, but on the average farm systematic cropping is not practiced. In the common rotation corn, the principal crop, is grown for two years, followed by a small-grain crop, usually oats or wheat, for one year. Timothy and clover are seeded with the small grain and constitute the hay crop. Sometimes corn is grown for three years and small grain for one year, after which clover is seeded. One crop of hay is cut and the second growth turned under as green manure. On the more hilly farms where the slopes prohibit thorough cultivation without damage through erosion, crops which do not require cultivation are preferred. On many cultivated bottom-land soils corn is grown continuously for several years with no apparent depletion of fertility, because these soils are high in organic matter and naturally fertile.

Manure is the principal fertilizer used, and commercial fertilizers are not in common use. Limestone is used to correct soil acidity on fields intended for sweet clover or alfalfa. Of the 2,283 farms in the county which average 135 acres each, only 41 reported the use of commercial fertilizers in 1919, and less than $110 per farm was spent for it.

The majority of the farm laborers are native-born Americans, though farmers living near mining camps often hire negroes and foreigners during the busy harvest season. Farm help is usually scarce when most needed and laborers command high wages. Harvest hands receive from $2 to $4 a day with board and lodging, and when hired by the month they receive from $45 to $60 during busy seasons and from $25 to $45 when they stay on the farm throughout the year. In corn-husking season from 4½ to 6 cents a bushel is paid for picking and cribbing the corn.

According to the 1920 census report for Appanoose County, 94.1 per cent of the total land area is in farms, and 78.2 per cent of this area consists of improved land. Of the 2,283 farms in the county, 75.6 per cent are operated by owners, 23.8 per cent by tenants, and 0.6 per cent by managers. A very small proportion of the tenant farms are rented for cash. On the share basis the owner furnishes the land, pays the taxes, usually buys the seed, and is the general overseer of the business, and the tenant supplies the machinery and labor. The owner usually receives one-half the corn, two-fifths of the small grain, and from $1 to $3 an acre for the use of hay and pasture land, unless livestock is kept in common, when all the farm products are fed or divided equally and the livestock sold in partnership.

The value of farm land depends largely upon the kind or type of soil, topography, location, and improvements. During 1923 estimates on land values obtained from farmers in several parts of the

county varied from $50 to $65 an acre for rough, hilly land and from $125 to $300 an acre for level or rolling land.

SOILS

The soils of Appanoose County have been differentiated in this report into series and types on the basis of their most obvious characteristics and their chemical constituents so far as these could be readily determined in the field. The features that distinguish the soil groups have been produced mainly by the accumulation of organic matter and by other soil-forming processes that may be classed under the general term weathering, but may include leaching, oxidation, aeration, etc. The composition of the parent rock from which the soils have developed has influenced the character of the upper 2 or 3 feet only to a slight degree, and below these depths the parent material exists in a much less altered condition.

The stage to which weathering has advanced depends on the intensity of the action of the soil-forming agents, the resistance of the materials, and the time during which the materials have been exposed to weathering action. It is only on the nearly level and well-drained upland that the most advanced stage of weathering and soil development is found. On eroded slopes the surface portion of the soil is being continually removed by erosion. Forests have gained a foothold on the slopes and provided conditions favorable for the development of soils widely different from those on level prairies. On poorly drained areas, where either surface or subsoil drainage, or both, have been retarded, the soil-forming processes have acted more slowly and other soils have developed.

The soils of the prairie region of the county have dark-colored surface layers and are nearly coextensive with the areas which were treeless when the country was first settled by the white man. The soils owe their dark color to a high percentage of organic matter, which is characteristic of soils formed under luxuriant grass vegetation where optimum moisture conditions prevail. The organic matter consists of finely divided black carbonaceous material from the decay of grass roots, mixed with the mineral constituents of the soil. The depth of this dark color depends on drainage conditions. On areas of restricted drainage the solid black color reaches a depth of about 12 inches, but streaks of black may penetrate to a depth of 2 or more feet in such quantity as to give a dark color to the soil mass. Drainage conditions have also influenced the texture, structure, and other properties of the soils.

In the flatter areas of dark-colored soils where drainage is, or was formerly more or less restricted and the soil is very moist, a characteristic profile has developed. Large quantities of organic matter in the surface soil give a solid, very dark, almost black color to depths ranging from 6 to 12 inches, and the soil is usually finely granular and loose and mellow when dry. Below this to depths ranging from 12 to 20 inches, the texture becomes heavier and faint gray splotches occur. The next layer to a depth of 30 or 40 inches is heavy mottled clay. The heaviest texture occurs between depths of 16 and 26 inches, the upper part of this layer having a dark mottled appearance when it is cut, but when broken the material is almost black. The dark material of the cut surface is lighter and more mottled lower

down where not so much of the organic matter from the surface has penetrated as in the upper part of the layer. Below this heavy layer is the less weathered parent material, which is usually grayish-yellow, yellow, or gray clay, more silty and friable than the layer above, with numerous iron stains and concretions. This profile is developed in the soils of the Grundy series, typically in Grundy silt loam.

On the well-drained areas on terraces and on rolling areas originally covered by prairie grasses along streams and drainage ways, the dark-colored surface soils have developed to less depth than on more level areas. The surface layer varies in thickness from 4 to 12 inches, with an average of about 6 inches, and is dark grayish brown, though not so dark as Grundy soil. The transition zone below the surface soil, through which the dark organic matter from above seeps and coats the soil granules, is much thinner than in Grundy soils, and in many places the transition from the surface soil to the brown layer is abrupt. At depths varying from 24 to 30 inches is the parent material, which is little altered by weathering. Where this material is Kansan drift the texture is variable, usually silty clay or clay containing gravel, coarse sand, and occasional bowlders. There is generally enough clay in the parent material to give a sticky, somewhat plastic consistence. The variegated color imparted for the most part by the partly decomposed rock is predominantly brown, but spots and splotches of red, yellow, and gray may occur. Exposures in a cut usually are brown or reddish brown. Soils having these charasteristics, developed over glacial drift, are classed as the Shelby soils. The well-drained soils in a similar stage of development on the terraces are grouped in the Waukesha series.

As drainage ways began to cut their way back from the main channels, dividing, subdividing, and sending their fingerlike branches into the adjoining upland, areas of more thorough drainage spread out from the courses of the principal streams. A lowering of the water table in dissected areas resulted in better aeration of both soil and subsoil and the more rapid oxidation of the soil materials. This change in drainage and soil conditions brought about a change in vegetation. The prairie grasses that grew so abundantly under abundant moisture conditions were gradually replaced by trees which established themselves along the older streams, on the bordering slopes, and in places encroached for a short distance upon the flat upland. The tree and underbrush cover hindered the growth of the native grasses and brought about a decrease in the supply of organic matter in the soil. The disappearance of a large part of the humus has caused a change in the soil color from the dark brown or black common to the prairie regions to lighter colors. The surface soils are grayish brown or gray, have a single-grain structure, and vary in depth from 4 to 10 inches, with the usual depth about 6 inches. The topsoils are underlain to depths varying from 18 to 24 inches by brown or yellowish-brown silty clay loam or clay, heavier in texture than the surface soils. Below this layer the substratum representing the parent material continues to a depth of many feet. In the case of the Clinton soils this is a silty material, usually yellowish brown, somewhat mottled with gray, and discolored by iron stains. The Lindley soils overlie glacial drift and below 18 inches have the heterogeneous composition common to the drift of this region.

On flat wooded areas where drainage has been more restricted, a gray subsurface layer is developed. The next lower layer is brown and rather compact, and at depths ranging from 18 to 30 inches the parent material is found. Where this profile is developed over loess the soils are classed as Marion soils. Terrace soils having similar profiles have been classed as the Calhoun series.

The smooth, nearly level upland areas which have not been dissected to any great depth by erosion are covered by loess. It is probable that a large and varied area, possibly including the entire county, was at one time covered by this deposit, but erosion has been very active and has removed the loess from the greater part of the county and exposed the underlying Kansan drift. This drift is a heterogeneous mixture of clay, silt, sand, and gravel. From these materials all the soils of the county have developed, except small areas of Crawford loam, which developed over small exposures of limestone. Sediments brought largely from the loess and drift areas and redeposited in the valleys, make up the greater part of the parent material of the alluvial soils which occur on the first bottoms subject to flooding, or have been left on terraces above the stream level.

On the basis of the mode of accumulation of the parent materials, the soils of the county may be grouped as loessial soils, glacial soils, and alluvial soils. The loessial group includes the Grundy, Edina, Putnam, Clinton, and Marion series. Over the drift, Shelby and Lindley soils have developed. The soils of the Bremer, Waukesha, and Calhoun series of the alluvial group have developed on the terraces, and Wabash soils on the lower bottoms.

The soils of the Grundy series are characterized by dark grayish-brown or almost black, loose, finely granulated topsoils. The next lower layer is much heavier in texture, the structure distinctly granular, and the dark color gradually decreases with depth. This is underlain by silty, loessial parent material. The silt loam and silty clay loam members of this series are mapped in Appanoose County.

Soils of Putnam series are similar to the Edina soils except in the lighter color of the surface soil, which is doubtless caused by the forest growth that spread over areas of this soil within comparatively recent times. Putnam silt loam is mapped in this county.

The Shelby series includes soils having shallow dark-brown topsoils underlain by brown or yellowish-brown heavy subsoils, in turn underlain by a substratum representing the parent material, unweathered Kansan drift. Glacial gravel and bowlders are abundant throughout the soil. Shelby loam is the only type of this series mapped. The layers below the topsoil are variable in texture, commonly consisting of gravelly clay loam material.

Edina soils have very dark grayish-brown or black surface layers and gray subsurface layers underlain by heavy subsoils similar to those of the Grundy soils, and under this the loessial parent material. Silt loam is the only member of this series mapped in the county.

The surface soils of the Marion series vary from gray to chalky white, and are underlain by more compact layers of lighter color. The subsoils consist of gray, drab, or yellowish-brown mottled clay,

very tough and impervious. Numerous iron concretions occur in this layer and small black iron concretions are present in the substratum. Marion soils occur on flat or slightly undulating, poorly drained areas formerly in forested sections. Marion silt loam is mapped in Appanoose County.

The Clinton series is represented in this county by one soil type, Clinton silt loam, a gray or grayish-brown silt loam, underlain by yellow or grayish-brown, tough, compact, silty clay. This land is rolling or broken, with good or in some places excessive drainage. It is a forest soil and supports oak, elm, hickory, and ash.

The Lindley soils differ from the Shelby soils in having gray or grayish-brown surface soils. They are forest soils of drift origin. The areas of these soils are hilly and broken, and erosion is a serious factor in their management. Lindley loam is mapped.

In Appanoose County the Crawford series is represented by but one soil type, Crawford loam, which occurs in small areas along the larger creeks. This soil represents material derived from the weathering of limestone. The topsoil is dark-brown, very shallow loam, and the subsoil is reddish-brown or chocolate-brown, very heavy greasy or soapy clay. This soil occurs on the slopes adjacent to stream courses where both loess and drift have been removed and the bedrock exposed.

Calhoun soils have gray or brownish-gray surface soils underlain by light-gray or almost white, floury silt loam material which changes rather abruptly to dark-gray and drab waxy, impervious clay mottled with brown or rust-brown. Because the land is level, drainage is usually poor. Iron stains and concretions are present in both topsoils and subsoils. One type of this series, Calhoun silt loam, is mapped in the county.

Soils of the Waukesha series have dark-brown topsoils and brown or yellowish-brown friable subsoils, which are slightly heavier than the topsoils. The land is level or rolling and the drainage good. Waukesha loam is mapped in Appanoose County.

The soils of the Bremer series have the following common-to-all characteristics: (1) A dark-brown or black topsoil to depths varying from 18 to 24 inches; and (2) a subsoil composed of dark-gray or drab, compact, tough, impervious clay, mottled with yellowish brown. Iron stains are present in both soil and subsoil. The land is level, which prevents good drainage. Bremer silt loam is the only Bremer soil mapped in this county.

The Wabash soils include first-bottom lands along practically all the streams of the county. The surface soils are dark brown or black to considerable depth. Here the subsoils are gray heavy clay mottled with brown and rust-brown. The lighter members of this series are fairly well drained, but the heavier soils hold the moisture on the surface for several days after rains or flooding. The Wabash series is represented in this county by three members—loam, silt loam, and silty clay loam.

In the following pages of this report the various soil types are discussed in detail and their agricultural possibilities brought out, their general distribution is shown on the accompanying soil map,

and the acreage and proportionate extent of each soil type is given in the following table:

Acreage and proportionate extent of each soil type in Appanoose County

Type of soil	Acres	Per cent	Type of soil	Acres	Per cent
Grundy silt loam	84,800	25.8	Calhoun silt loam	2,048	0.6
Grundy silty clay loam	256	.1	Waukesha loam	768	.2
Putnam silt loam	23,808	7.3	Bremer silt loam	896	.3
Shelby loam	131,584	40.1	Wabash silty clay loam	13,952	4.2
Edina silt loam	1,152	.4	Wabash silt loam	11,968	3.6
Marion silt loam	5,056	1.5	Wabash loam	14,464	4.4
Clinton silt loam	1,984	.6			
Lindley loam	35,328	10.8	Total	328,320	
Crawford loam	256	.1			

GRUNDY SILT LOAM

The surface soil of Grundy silt loam to a depth of about 12 inches, is very dark grayish-brown, friable silt loam, mellow when dry, but sticky and almost black when wet. The structure is finely granular with some loose silt, and in the lower part of the surface soil faint gray splotches appear. Between depths of 12 and 17 inches the material is silty clay loam, slightly browner than the surface soil. The dark color occurs as a coating on the granules which when crushed are lighter than the broken surface of the clods. The granules are larger and more resistant than in the surface soil. The next layer, which reaches a depth of 25 inches, is heavy clay, compact in position, but disintegrating into a mass of distinct particles when removed. The broken clod appears almost black, but when closely examined the dark color is disclosed as a coating on the granules, the coloring substance being organic matter that has penetrated downward from the surface. Inside the dark coating is one of gray and the center of the granule is yellow or brown. Near the upper part of this layer the dark coating is thicker and may in some cases have permeated to the center of the granule. The dark coating decreases with depth and finally becomes so slight that the granules take on a mottled appearance. Numerous small, dark iron concretions hardly distinguishable among the soil granules may be found. To depths ranging from 36 to 48 inches, the dark coating of the particles becomes thinner and finally disappears, except along streaks, tongues, and spots where the dark organic matter has penetrated along cracks, root holes, or animal and insect burrows. The texture of the heavy silty plastic clay of this layer is slightly lighter than that in the layer above. Below this, the slightly weathered parent material consists of yellow silty clay loam, compact in position, but breaking up easily. Iron stains and concretions give a speckled and splotched appearance. Below a depth of 6 feet the texture may become heavier and less silty, and the color gray or gray mottled with yellow or rust-brown.

As mapped, areas of Grundy silt loam include many patches of Putnam silt loam, the most important of which are on the high divide between Chariton and Fox Rivers, and north of Plano and northwest of Walnut City.

The larger areas of Grundy silt loam are mapped in the northern part of the county, over entire ridges between drainage channels. In the southern part of the county smaller areas occur as narrow strips between areas of Shelby loam on slopes and Putnam silt loam on flat or undulating divides.

The surface drainage of Grundy silt loam varies. Where fields are nearly level, artificial drainage is necessary to carry off the surplus moisture after heavy rains; but on the more eroded areas, surface drainage in many places is excessive. The tough and compact subsoil retards the penetration of moisture, with the result that water stands on level fields for some time after rains.

Though not the most extensive soil type in the county, Grundy silt loam is of agricultural importance, is considered the best soil in the county for general farming purposes, and is best suited for the production of the staple crops grown in this region. Practically all of it is under cultivation. This soil was in a prairie condition when the first white settlers entered the county, and the trees now found on some of the fields are of recent volunteer growth or have been planted by farmers to serve as shade trees and windbreaks. Land of this kind is used for corn, wheat, oats, clover, and hay. The average yield of corn on Grundy silt loam is 40 bushels an acre, yields ranging from 30 to 65 bushels, depending upon variety of seed, climatic conditions, and treatment of the soil. Yields of oats vary from 15 to 35 bushels an acre; wheat, from 12 to 25 bushels; and hay, from 1 to 2½ tons. Old worn-out pastures and hay meadows furnish a small supply of organic matter when they are plowed up and reseeded.

The value of Grundy silt loam land depends upon its location with respect to towns and shipping points, and the size and upkeep of the farm. In 1923 current values ranged from $150 to $275 an acre.

With improved methods of treatment, such as liming for acidity, the productive value of this soil would increase. Corn should never be grown more than two years in succession on any field, but a rotation should be adopted, and the second growth of legumes plowed under. Better drainage is greatly needed on some of the more level fields to insure good crops during seasons of excessive rainfall. Tile drains should be laid close together and not very deep, covered with gravel or broken stone, and the remainder of the ditch filled with the heavy subsoil.

GRUNDY SILTY CLAY LOAM

The surface soil of Grundy silty clay loam is black, heavy silty clay loam, sticky and tenacious when wet, but breaking up into fine granules when dry. The black color penetrates deeper than in Grundy silt loam, from 12 to 18 inches, but the silty clay loam texture continues only to a depth of about 8 inches, below which the material is silty clay. The next layer, in which the dark color is seen as a coating on the soil granules, usually reaches a depth of 30 inches. It has a heavy clay texture, similar to the lower part of the solid black layer above it. As in Grundy silt loam, the dark color gradually decreases with depth. The structure, as seen in the soil when it becomes moderately dry, is distinctly granular. At a depth of about 30 inches there is an abrupt change to grayish-yellow, gray,

or mottled gray and yellow, silty clay loam or silty clay, with abundant iron concretions. This material gradually changes to the grayish-yellow, structureless silty clay loam of the loessial parent material.

Grundy silty clay loam is not extensive and is developed on flat surfaces or in slight depressions on wide upland divides within areas of Grundy silt loam. Drainage is poor, and owing to the slow run-off, crops are seriously damaged after heavy rains where the fields are not artificially drained. With the same treatment as that given Grundy silt loam, crops on Grundy silty clay loam yield well under average seasonal conditions of temperature and rainfall. Corn yields range from 50 to 70 bushels an acre; oats, from 20 to 35 bushels; wheat, from 12 to 30 bushels; and hay, from 1½ to 2 tons. The value of this soil depends upon improvements and location in regard to markets. Estimates obtained from farmers during 1923 placed its current value between $200 and $275 an acre.

Proper drainage, with care in planting and working the fields only under optimum moisture conditions, and liming to correct soil acidity, are recommended to improve the condition and fertility of this soil.

PUTNAM SILT LOAM

Putnam silt loam has dark grayish-brown, smooth, friable, powdery silt loam surface soil, from 4 to 8 inches deep, underlain by a more compact, ash-gray, velvety or floury silt loam layer, which is usually about 8 inches thick but may vary from 6 to 14 inches. On areas having a more level surface this light-colored layer is usually deeper and more pronounced than on slightly rolling areas. In places it lies within plow depth, which causes the white spots so common in areas of Putnam silt loam. Below this is a layer of yellowish-brown clay loam or clay mottled with gray and rust-brown. It is tough and compact in structure, and contains an abundance of iron concretions in the lower part. Thirty or 40 inches deep this grades into mottled gray and yellow clay in which yellow predominates. In most places this layer becomes more friable with depth and contains numerous iron stains and concretions.

Putnam silt loam is well distributed throughout the county, but occurs most extensively west of Chariton River and on the uplands east of the river in the vicinity of Moulton. It is developed on flat-topped ridges between stream courses and is usually surrounded by Grundy silt loam.

Areas of this soil are only slightly rolling and drainage is poor, making artificial drainage necessary on many of the more level areas.

Putnam silt loam is considered one of the better soils of the county, and though it occurs in small areas only, its high fertility makes it a valuable soil. Practically all this land is under cultivation and utilized for the production of corn, oats, or wheat, and a mixture of clover and timothy hay. Crops yield well on this type of soil. Yields of corn, the major crop, range from 30 to 55 bushels per acre; oats, from 15 to 20 bushels; wheat, from 10 to 22 bushels; and hay, from 1 to 2 tons. General farming practices prevail. Stable manure, green-manure crops, and crop residues con-

stitute the chief fertilizers. Limestone is used to a small extent to correct soil acidity.

Current values of Putnam silt loam range from $175 to $285 an acre, depending on location with respect to transportation lines and markets, and improvements on the farm.

In order to maintain the fertility of Putnam silt loam it is important to practice a systematic rotation, growing leguminous crops at certain intervals and plowing under any crop residue.

Because the land is level and the subsoil impervious, tiling is necessary on some fields to insure good crops.

SHELBY LOAM

Shelby loam, to depths ranging from 4 to 8 inches, is dark grayish-brown, finely granular, friable loam, containing some fine-grained sand, which works up readily into a mellow condition unless very wet. This dark-colored surface soil is underlain by yellowish-brown, granular silty clay loam. In some cases a transition zone occurs between the surface soil and this silty clay loam layer, the dark color of which decreases with depth and disappears in the lower part of this transitional zone. Below a depth of 18 or 24 inches, the parent material is heterogeneous glacial drift composed of fragments of many kinds of rock. Its color is usually reddish brown or yellowish brown, variegated with streaks and spots of red, brown, or gray, the coloration being imparted by the parent rock which remains in this layer in a partly decomposed condition. The texture is silty clay, tough and containing varying quantities of sand, gravel, and bowlders. There are bowlders throughout the soil but they are more abundant in the parent material. Small pockets of sand and gravel may occur but there is usually sufficient clay to give the mass a sticky consistence.

The surface layer of Shelby loam varies in both texture and depth, and in many sections areas of silt loam, loam, and sandy loam occur on the same hillside. Silt loam predominates at the crests of the hills where the surface soil is modified to a considerable extent by silt loam material washed from higher upland ridges; farther down the slope, loam occurs; and at the base is sandy loam. Since areas of Shelby silt loam and Shelby sandy loam are not extensive, the dominant type, Shelby loam, has been shown on the map. Where erosion has been active on cultivated slopes, the surface material has been completely washed away exposing the underlying yellowish-brown gritty clay, which, after a long period of exposure, becomes more highly oxidized and reddish brown in color. At the base of slopes the dark-brown color continues to depths varying from 8 to 15 inches, in many places.

Shelby loam is well distributed over the county, occurring on slopes and ridges adjacent to stream channels and small gullies where the silty loessial covering has been removed through erosion. The most extensive areas are in the badly eroded, hilly sections of the southern part of the county where creeks and gullies have thoroughly dissected the upland plains.

Drainage on all the land varies from good to excessive. Considerable damage from surface wash occurs during heavy rains, the excess

water running down the slopes, forming innumerable small gullies in the fields and carrying the black surface soil to the base of the slopes or into the stream.

Shelby loam is the most extensive type of soil in the county, but not so important agriculturally as the Putnam or Grundy soils. On account of its occurrence on hillsides, cultivation of crops is difficult without serious and permanent damage to the fields through erosion. About one-half of the acreage of this soil is under cultivation, the remainder being utilized as hay and pasture land. In many of the ravines along the streams, the tree growth is elm, hickory, oak, walnut, basswood, and ash, though the dark color of the surface soil indicates that this forest growth is recent. Bluegrass and redtop grow luxuriantly on this soil, becoming firmly established in a very short time, and making excellent feed for livestock.

General farm crops including corn, small grains, and hay may be grown on the gentle slopes. Corn is not grown so extensively nor so frequently as small grains or hay, owing largely to the difficulty of preventing erosion after cultivation. Oats, wheat, and mixed clover and timothy hay are on the land most of the time. Hay meadows are used for pasture for two or three years after the clover and timothy growth becomes too thin to cut. On farms near towns, dairy cattle are kept and pastured through the summer on the steeper slopes. Cultivation of the ridges and more gentle slopes produces sufficient grain and hay for winter feeding.

Corn yields on Shelby loam vary widely. Where the soil is thin more than 30 bushels an acre is seldom obtained, but on ridges and rolling areas yields are as high as 50 or 60 bushels an acre. Yields of oats vary from 15 to 25 bushels an acre, and hay from 1 to 2 tons, including two cuttings.

Great care must be taken to prevent erosion in fields of Shelby loam. When corn is planted the fields should be plowed as late in the spring as possible and the seed planted immediately. Contour plowing and cultivation are generally practiced, but where the corn has been planted in checkrows, cultivation is carried on in several directions. The last cultivation should always be on the contour in order to eliminate any up-and-down furrows, and thus prevent serious surface washing on the slopes. If wheat is to follow corn, it is sown the same fall; but if oats are grown, they are sown the following spring. In either case the timothy and clover mixture is sown with the small grain, the roots of the small grains and grasses forming a binder for the soil and preventing erosion.

Manure is the only fertilizer used on Shelby loam. Light applications are made on gentle slopes and ridges, but it is found impractical to fertilize slopes subject to severe erosion.

Current values of farms consisting principally of Shelby loam range from $60 to $110 an acre, depending on location, improvements, and topography; but that of farms containing Grundy and Putnam soils also, from $100 to $150 an acre.

Shelby loam is better adapted to the livestock industry, especially dairying, than any other soil in the county. Too much of this soil is devoted to the production of cultivated crops, whereas the steep slopes are more suitable for pasturage. Small grains should be grown when it is necessary to reseed old pastures or hay meadows,

the plowing should be done late in the spring, and the grain seeded immediately. Shallow plowing is advisable.

EDINA SILT LOAM

The topsoil of Edina silt loam is very dark grayish-brown, finely granular silt loam from 4 to 10 inches deep, not perceptibly different from the topsoil of Grundy silt loam. This is underlain by a gray granular heavy silt loam layer from 8 to 14 inches thick, which shows well-defined lamination and slightly flattened granules in the upper part of the layer. The gray coating around the particles, which is only slightly apparent in the upper part of the layer, becomes thicker as the depth in this layer increases. A 3-inch or 4-inch transition zone of heavy clay underlies this, the gray color of the coating gradually grading to black. At a depth of about 20 inches the material is heavy clay, which appears almost black and resembles very closely the heavy layer of the Grundy soils. The granules are larger than in the layer above and are well defined. The black color occurs as a coating over the granules, which are yellowish brown, reddish brown, or rust-brown inside. The thickness of the dark coating decreases with depth, and below a depth of 24 to 30 inches mottlings appear as the thin coating exposes the granule centers. The granular structure continues through the dark-colored layers to a depth of about 4 feet, where the substratum which represents the parent material is reached. This consists of light grayish-brown or light olive-brown, friable, silty clay loam material, which is rather firm but breaks readily and falls into soft structureless clods. Streaks and spots of iron stains are common throughout this layer and in places thin beds of iron accumulations consisting of concretions and soft ferruginous material may be seen. The loessial substratum material is little altered by weathering and continues without any marked change throughout the loess deposit.

Included in mapped areas of Edina silt loam are bodies of Putnam silt loam too small to be mapped separately. Edina silt loam differs from Grundy silt loam in having a distinct gray subsurface layer and from Putnam silt loam in having dark-colored surface soil.

The principal areas of Edina silt loam occur just east of Walnut City and east of Moulton. Other small bodies, some of which are included with adjoining soils on the map, occur throughout the county within areas of Grundy and Putnam soils on the more level upland plains. This land is level or slightly depressed, resulting in poor natural drainage in many places.

Although Edina silt loam is not extensively developed in the county, it is considered one of the most fertile soils, and crops yield very well where the fields are properly drained. Practically the entire acreage is under cultivation. No farms are wholly made up of this soil type and it is treated in the same manner as adjacent soils. The yields obtained are slightly higher than those on Grundy or Putnam soils.

Barnyard manure is the only fertilizer used, light applications being made at long intervals. The dark color of the soil is considered an indication of its high state of fertility and the application of any fertilizer is deemed unnecessary.

The value of Edina silt loam depends upon its location with respect to shipping points, improvements on the farm, and the character of the adjoining soils. Estimates of the current value during 1923 ranged from $175 to $225 an acre.

Practices recommended for the improvement of this soil include applications of manure, liming, and the growing of a leguminous crop to be plowed under. Good drainage is necessary to obtain good yields.

The following table gives the results of mechanical analyses of samples of the topsoil and subsoil of Edina silt loam:

Mechanical analyses of Edina silt loam

Number	Description	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
		Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
335706	Topsoil, 0 to 7 inches	0.6	0.6	0.4	1.0	9.4	68.0	20.2
335707	Subsoil, 7 to 20 inches	.4	1.2	.7	2.0	10.4	64.9	20.5
335708	Subsoil, 20 to 36 inches	.4	2.6	.8	3.0	9.4	47.6	36.0

MARION SILT LOAM

The surface soil of Marion silt loam is light grayish-brown or gray very fine, floury silt loam from 6 to 10 inches deep, underlain by very fine, powdery, compact silt loam material, lighter in color than the surface soil and giving the appearance of a distinct white subsurface layer. Iron stains and concretions resembling sand particles are present in this layer. At depths varying from 15 to 20 inches, this is underlain by tough, compact, waxy clay, grayish brown or brownish yellow in color, with rust-colored mottlings and iron concretions becoming more abundant at increasing depths. Spots where the loessial material has been washed away so that glacial till lies within 3 feet of the surface may be seen on some narrow ridges and slopes.

Marion silt loam occurs on narrow upland divides in forested sections of the county, being more extensively developed on ridges between Soap Creek and North Soap Creek, north of Unionville. It also occurs along Chariton River south of Iconium, east of this river and north of the Douglas Township line, and east of this river along the ridge road in sections 14, 15, and 16 of Wells Township. Narrow strips of Clinton silt loam are included with this soil as mapped.

This land is smooth or undulating and drainage is good.

Marion silt loam is the most important light-colored or forest soil in the county, and the entire acreage is devoted to the production of staple farm crops. This soil was forested at one time with oak, elm, hickory, birch, and an undergrowth of buck brush, hazel brush, scrub oak, and thorn apple. It was the first of the forested soils to be cleared, and some fields have been under cultivation ever since white settlers first entered the county.

The adjoining soils, Clinton silt loam and Lindley loam, provide pasture and hay land, but this ridge soil is devoted almost entirely to growing corn and small grains. The fields are seeded with a mixture of timothy and clover once every five or six years.

Cattle and sheep raising are the most important agricultural industries. Some feed for livestock is purchased by most farmers, since areas of Marion silt loam are too small to supply feed for all the farm animals. Sheep are fed in much the same manner as cattle. The young lambs are sold when they have reached a weight of 60 to 80 pounds, and the older sheep are pastured until fall when they are fattened and placed on the market. Considerable income is derived from the wool which is pooled by a number of farmers and held for the highest price. Shearing is usually done in May, the time varying to some extent according to seasonal conditions.

Crops on Marion silt loam do not yield so well as those on some of the darker soils of the uplands. Corn yields range from 25 to 40 bushels an acre; oats, from 15 to 25 bushels; wheat, from 10 to 20 bushels; and hay, from 1½ to 2½ tons, including two cuttings.

The methods of working this soil are practically the same as those used on other soils of the county. Manure is the only fertilizer used, light applications being made as often as the supply allows. The light color of Marion silt loam indicates a lack of organic matter. Liberal applications of barnyard manure, and the turning under of crop residues and green-manure crops, preferably legumes, will greatly improve the producing power of this soil. Liming to correct soil acidity would aid in obtaining good stands of clover, the second cutting of which should in all cases be plowed under when the fields are broken in order to supply humus-forming material. A definite rotation or cropping system is recommended for farms on this soil. The timothy-and-clover mixture seems to be well adapted to this soil and is grown with success.

The current value of farms composed of Marion silt loam range from $75 to $125 an acre, depending on the size of the fields, the location with respect to markets and shipping points, and the improvements.

CLINTON SILT LOAM

Clinton silt loam is grayish-brown or gray friable silt loam 4 to 6 inches deep, underlain by mottled yellowish-brown and gray, tough, compact silty clay loam material to depths ranging from 24 to 30 inches. The compact subsoil is underlain by more friable silty clay loam material which usually becomes more silty with increasing depth, and at depths of 4 or 5 feet has the characteristics of the parent loess. Iron strains are present in many cases below a depth of 30 inches.

This soil differs from Marion silt loam in having no gray subsurface layer. Clinton silt loam is derived from loessial material and is developed between areas of Marion silt loam on ridges and Lindley loam on slopes. The land is hilly and the drainage good or excessive. This soil is closely associated with Marion soils, and where cultivated, it is farmed with these soils.

Most of the Clinton silt loam land is utilized as pasture and hay land, since in many places cultivation would result in irreparable damage through erosion. Approximately 60 per cent of it is densely forested with oaks, elms, ash, birch, hickory, and underbrush of hazel brush, buck brush, gooseberry, wild rose, and thorn apple.

Where this soil is farmed, crops yield about the same as on Marion silt loam. Only a small acreage of Clinton silt loam is cultivated;

and since it is not extensively developed in the county it is of minor agricultural importance, most of the land being allowed to remain in pasture. The forest cover protects the land and prevents erosion during heavy rains. The current value of Clinton silt loam ranges from $50 to $85 an acre, depending on the location, and farm improvements.

Recommendations for the improvement of Marion silt loam apply also to this soil. Cultivation should not be attempted where gullies are easily formed by run-off during rains. Fields should not be left bare longer than necessary. Incorporation of large quantities of organic matter would improve the soil, and only the gentler slopes should be cultivated.

LINDLEY LOAM

The surface soil of Lindley loam is brownish-gray loose, friable, and shallow, rarely exceeding 5 inches in depth. This is underlain by a heterogeneous mixture of sand, gravel, small bowlders, and clay, yellowish brown mottled with reddish brown to depths ranging from 20 to 28 inches. Below this, the sand and gravel decreases to a marked degree, and black and dark rusty iron concretions are abundant throughout the subsoil. In places where the underlying drift has been exposed to weathering and has reached a more advanced state of oxidation, the subsoil is reddish brown.

Erosion during heavy rains is responsible for the variable depth of the surface soil, and on many areas mapped as Lindley loam the surface soil has been completely removed and the yellowish-brown subsoil exposed. Lindley loam differs from Shelby loam in having light-colored surface soil. Both have developed from Kansan drift material, but Lindley soils have developed in forested sections of the county and Shelby soils occur on slopes adjacent to the prairie uplands. Lindley loam is closely associated with Marion and Clinton soils. It occurs on slopes bordering these ridge soils and extends down the slopes to the flood plains of the streams. It is most extensively developed in the northeastern part of the county along Soap Creek and North Soap Creek. Other areas are mapped along Chariton and South Chariton Rivers, and Walnut, Cooper, and Shoal Creeks.

The land is rough and drainage excessive, making the soil unsuited for farming, so that only a small part of it is used for the production of cultivated crops. Its principal use is for pasture and hay land, and then only the smooth rounded knolls can be utilized. Lindley loam supports a rather dense growth of trees, oak, elm, hickory, walnut, butternut, and basswood, with an undergrowth of hazel brush, buck brush, hackberry, scrub oak, and thorn apple.

Sheep, cattle, and a few goats are pastured throughout the grazing season, the native grasses and underbrush furnishing abundant feed for all livestock.

Since it is not practicable to grow cultivated crops extensively, small grains and hay are produced on the narrow ridges and the more gentle slopes. Corn yields range from 20 to 40 bushels an acre; oats, from 13 to 20 bushels; and hay, from 1 to 2 tons.

In order to prevent erosion it is usual to allow grass to become firmly established, plowing the fields only when it is necessary to

reseed the pasture. No fertilizers are used on this soil, owing to the difficulty of holding the soil in place.

Lindley loam, because it grows excellent pasturage, is well suited to the dairy industry. Most of the farms have a sufficiently large acreage which may be devoted to the production of cultivated crops and grain, and in addition produce the winter supply of roughage. The steeper slopes should be left in grass and the forest cleared only enough to permit the growth of grasses. The combination of grass and forest growth will aid in holding the surface soil in place during heavy rains.

The current value of Lindley loam ranges from $40 to $75 an acre, depending upon location, and acreage available for cultivation. It is highly prized as pasture land.

CRAWFORD LOAM

Crawford loam consists of very shallow, dark-brown or black loam, not exceeding 4 inches in depth, underlain by tough, compact, waxy, greasy, or soapy, reddish-brown or chocolate-brown clay. At depths varying from 22 to 26 inches limestone bedrock occurs. The texture of the surface material is decidedly variable, ranging from loam to clay loam, these areas of different texture in many places occurring within a few feet of each other, so that their separation on the map was not practicable.

The most extensive areas of Crawford loam occur near the towns of Centerville, Rathbun, and Clarkdale, along streams which have cut through the loessial and drift material to bedrock, exposing it. Where areas of Crawford loam are very small, they are indicated on the map, in areas of other soil, by rock-outcrop symbols. The soil on the slopes along the lower course of Cooper Creek above its junction with Chariton River consists largely of Crawford loam.

Crawford loam is unimportant agriculturally because it can be used only as pasture land, the steep rugged slopes and large outcrops of limestone rock making cultivation impracticable. This soil occurs in conjunction with Shelby loam and Grundy silt loam, and when sold is included with these soils. No crops were grown on this soil in 1923.

CALHOUN SILT LOAM

The surface of Calhoun silt loam is grayish-brown or gray, fine, friable, smooth silt loam 6 or 8 inches deep, grading into more compact, light-gray or white, powdery silt loam, mottled with rust-colored iron stains, the silt particles in this layer appearing finer than in the surface layer. At a depth of 18 or 22 inches, this is abruptly underlain by mottled gray, brown, and rust-colored, compact, waxy, impervious clay loam or clay, containing an abundance of black iron concretions. Both topsoil and subsoil are acid.

Calhoun silt loam is second-bottom land or it occurs on terraces well above the present flood plains of the streams, and as it is of alluvial origin, it is noticeably variable in texture in different localities. On the south bank of Chariton River due north of Griffinsville are two small knolls on which loamy sand occurs, and on the west side of the road the same terrace is heavy silt loam somewhat darker in color than typical Calhoun silt loam. A small terrace north

of Numa along Cooper Creek, on which is mapped Calhoun silt loam, the soil has a very sandy texture. Small patches of silt loam containing some very fine sand commonly occur in areas of Calhoun silt loam.

The most extensive areas of Calhoun silt loam are along Chariton River, generally occurring in the fork where a small stream empties into the river. Smaller areas are mapped along Walnut, Cooper, and Shoal Creeks in the western part of the county, and along Soap Creek and North Soap Creek in the northeastern corner.

The terraces on which this soil occurs vary from 8 to 20 feet above the present overflow of the streams, and, with the exception of the area north of Griffinsville, which is rolling, the land is level and poorly drained. Water stands on the surface for several days after heavy rains unless artificial drainage is provided.

Calhoun silt loam is the most extensively developed terrace soil in the county. Practically the entire acreage is under cultivation and devoted to the production of staple farm crops. The light color of the surface soil and the presence of the gray subsurface layer indicates that this soil was at one time forested, but at the present time trees grow only on the edges of terraces adjacent to the hillside slopes.

Corn is the principal crop, and yields from 30 to 55 bushels an acre. The methods of cultivating and harvesting the crop are similar to those followed on the upland soils. Oats yield from 20 to 30 bushels an acre, depending on seasonal conditions. Mixed clover and timothy do well on this soil, yielding from 1 to 2 tons of hay an acre.

Barnyard manure is applied regularly to the fields, but the applications are rather light for the intensive cropping system practiced. No commercial fertilizers are used.

This soil ranges in value from $100 to $160 an acre, depending on location, improvements, and the kind of adjoining soils.

The productivity of Calhoun silt loam may be increased by establishing adequate drainage, practicing systematic crop rotation, and plowing under the second crop of legumes or grasses to increase the organic matter. Applications of ground limestone before the legume crop is seeded would increase the yield and ultimately cause an increase in the grain crops.

WAUKESHA LOAM

Waukesha loam has a dark-brown, loose, friable loam surface layer 8 to 12 inches deep, which gradually grades to slightly more compact yellowish-brown loam or silt loam material, the color becoming lighter with depth. At a depth of about 36 inches the material is almost yellow, lighter textured, and more friable.

Waukesha loam occurs on terraces along Chariton River, lying well above overflow. The largest area in the county is south of the river in sections 6 and 7 of Independence Township. Numerous small areas are mapped along both sides of the river throughout its course, the more extensive of these lying southeast of Sedan and west of Dean, within the first bottom or flood plain, and on small knolls from 5 to 8 feet above the surrounding land.

Areas of this soil are level or undulating, but owing to the texture of both topsoil and subsoil, drainage is good. The greater part of this land is under cultivation, and since it occurs in such small areas the methods of treating the soil and working the crops are the same as those used on adjacent soils.

Areas of Waukesha loam lying adjacent to first-bottom lands are devoted almost entirely to growing corn. Hog raising and cattle feeding are important industries on these lowland soils. Large yields of corn are obtained and the livestock industry furnishes a good opportunity for marketing the crop to the best advantage.

When a regular rotation is practiced on this soil, good yields are obtained. Corn yields range from 40 to 65 bushels an acre, and oats from 15 to 35 bushels. Very little hay is grown, as the first-bottom soils furnish an abundant supply of wild hay for winter feeding.

No farms consist entirely of this type of soil, and it is usually sold in connection with upland and bottom-land soils. When sold in this manner, the current value of Waukesha loam ranges from $100 to $150 an acre, depending on location, improvements, and associated soils.

BREMER SILT LOAM

The surface soil of Bremer silt loam is dark-brown or black heavy silt loam from 10 to 18 inches deep. Immediately below this layer is dark-gray, heavy, compact, impervious subsoil material mottled with brown and rust-brown, and having iron concretions in the lower part.

Bremer silt loam is found on the low stream terraces, but lies from 8 to 12 feet above overflow. This soil occurs in the southern part of the county along the lower Chariton River, the most extensive areas being mapped along the edge of the river bottom 5 miles east of Centerville, west of the river near Coal City, and in the town of Dean. Several small areas also are shown on the map. Where the acreage did not warrant separation small areas of this terrace soil were included with adjacent first-bottom soil in mapping. This land is level or slightly undulating, which, together with the impervious nature of the subsoil, makes the drainage poor.

Bremer silt loam although not extensive, is one of the most fertile soils of the county, and is farmed with adjacent upland soils. Practically the entire acreage is devoted to the production of corn. Small grains, when grown, produce a rank growth of stalk with but little grain, and poor drainage conditions retard their growth during wet seasons. Slough grass furnishes abundant wild hay for winter feeding of livestock. The lower-lying, more poorly drained areas are utilized as hay land.

The current value of Bremer silt loam ranges from $90 to $125 an acre, depending upon location, drainage conditions, improvements on the farm, and the associated soils.

Adequate drainage of both topsoil and subsoil is neccessary to insure maximum crop yields in all seasons. Where good drainage has been established it is advisable to lime the land in order to correct the decidedly acid condition, and better fit it for growing legumes. In order to maintain the present high productivity of the

soil, applications of barnyard manure should be made and green-manure crops should be plowed under at regular intervals.

WABASH SILTY CLAY LOAM

Wabash silty clay loam, to depths varying from 8 to 30 inches, is dark-brown or black, sticky, plastic silty clay loam, underlain by gray, compact, waxy, plastic, and impervious clay mottled with brown and rust-brown. A few very small areas of clay and clay loam, too small to indicate on the map, are found in lower-lying areas of this soil type. The lighter-textured surface soil occurs near the streams.

Wabash silty clay loam is the most important first-bottom soil of the county for agricultural purposes. It occurs on wide flood-plains along Chariton River, these areas in places being 2 or 3 miles wide, but it is usually a short distance back from the banks of the stream.

Areas of this soil are level or gently sloping toward the stream, and drainage, owing to the heavy, impervious topsoil and subsoil, is very poor. These bottoms are subject to inundation and water stands on the surface of the lower areas for several days after rains.

Wabash silty clay loam is excellent cornland where proper precautions are taken to control flood waters. A considerable acreage of this soil has been reclaimed by the establishment of a deep drainage ditch which straightened the channel of Chariton River from near Centerville to the southern boundary of the county. Approximately 65 per cent of this soil is under cultivation, and the remainder supports a growth of cottonwood, elm, maple, birch, swamp oak, and hickory, and is utilized as pasture land.

Corn is the chief crop, yielding about 45 bushels an acre, but at times the crop on this land is totally lost through floods. However, if such floods do not occur more frequently than every four or five years, the growing of corn is deemed profitable. The small grains are not successfully raised, as they have a tendency to produce a rank growth of straw and very little grain. Furthermore, the small grains are more seriously endangered during periods of inundation. The rank growth of wild slough grass supplies roughage for the livestock during the winter months. Low wet areas are used as hay land. Hog and cattle raising is extensively practiced on the bottom-land soils.

Special attention is given to working this soil when the moisture content is right for pulverization. After the seed bed is prepared the corn crop is cared for in the same manner as on other soils of the county.

Like all dark flood-plain soils, Wabash silty clay loam is very fertile. Continuous cropping to corn does not materially affect the yield, and even though no fertilizers are applied, the soil retains its high state of fertility.

The current value of this land ranges from $100 to $175 an acre, depending on location, improvements, drainage conditions, and the acreage available for cultivation.

Thorough drainage is one of the most essential requirements in obtaining a crop every year. A levee should be constructed along the banks of the stream and the level fields tiled or ditched as an extra precaution. The soil should be limed to correct the acidity and improve the physical condition. Heavy alkaline soils do not clod so

readily as acid soils and when clods do form they are much more easily pulverized. Instead of continuous cropping to corn, a systematic rotation should be adopted.

WABASH SILT LOAM

The surface soil of Wabash silt loam is dark-brown or almost black friable silt loam, from 8 to 14 inches deep. This is underlain by gray and brown or yellowish-brown clay loam or clay material which shows iron concretions, and is more or less stained with iron oxide.

Like all soils occurring on first bottoms, Wabash silt loam varies in places. The surface soil in nearly all places has a noticeable proportion of very fine sand mixed with silt. The gradation from Wabash silt loam to Wabash loam is so gradual as to make it difficult to determine where the boundary line should be drawn between areas of these soils.

The largest areas of Wabash silt loam occur on higher flood plains along Chariton River, and narrow strips one-fourth to one-half mile wide are developed along the larger creeks of the county. The land is level or undulating, and drainage is fairly well developed.

Most of this soil is under cultivation. It is treated in the same manner as Wabash silty clay loam, but is less subject to inundation, owing to its higher elevation. The very narrow strips mapped along small streams are forested and are too small to be utilized for any other purpose than pasture.

All farm crops common to the region are grown and yield well. Corn yields range from 30 to 60 bushels an acre, and oats from 25 to 35 bushels. The dark color of the surface soil is considered an indication of its high fertility, and it is unnecessary to use fertilizers other than small quantities of manure.

The current value of Wabash silt loam ranges from $75 to $150 an acre, depending on location, improvements, drainage, and adjoining soils. No farm consists wholly of Wabash silt loam, and it is sold in connection with other soils.

To improve and maintain the fertility of this soil type, it is recommended that a definite rotation of crops be practiced. Manure and the second cutting of legume crops should be turned under at regular intervals, and on fields where drainage is poor, tiling or ditching would improve the soil.

WABASH LOAM

The surface soil of Wabash loam is dark-brown, loose, friable, mellow loam, from 6 to 12 inches deep. The upper part of the subsoil is brown and gray silt loam, more compact than the surface soil, but containing a high percentage of very fine sand; and the lower portion of the subsoil is mottled gray and drab, compact, heavy, impervious clay.

Wabash loam is rather extensively developed in the county, occurring as narrow strips along smaller streams and at the bases of slopes. The level or undulating surface is broken in places by small knolls. The drainage is poor or only fair, and inundations are rather frequent.

Forests cover 80 per cent of this narrow bottom land, and owing to the cost of clearing and the frequent floods, only those areas adjacent to the wide bottoms are farmed. Where the forest growth is not so heavy as to shade the ground, bluegrass grows luxuriantly and furnishes excellent pasturage for livestock through the grazing season.

Where the soil occurs on wide bottoms it is closely associated with the silt loam and the silty clay loam members of the Wabash series, and is worked, cropped, and treated in the same manner as these soils. The recommendations for the improvements of other Wabash soils are also applicable to Wabash loam. Corn yields range from 25 to 50 bushels an acre; oats, from 20 to 30 bushels; and mixed timothy and clover hay from 1 to 2½ tons.

Barnyard manure and crop residues are used to maintain the fertility of this land, heavier applications being made than on the black flood-plain soils.

When this soil is sold in conjunction with other bottom land it brings from $75 to $125 an acre, and when sold in connection with Grundy, Putnam, and Shelby soils the value increases to about $135 an acre, depending on location, extent to which it is developed, and nature of the adjoining soils.

Unless the flood waters of the streams are controlled, cultivation of this soil is not practical, and it should be left in grass. Liming, practicing crop rotation, and establishing good drainage would improve the fertility of this soil.

SUMMARY

Appanoose County, Iowa, is in the southeastern part of the State bordering the Iowa-Missouri State line. The county is rectangular in shape and has an area of 513 square miles or 328,320 acres.

The prevailing topography is that of an old glacial drift plain, having a covering of silty material called loess, and dissected by numerous streams. The average elevation is about 1,000 feet above sea level, with a range in elevation from 831 feet to 1,042 feet. The prevailing slope is to the south and east.

The drainage of the county belongs in part to the Missouri River system and in part to the Mississippi River system. Chariton River carries drainage water to Missouri River, and Soap, North Soap, and Fox Creeks, to Mississippi River. The streams are sluggish and ramify all parts of the county, thoroughly dissecting the entire county and establishing good drainage conditions.

Appanoose County was organized in 1846. The total population in 1920 was 30,535 persons of whom 63.1 per cent were classed as rural.

Four railroad systems, in addition to an electric line, afford excellent communication with the Chicago, Kansas City, St. Louis, St. Paul, and Omaha grain and livestock markets. The leading local markets are Centerville, Moulton, Mystic, Cincinnati, Exline, and Moravia. Small towns and villages are shipping points for different parts of the county.

The mean annual temperature is 51.8° F.; the mean summer temperature, 74.4°; and the winter mean, 27°. The mean annual precipi-

tation is 32.86 inches, most of the rain falling during the frost-free period, averaging 166 days.

Agricultural industries lead in Appanoose County. Corn, oats, and hay are the chief crops grown, with barley, millet, sorghum, potatoes, and truck crops secondary in importance. Small orchards are maintained on practically all farms. With the exception of the wheat crop which is sold for cash, the grain is fed to livestock on the farms.

Hog raising is the important livestock industry, large numbers being raised and fattened annually. In recent years, pasturing and feeding of feeder cattle has become profitable among the farmers of the county. Dairying has developed to a marked degree in the last few years in the vicinity of towns, especially those located in the more hilly and broken parts of the county. Sheep and goats are kept in small numbers.

The farm buildings are in good repair, and the older buildings are rapidly being replaced by modern structures. Farms are well equipped with labor-saving farm implements. Tractors are used to a small extent, but horses furnish the greater part of the farm power.

A system of cropping which favors the production of corn is used by all the farmers, but systematic crop rotations are uncommon. Manure is practically the only fertilizer used on any of the soils. Small fields to be used for a special legume crop are limed to correct acidity, but this practice is not universal.

The majority of the farm laborers are native-born Americans, but some foreign laborers are employed on farms located near mining camps.

Farms range in size from 20 to 803 acres, the average being about 135 acres. Of 2,283 farms in the county, 75.6 per cent are operated by the owners, 23.8 per cent by tenants, and 0.6 per cent by managers. Most of the farms are rented on shares, and the crops divided proportionately between landlord and tenant. Cash rents in 1923 ranged from $5 to $15 an acre and land values from $50 to $300, depending on location, improvements, topography, and the type of soil.

The soils of Appanoose County are classed into three broad groups based on the origin of the parent material, mode of formation, and topography. The first group includes soils of loessial origin occurring on upland plains; the second, those on hillside slopes, derived from the underlying glacial drift material; and the third, alluvial soils or those occurring on terraces and first bottoms. These different soils are classed in series according to the color, structure, and other characteristics of each layer and the arrangement and thickness of these layers.

Upland loessial soils are classed as Grundy, Putnam, Edina, Marion, and Clinton series; glacial drift soils as the Shelby and Lindley series; terrace soils as the Bremer, Calhoun, and Waukesha series; first-bottom soils as the Wabash series; and small areas of residual soil mapped along Cooper Creek, are classed in the Crawford series.

Grundy silt loam consists of deep dark-brown topsoil underlain by mottled gray and drab subsoil. It is one of the most fertile soils of the county and is well adapted to all the crops grown in the Corn Belt.

Grundy silty clay loam differs from Grundy silt loam only in the texture of the surface soil. It is treated and cropped in the same manner as Grundy silt loam.

Putnam silt loam surface soil is light-brown or brown, smooth, friable silt loam, with a subsurface layer of gray or white, powdery, rather compact silt loam, abruptly underlain by heavy mottled gray and drab subsoil. Putnam silt loam is most extensively developed in the southern part of the county on upland divides. Corn, small grains, and hay are grown profitably.

Shelby loam is dark-brown friable loam, rather shallow in depth, with a subsoil of yellowish-brown sandy, gravelly clay loam material. This soil is of glacial drift origin and is found on slopes along the drainage channels which have dissected the prairie regions. The land is rolling or broken and the smooth slopes are cultivated, but the greater part of the land is utilized as hay and pasture land. Dairying is an important industry on this soil. Bluegrass grows luxuriantly on all the slopes.

Edina silt loam is dark soil, underlain by a gray, floury silt loam subsurface layer and a gray and drab, compact, heavy, impervious subsoil. It occurs on the more level plains where the land is slightly depressed. This soil is closely associated with Putnam and Grundy soils and is farmed with these soils.

Marion silt loam differs from Clinton silt loam in having a gray or white subsurface layer, and the surface soil in some places is also lighter in color. Marion silt loam is a forest soil. It occurs on the ridges and where the land is level or rolling.

Clinton silt loam is associated with the forested parts of the county. It occurs as narrow bands between Marion silt loam and Lindley loam and on very narrow ridges in the forested areas. The surface soil is gray and the subsoil is yellowish-brown, heavy, compact clay loam or clay. This land is hilly and broken and the drainage good or excessive. The greater part of it is utilized as pasture and hay land.

Lindley loam of glacial drift origin occurs on slopes in the larger areas of Marion and Clinton soils. The surface soil is loose, friable loam, shallow in depth, and is underlain by yellowish-brown, gritty clay subsoil. Farms consisting mainly of this soil type are used as grazing lands.

Crawford loam is the only residual soil mapped in the county. It occurs on slopes along Cooper Creek. The land is rough and broken, and none of it was under cultivation during the year of the survey. It is of minor agricultural importance and value.

Calhoun silt loam occurs on terraces along the larger streams of the county. The land is level or slightly undulating and the drainage is fair. It is considered a fertile soil although light in color. All the general farm crops are grown. Terraces on which this soil occurs are well above overflow.

Waukesha loam is friable loam, underlain by material slightly more compact than the surface soil and heavier in texture. Terraces on which this soil occurs are high and never inundated. The land is rolling and drainage good. This soil is not extensively developed in Appanoose County, but the entire acreage is devoted to the production of all staple farm crops.

Bremer silt loam occurs on lower terraces along Chariton River. This soil is of minor agricultural importance, owing to its small extent. When farmed, all the crops do well. Corn is the most important crop.

The first-bottom lands are all classed as Wabash soils. Three members of this series are mapped in the county. Wabash silty clay loam is distributed over the greater part of the wide flood plain of Chariton River. After drainage is established and the flood waters controlled, this soil proves very fertile. The lighter members of the Wabash series occur along smaller streams and near bluffs where the slopes and the bottom land join.

[PUBLIC RESOLUTION—No. 9.]

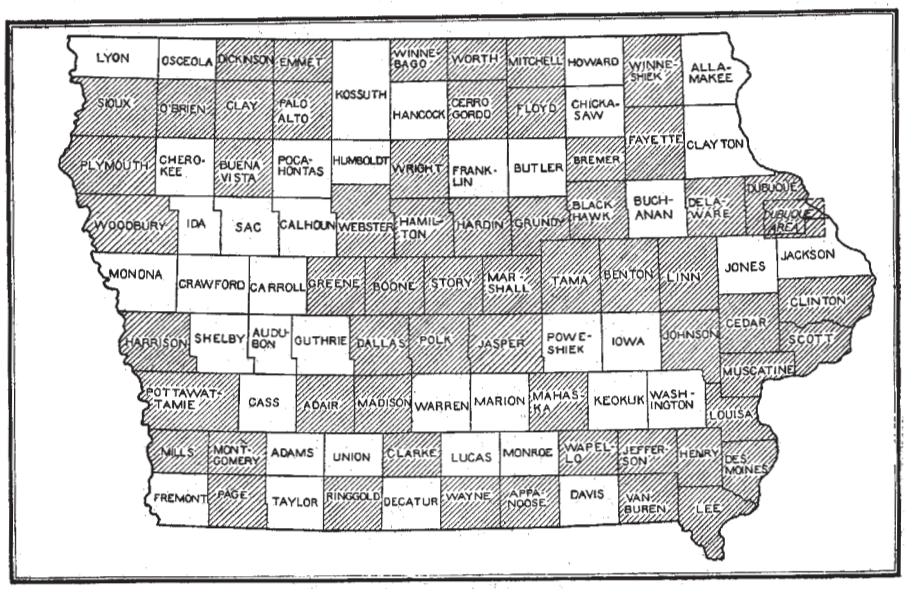
JOINT RESOLUTION Amending public resolution numbered eight, Fifty-sixth Congress, second session, approved February twenty-third, nineteen hundred and one, "providing for the printing annually of the report on field operations of the Division of Soils, Department of Agriculture."

Resolved by the Senate and House of Representatives of the United States of America in Congress assembled, That public resolution numbered eight, Fifty-sixth Congress, second session, approved February twenty-third, nineteen hundred and one, be amended by striking out all after the resolving clause and inserting in lieu thereof the following:

That there shall be printed ten thousand five hundred copies of the report on field operations of the Division of Soils, Department of Agriculture, of which one thousand five hundred copies shall be for the use of the Senate, three thousand copies for the use of the House of Representatives, and six thousand copies for the use of the Department of Agriculture: *Provided*, That in addition to the number of copies above provided for there shall be printed, as soon as the manuscript can be prepared, with the necessary maps and illustrations to accompany it, a report on each area surveyed, in the form of advance sheets, bound in paper covers, of which five hundred copies shall be for the use of each Senator from the State, two thousand copies for the use of each Representative for the congressional district or districts in which the survey is made and one thousand copies for the use of the Department of Agriculture.

Approved March 14, 1904.

[On July 1, 1901, the Division of Soils was reorganized as the Bureau of Soils.]



Areas surveyed in Iowa, shown by shading

Accessibility Statement

This document is not accessible by screen-reader software. The Natural Resources Conservation Service (NRCS) is committed to making its information accessible to all of its customers and employees. If you are experiencing accessibility issues and need assistance, please contact our Helpdesk by phone at 1-800-457-3642 or by e-mail at ServiceDesk-FTC@ftc.usda.gov. For assistance with publications that include maps, graphs, or similar forms of information, you may also wish to contact our State or local office. You can locate the correct office and phone number at http://offices.sc.egov.usda.gov/locator/app.

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, S.W., Washington, D.C. 20250-9410, or call (800) 795-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal opportunity provider and employer.