Number 5 Series 1925

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

SOIL SURVEY
OF
HOWARD COUNTY, IOWA

BY
C. L. ORRBEN, Iowa Agricultural Experiment Station, in Charge
and A. L. GRAY, 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–."

BUREAU OF CHEMISTRY AND SOILS

HENRY G. KNIGHT, *Chief*
A. G. McCALL, *Chief, Soil Investigations*
SYDNEY FRISSELL, *Editor in Chief*

SOIL SURVEY

CURTIS F. MARBUT, *in Charge*
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	1
Climate	2
Agriculture	3
Soils	9
Carrington silt loam	14
Carrington loam	17
Carrington fine sandy loam	19
Clyde silt loam	20
Floyd silt loam	22
Tama silt loam	23
Dickinson fine sandy loam	25
Dickinson loam	27
Dodgeville loam	27
Dodgeville silt loam	28
Fayette silt loam	29
Lindley fine sandy loam	30
O'Neill loam	31
O'Neill fine sandy loam	32
Wabash loam	33
Wabash silt loam	33
Bremer silt loam	34
La Crosse sandy loam	34
Rough stony land	35
Summary	35

SOIL SURVEY OF HOWARD COUNTY, IOWA

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

COUNTY SURVEYED

Howard County is in the northeastern part of Iowa on the Minnesota State line and in the third tier of counties west of Mississippi River. It is rectangular, the longer side extending 24 miles east and west and the shorter side approximately 20 miles north and south. The county is divided into 12 civil townships of irregular size. The total area of the county is 468 square miles or 299,520 acres.

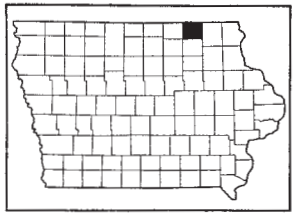


FIGURE 1.—Sketch map showing location of Howard County, Iowa

Physiographically, Howard County consists of a moderately hilly area covering a little more than 20 square miles in the northeastern part of the county and a gently undulating plain covering the remainder of the county. The hilly area in the northeastern part is merely a dissected fringe of the plain covering the rest of the county, the plain having formerly stretched eastward beyond its existing boundary. The plain in essentially its present form is an old one, having been in existence prior to glacial times, though its elevation was not necessarily the same then as now. During glacial times its surface form was modified in detail by the deposition of rock débris by the ice. Its existing details of relief were caused by the unequal accumulation, from place to place, of this material, a thick accumulation producing a low hill and a thin one a depression. A very slight modification of this relief has been effected by the existing streams.

The average elevation of the county is between 1,229 feet and 1,298 feet above sea level. Elevations at various points within the county, which show the general slope, are as follows: Cresco, 1,298 feet above sea level; Limesprings, 1,245 feet; Riceville, 1,229 feet; and Elma, 1,188 feet. Upper Iowa and Turkey Rivers flow due east out of the county, and the other streams flow in a southeasterly direction.

The farms and towns within the county obtain a plentiful supply of wholesome water from drilled wells from 40 to 500 feet deep. The numerous perennial streams furnish a good supply of water for livestock throughout the year.

The first white settlers entered Howard County in 1851. The wooded sections were settled first, mainly because of the need of material for building the homes and because of their nearness to water and game. In 1855 the county was organized, and the towns of New Oregon and Vernon Springs were established. In 1856, the first land entry was made. Native Americans from States to the east and south

31326—29——1

were first to settle in the county, but later Germans, Scandinavians, and Bohemians settled in communities, by nationality.

The population of the county, according to the 1920 census, is 13,705, of which total 10,510 are classed as rural. The average density of the rural population is 22.5 persons to the square mile. The population has not increased rapidly since 1880, when the census showed 10,837 inhabitants.

Cresco, the county seat, with a population of 3,195, is the largest town in the county. Other towns of importance are Elma, with a population of 874, Limesprings with 595, and Riceville with 960 persons. Granger, Bonair, Acme, and Chester are the other railroad towns which serve as important shipping points. The inland towns of Lourdes, Protivin, Mapleleaf, Saratoga, and Schley serve as centers for marketing dairy products. Creameries are in operation constantly in these towns. A cheese factory is located in the village of Jamestown. Although agriculture is the principal industry of the county, Cresco has a few manufacturing plants of importance among which are an electrical condenser factory and a stump-puller plant.

A branch of the Chicago, Milwaukee & St. Paul Railway supplies the transportation facilities for the eastern part of the county, and the Minneapolis line of the Chicago, Great Western Railroad traverses the western part. Chicago, Minneapolis, St. Paul, and Rochester are the principal outside markets for the surplus grain and livestock.

Public highways follow land lines, except where the relief necessitates following the contour lines in order to avoid dangerous and expensive cuts and fills. The main highways are graveled and well maintained. County and township roads are rapidly being brought to grade and the main traveled roads graveled. The earth roads are heavy during wet weather but are kept well dragged throughout the year. Two improved roads, designated as State highways, traverse the county.

Telephones are in use in more than 90 per cent of the farm homes of the county. Country schools are located at 2-mile intervals, and high schools are maintained in all the larger towns. Country churches have been built at various points over the county.

CLIMATE

Although there is a wide variation in the temperature and the amount of rainfall during the different seasons of the year, climatic conditions in Howard County are favorable for the successful growth of the crops common to the State. The mean annual rainfall, as recorded at New Hampton (county seat of Chickasaw County, south of Howard County), is 30.35 inches. Of this total, 71 per cent falls during the growing season from April to September, inclusive. Heavy, steady rains fall during the spring and early summer, at the beginning of the growing season, but during the summer months the rains are often torrential and are usually accompanied by electrical displays and windstorms of varying intensity. During the months of July and August, periods of drought lasting from two to five weeks are common. These are broken, however, before the crops suffer from the want of moisture, and crop failures are uncommon from drought. The precipitation during the winter is in the form of snow. This remains on the ground throughout the cold season.

Periods of extreme heat or cold are usually of short duration. Storms break the hot waves, and south winds bring the cold spells to an end. The average date of the last killing frost is May 6, and the latest recorded was on May 27. The average date of the first killing frost is October 1, and the earliest recorded was September 14. This gives an average frost-free season of 148 days, sufficiently long to mature the early varieties of the Corn-Belt grain crops.

Table 1 gives the normal monthly, seasonal, and annual temperature and precipitation at New Hampton, Chickasaw County.

TABLE 1.—*Normal monthly, seasonal, and annual temperature and precipitation at New Hampton, Chickasaw County*

[Elevation, 1,169 feet]

Month	Temperature			Precipitation		
	Mean	Aboslute maximum	Absolute minimum	Mean	Total amount for the driest year (1910)	Total amount for the wettest year (1902)
	°F.	°F.	°F.	*Inches*	*Inches*	*Inches*
December	20.9	53	−25	1.13	0.40	2.20
January	13.3	52	−34	.90	2.10	.90
February	16.6	56	−26	.92	.75	.74
Winter	16.9	56	−34	2.95	3.25	3.84
March	29.6	81	−17	1.93	.15	1.94
April	46.4	90	5	2.42	1.64	1.04
May	58.5	91	26	4.67	2.91	12.04
Spring	44.8	91	−17	9.02	4.70	15.02
June	67.2	97	35	3.94	.87	7.38
July	72.2	104	45	3.75	.12	8.19
August	69.3	97	35	3.67	4.81	3.72
Summer	69.6	104	35	11.36	5.80	19.29
September	60.9	94	27	3.12	2.18	6.75
October	48.1	87	12	2.27	.54	1.40
November	33.0	75	−6	1.63	.22	2.37
Fall	47.3	94	−6	7.02	2.94	10.52
Year	44.7	104	−34	30.35	16.69	48.67

AGRICULTURE

Agriculture began in Howard County when the first white settlers established their homes in the wooded sections along the main streams. Large areas of virgin prairie lands extended to the west of this wooded section, but these areas were not considered desirable. With the coming of the railroads, however, the prairies were settled, and the population increased rapidly. Large areas of marshy or wet land interspersed the higher lands, and the luxuriant growth of prairie grasses formed a tough sod which made the breaking of the land a difficult task with the implements then available. As the population increased, all the good or well-drained land was taken, and it became necessary to drain the wet areas and utilize them for crop production.

Table 2 shows the acreage and production of the principal crops, as reported by the census from 1879 to 1924.

TABLE 2.—*Acreage and production of principal crops in stated years*

	1879		1889		1899		1909		1919		1924	
	Acres	Bushels	Acres	Bushels	Acres	Bushels	Acres	Bushels	Acres	Bushels	Acres	Bushels
Corn	18,652	618,133	31,511	903,460	52,701	1,963,850	47,523	1,488,538	36,942	1,327,553	23,065	371,173
Oats	19,887	667,911	35,422	1,555,828	67,397	2,512,300	52,270	1,324,616	57,484	1,646,915	59,189	2,268,187
Wheat	80,231	612,100	2,074	29,372	3,388	46,130	755	12,701	4,190	39,930	715	17,813
Barley	4,835	103,579	3,764	105,980	7,064	212,280	11,080	225,124	3,636	75,773	1,250	40,945
Potatoes	-------	86,894	1,165	131,341	1,366	170,968	1,134	101,793	889	44,592	566	71,705
		Tons		*Tons*		*Tons*		*Tons*		*Tons*		*Tons*
Hay	26,101	34,913	49,426	64,526	39,278	48,162	49,241	68,506	51,171	68,779	54,136	52,940

Corn and oats have been the leading crops in Howard County since the railroads were established, affording suitable markets for surplus grain and livestock. Wheat, barley, hay, rye, buckwheat, flax, and potatoes are grown, the acreages depending on the seasonal conditions and the price of the crop the preceding season.

The production of corn has a tendency to follow the market conditions; that is, if the production in any given year is below normal with prices high, the acreage devoted to the crop the following year will be increased, but if the production is high and the prices low less land will be devoted to the crop the following year. Until recently, the greater part of the corn crop was fed on the farms to livestock, but with the increasing number of tenant farmers this practice is giving way to the marketing of the grain as a cash crop. Corn is grown in all parts of the county on the better-drained soils, Carrington loam and Carrington silt loam being preferred for it. The location of Howard County makes it necessary to grow an early-maturing variety. These are less productive than the later-maturing varieties, and consequently the yields obtained in this part of the State are not so high as in the southern part where the later varieties are grown. Silver King, Minnesota 13, Kossuth Reliance, Early Murdock, Calico, and Iowa Silvermine, together with strains and crosses of these varieties, are best adapted to this county.

Cornland is plowed, either in the spring or fall, to a depth of 4 or 6 inches and is thoroughly disked and dragged before planting. Sod land is usually plowed in the fall and stubble land in the spring. Planting is done about May 20, the time depending on the seasonal conditions. The seed is planted in checkrows or is drilled in rows if the crop is to be used as silage. From three to five cultivations are given, the number depending on the growth of weeds and the frequency of rains. The corn is usually "laid by" about the first week in July. It is either cut with binders and shocked in the field, to be hauled to the barns later and shredded and husked by machinery, or is husked from the standing stalks and the grain stored.

The acreage devoted to the production of oats greatly exceeds that of corn planted for grain. These two crops are important as feed and cash crops and are always given the preference in the cropping systems. The oats are utilized as feed for the work animals and are ground with some other grain and fed to dairy cows and hogs. Gristmills are located in the various towns, and although the hauls are sometimes long, farmers consider that the increased feeding value

more than pays for this cost. The favorite oat varieties are Kherson, Albion (Iowa 103), Richland (Iowa 105), and Early Champion. Oats usually follow the corn crop. The fields are prepared by dragging down and cutting the stalks and thoroughly disking the soil. Timothy and clover are generally seeded with the oats. The young timothy and clover plants need protection from the sun until they are firmly established. The oats mature early in July, are cut and shocked in the field, allowed to cure, and later threshed from the shock. The practice of stacking the grain is becoming obsolete, for this necessitates handling the crop several times more than is necessary in threshing from the shock. After the removal of the oats the timothy and clover grow more rapidly and by the following year are well established.

Between 1879 and 1899 the production of wheat and barley in Howard County was at its highest stage. By 1909 the acreage had decreased until there were only 755 acres devoted to wheat in the entire county. During the World War, when the price of wheat advanced materially, the acreage was increased. Since 1919 the acreage has decreased rapidly. Wheat either follows corn or oats in the rotation. Both spring and winter varieties are grown.

This section of Iowa, being particularly adapted to barley production, gradually became the barley-raising area of the State. The acreage, for several reasons, began to decrease after 1909. Barley was formerly utilized as a cash crop, but at the present time it is mixed with other grains and ground and fed to dairy cattle and hogs.

Hay is one of the important crops in the county. The acreage devoted to it has remained practically constant for several decades. The most common hay mixture grown is timothy and clover. Clover is grown alone on some farms, but the practice is not common. The hay the first year consists of a rather uniform mixture of clover and timothy, but the second cutting in the fall is mostly clover. The following year the timothy makes its maximum growth, and the hay consists mainly of timothy. A few fields are sown for seed. When the stand of timothy and clover becomes thin the fields are pastured. Sweet clover and alfalfa are of minor importance, but their value is being recognized, and more fields will be seeded to these legumes in the future. Wild hay is allowed to grow on the broad, poorly drained swales and is either cut and utilized as roughage during the winter or is pastured during the grazing season.

Potatoes are considered one of the staple crops. The acreage does not vary to any great extent from one season to another, remaining at about 1,000 acres. The yield depends largely on the seasonal conditions. The production of potatoes is not conducted on a large scale on any one farm, but patches are planted on practically every farm. Any surplus over the amount needed for home consumption is marketed.

Some flax is grown on the newly drained areas or on fields which have not been under cultivation for several years. The crop is grown one or two years on these fields, and the grain is sold as a cash crop. Buckwheat is sown as a catch crop when some of the more important grains fail. This crop often replaces flax on newly drained fields. Little attention is given flax and buckwheat, other than plowing the sod. The grain is usually sold at threshing time.

The present system of farming within the county consists, primarily, of the production of corn, oats, and hay, with an occasional cash crop of wheat, barley, or flax, and the raising and feeding of dairy cattle, beef cattle, and hogs.

When the county was first settled, cattle and hogs were allowed to roam at will in the neighboring timber and prairie lands. The growth of the livestock industry has followed closely the increase in the population of the county. In 1910 there were 41,128 hogs; 43,046 head of cattle, 15,687 of which were dairy cows; 11,619 sheep; and 9,897 horses in the county. Census reports for 1925 show that 43,684 hogs; 43,762 head of cattle 12,133 of which were dairy cattle; 5,413 sheep; and 9,496 horses were on farms in the county.

Hog raising is one of the principal divisions of the livestock industry. The average kept is 45 head to the farm, but the actual number on each farm varies and depends largely on the amount of feed available and the type of farming followed. Duroc-Jersey, Poland China, Chester White, and grades of these breeds are popular. Cholera and influenza among the hogs cause heavy losses in some years, but with improved feeding methods and vaccination, together with sanitary housing, this loss is materially lowered.

Dairying has proved a profitable industry, as is indicated by the number of milk cows kept on the farms. The dairy farmers usually maintain herds of 25 or 30 cows, the Holstein breed being preferred. Jersey, Guernsey, and Swiss cattle are found in some sections. Milking strains of the beef cattle and grades of various crosses are also used for dairy purposes. The milk and cream are sold to creameries. One cheese factory located at Jamestown utilizes milk from this county. Butter manufactured at the creameries is shipped to Chicago and eastern markets.

The raising of beef cattle is not so extensively practiced as it was a decade ago. Shorthorn, Angus, and Hereford cattle are bred and fed on the farms. The most common practice in handling beef cattle is to purchase feeders on the market, pasture them through the summer, feed them heavily on corn and concentrates between 60 and 120 days, and market as fat cattle.

Although sheep raising is a minor industry in Howard County, considerable income is derived from this source. In 1924, 4,307 sheep were shorn, and the wool produced was valued at $17,047. Sheep are kept mainly to clean up weedy or shrubby pastures and fields in the wooded sections of the county. From 20 to 75 head are kept on these farms. The old animals are sold after the lambs are old enough to care for themselves. Shropshire, Hampshire, and Southdown are the breeds favored.

Horse raising consists of the raising of one or two colts each year to furnish new work animals and to have one or more of the animals for sale. Belgian, Percheron, and Clydesdale are the breeds most commonly found on the farms.

Poultry, although raised as a side line on most farms, is a valuable source of income on practically all farms. The 1920 census reports the value of poultry and eggs as $469,872 in 1919. This industry is becoming popular and proving profitable where it is properly conducted. The products are marketed through local produce dealers who ship in carload lots to the eastern markets. The Leghorn is

preferred for egg production and the Rhode Island Red, Plymouth Rock, and Brahma for sale as fryers and broilers. Geese and ducks are raised in large numbers, especially in the drift sections where there are swampy areas and perennial streams. A few turkeys are raised in the northeastern part of the county. One of the most modern chicken ranches in this section of the United States is at Oakdale, a small village in the northwestern part of the county near the Minnesota State line. Modern buildings and equipment necessary for the profitable raising of poultry have been constructed, and the business is run on a scientific basis. Several thousand chickens of all breeds are raised annually.

Although the relief and soil conditions do not materially affect farming methods, they influence the cropping systems to some extent. The wide, poorly drained swales occupied by Clyde silt loam and the flat areas of Floyd silt loam are often allowed to remain in wild hay, and the better-drained areas are utilized for corn and small grains. Extensive acreages of hilly land along Upper Iowa and Turkey Rivers are used as pastures, and the ridges which are wide enough to cultivate are used for crops. The extremely sandy soils require more care to maintain their productivity than the heavier-textured soils. The better-drained soils, especially Carrington loam and Carrington silt loam, are considered the best upland soils for general farming and grain production. The O'Neill soils on the terraces are well adapted to grain production during seasons of adequate rainfall, but during periods of drought the crops often suffer for moisture, owing to the openness and porosity of the subsoils.

Systematic crop rotations are, as a rule, not followed, but regular cropping systems are practiced by the better farmers. They grow corn two or three years, oats one year, and a hay crop two or three years, the hay being seeded with the oats in the spring. Other cropping systems consist merely of alternating the corn and oats, with the occasional substitution of some catch crop for the corn or oats if either one of these crops fails.

Many of the farm buildings are old, but they are kept in a good state of repair. In the more prosperous sections of the county comfortable modern homes are replacing the old ones. Care is taken to arrange the buildings and shrubbery so as to make the farmstead attractive.

Practically all the farms are equipped with modern labor-saving machinery. Horses and tractors supply the power for plowing, cultivating the crops, and seeding and harvesting the grain. Cooperatively owned threshers serve the farmers who have an interest in the machine. Corn binders are used to cut the corn. Silos are located mostly on the dairy farms. The State census reports a total of 394 silos on farms in 1922. Trucks are becoming popular as a means of marketing the grain and livestock quickly.

Stable manure and crop residues constitute the principal fertilizers. Ground limestone has been used on small fields in order to obtain satisfactory stands of either sweet clover or alfalfa. The 1920 census shows that on only 0.8 per cent of the farms are commercial fertilizers used. The average cost to the farm, on the 14 farms reporting the use of fertilizers, was $93.57. During the season of the survey (1925) the use of limestone and superphosphate (acid

phosphate) was being recommended, and farmers in several communities were testing the value of these materials on small plots running through their fields.

The majority of the farm laborers are of Bohemian descent. They come from neighboring farms and the small towns. Hired hands receive from $40 to $60 a month or from $2 to $3 a day with board and lodging furnished. Men hired by the season or year receive less than those hired by the day or month. Corn huskers receive from 4 to 6 cents a bushel.

Table 3 shows the range in the size of farms, the acreage of improved land in the county, land values, and tenure as based on census reports from 1880 to 1920.

TABLE 3.—*Number and size of farms, improved land, value, and tenure in stated years*

Year	Farms	Area in farms		Improved land in farms		Land values per acre	Per cent of farms operated by—		
							Owners	Tenants	Managers
	Number	*Per cent*	*Acres*	*Per cent*	*Acres*				
1880	1,502	75.3	150.0	84.2	126.6	----------	78.8	21.2	----------
1890	1,403	79.5	170.0	88.3	150.1	----------	68.1	31.9	----------
1900	1,708	97.2	170.5	88.6	151.0	$33.65	74.2	25.6	0.2
1910	1,650	95.2	173.0	88.6	153.2	57.24	67.9	31.6	.5
1920	1,708	93.8	164.4	82.8	136.1	115.46	60.8	37.9	1.3

With the increasing population of the county, improved farming methods, and the desire to invest in farm land, the average value of land has increased from about $20 an acre to $115.46. Since 1920, however, there has been a decided decrease in land values thoughout the entire State. Very little land is changing hands at the present time, and the sales which are made do not represent the true value of the land.

Within the last decade the percentage of farms operated by tenants has increased rapidly. Statements made to the field party in this county during the season of the survey (1925) by residents of the the county place the percentage of tenant-operated farms at 60 or 70 per cent of the total number, or nearly double the number as compared to figures for 1920. Various methods and agreements are adopted in renting land. Owners of land adjoining farms for rent lease the land on a grain-share basis, which allows the landlord one-half the corn crop, two-fifths of the small grain, and an equal share of the hay or from $3 to $5 an acre cash for the hay land. Pasture land rents for $1 or $2 an acre. Tenants living on the rented farms usually choose the livestock-share lease, which provides for the equal sharing of the crops and the raising and feeding of livestock which are owned in common by the landlord and the tenant. By this plan the tenant furnishes the labor and machinery for the successful operation of the farm and the landlord furnishes the land and pays the taxes. Different agreements are made concerning the purchase of the seed, but in most cases it is supplied by the owner. The tenant is allowed a small piece of land for a garden, a few chickens, and all the dairy products necessary for the table. Cash rentals for farms range from $6 to $10 an acre, depending on the location, state of fertility, and improvements.

SOILS

Howard County lies in the prairie region of the United States where a temperate climate, a level surface, and a moderately plentiful supply of moisture have favored a luxuriant growth of grasses. The most striking characteristics of the soils have been produced by these regional influences. The soils under a grass vegetation for ages have accumulated a large quantity of organic matter in their upper layers. This organic matter, incorporated in the soil through the decay of the grass roots, imparts to the prairie soils their characteristic dark color. On comparatively small, steeper areas bordering the larger streams where surface and subsoil drainage were more efficient a sparse growth of timber established itself. The soils of such forested areas have not accumulated any large quantities of organic matter and have a light-colored surface layer. The soils of this county may, therefore, be separated, on the basis of their most striking characteristic, into dark-colored and light-colored soils.

The dark-colored soils of the county fall into two major groups whose differentiation is based on characteristics produced, during their development, by drainage conditions of either surface soil or subsoil or both.

The soils of one of these groups, of which members of the Carrington series are representative, were developed under conditions of good surface drainage and subdrainage. The typical profile shows a surface layer ranging in color from dark grayish brown to black. The structure is single grained or finely granular. In the virgin soil the upper 3-inch or 4-inch layer is filled with grass roots, forming a turf. In the lower part of the surface layer the grass roots are present but are not so abundant as in the upper part. The material is also more distinctly granular in the lower part. The next lower layer is transitional in color between the surface soil and the brown layer below. The color changes downward from very dark grayish brown in the upper part to brown in the lower part of the layer. The material is distinctly granular. The texture becomes heavier, changing downward from loam or silt loam to silty clay loam. This transitional layer is underlain, between depths of 18 and 36 inches, by a brown or yellowish-brown layer, the heaviest layer in this soil. The material which underlies the weathered part of the soil is the parent material. In this county this may be glacial drift, silty material or loess, or river deposits of the older terraces. The material is yellowish brown and is commonly friable. Except in the Dodgeville soils, which overlie limestone, it is lacking in carbonates to a depth of many feet. Iron stains and concretions are common in the parent material below a depth of 4 feet. This group of soils includes, besides the Carrington soils, members of the Dickinson, Tama, and Dodgeville series on the upland and of the O'Neill and La Crosse series on the high terraces.

The soils of the second group of dark-colored soils, which have developed under conditions of more or less excessive moisture, have not developed the normal profile of the region. The broad swales, large depressions, and immature drainage courses scattered throughout the upland plains of the glaciated part of the county cover a large area, when taken collectively. Drainage conditions within these areas were poor. Water accumulated during rains and remained on the surface until, by the slow process of seepage and evaporation, it was

finally removed. Conditions were favorable for the growth of water-loving plants, as is evidenced by the extremely dark color of the soils, but were unfavorable to the accumulation of any appreciable quantities of organic material, as is shown by the absence of extensive peat and muck areas. These soils have a surface layer of very dark grayish-brown or black, finely granular material. This is underlain by a gray or mottled gray, yellow, and brown subsoil, heavier in texture than the surface soil. The details of the profile of these soils vary considerably, depending on the depth to which good drainage and oxidation have reached. In some places both surface soil and subsoil have developed under cover of water for a part of the year or under a permanently wet condition. Weathering under such conditions has produced the Clyde, Bremer, and Wabash soils. The Floyd soils have developed on a flat or gently rolling upland where the surface soil has been fairly well drained but the deeper part of the subsoil has been frequently wet, resulting in a slight mottling in the lower part. These soils, developed over glacial drift, may be regarded as being in an intermediate stage of development between the well-drained soils represented by the Carrington series and the poorly drained group represented by the Clyde series.

The areas of light-colored soils are very nearly coextensive with the areas covered by forest when the county was first settled. The surface layers of the forest soils are thinner than those of the smooth upland soils, varying in thickness from 3 to 8 inches. The color is gray or grayish brown, and the structure is loose or silty. The surface soil is underlain, to a depth of 2 or 3 feet, by a heavy brown or yellowish-brown layer. Below this is the parent material, commonly yellowish brown and lighter in texture and more friable than the layer above. The Fayette soils, derived from loess, and the Lindley soils, derived from glacial drift, belong to the light-colored group.

The principal soil characteristics mentioned have been imparted to the soils by the soil-forming processes, and no account has been taken of the characteristics resulting from the composition and the processes of accumulation of the mineral matter from which the soils have developed. In the following pages the grouping of these soils into series has included a consideration of the source of the soil material.

Approximately 95 per cent of the total area of the county is covered by the Iowan drift material. The relief, ranging from level or undulating to rolling, has afforded drainage conditions suitable for the formation of soils under both optimum and excess moisture conditions. The dark-colored well-drained soils in the drift-covered area include members of the Carrington and Dickinson series. The Dickinson soils have developed over a sandier drift than the Carrington. The drift materials that have weathered under conditions of excessive moisture have produced the Clyde soils of the imperfectly drained valleys and swales and the Floyd soils of the flat uplands.

Soils developed over loess occur in the extreme northeastern part of the county. This area was overun by the Kansan ice sheet and was left with a level or undulating surface. During the following ages erosion was active in carving out the valleys and giving a great relief to the region. The Iowan ice sheet invaded the State but failed to cover the northeastern part of the county. At some later period a deposit of silty material or loess was laid down, presumably by wind,

over the old Kansan till. The soils which have developed the normal regional profile over the loess are those of the Tama series. On the forested areas a light-colored soil belonging to the Fayette series has developed.

Beneath the drift deposit and exposed most prominently in the east-central part of the county, in the vicinity of the city of Cresco, are beds of consolidated limestone. Large exposures are visible along the streams, and in the more hilly sections fragments of rock are scattered over the surface on the ridges and slopes. Turkey River, traversing this area, has cut through the limestone, forming a rock-walled gorge along its course. The drift material overlying this rock is commonly sandy and shallow, varying in thickness from 4 to 12 inches. It rests on reddish-brown waxy, stiff, compact clay having a distinct nut structure. The small areas of residual soils which have been mapped within the loessial region differ from the residual soils of the drift section only in the texture of the surface material. The underlying layers correspond in texture and color. The Dodgeville series includes the soils of this group.

The alluvial soils of the county may be divided into two groups, the terrace and first-bottom soils.

Terraces varying in width from a few rods to three-fourths mile border practically all the larger streams of the county. The majority of these terraces were formed from the glacial outwash during the melting and recession of the ice sheet. All the streams carried large volumes of water, and the flood plain covered extensive areas. With the disappearance of the glacier, the water supply was diminished, the streams became smaller, and the channels were cut deeper. This resulted in the lowering of the stream bed, leaving the material deposited during the high stages of the streams well above overflow. The material deposited by the glacial waters consisted mainly of unassorted sand and gravel. When the current of the streams was checked as the supply of water decreased, the finer material now present on the surface was deposited over the coarser sand and gravel subsoils. The O'Neill and La Crosse soils are the terrace soils having a sandy or gravelly subsoil. Bremer silt loam is the only terrace soil having a heavy and compact subsoil.

The flood plains or the first bottoms of the streams within the county are extensive. They vary in width from one-eighth to one-half mile. Where the drainage courses are comparatively young and the base level of the stream has not been reached, the channels are meandering and the flood waters spread over wide areas, but in the older streams the bottoms are narrow and the waters are confined more closely within the banks. The material deposited by the flood waters is of recent origin and consists of sediment washed from the uplands. Sand, silt, and clay are laid down with no uniformity. The alluvial soils are classed in the Wabash series.

Thus the soil materials of the county, as modified by weathering either in place or after erosion and sedimentation, have given rise to a number of types of soil. These soils are grouped into series on the basis of the thickness and arrangement of the soil layers, the physical properties, such as color, texture (except in the surface layer), structure, and consistence, and the chemical properties and reactions where these can be determined by examination or by simple tests. The soil

type is a subdivision of the series, differentiated on the basis of the texture of the surface soil.

The following series descriptions apply to the soils as they occur in this county and elsewhere.

The surface layer of the Carrington soils in the virgin state consists of a 2 or 3 inch layer of very dark grayish-brown friable material containing grass roots in sufficient quantity to form a turf. Beneath this is very dark grayish-brown friable material having a finely granular structure. Underlying this layer to a depth of 18 inches is heavy, coarsely granular silt loam. Organic matter has leached into this layer and coated the soil aggregates with a dark-colored film. When the particles are crushed between the fingers the resulting color is much lighter. Between depths of 18 and 34 inches the material is yellowish-brown silty clay or clay loam. The parent or unweathered material of glacial till occurs at varying depths below 34 inches, depending largely on the surface relief. The entire soil is noncalcareous. The silt loam, loam, and fine sandy loam members of this series are mapped in the county.

The surface layer of the Dickinson soils, to a depth of 3 or 4 inches, is dark grayish-brown, loose material. The percentage of organic matter is high. This layer grades into loose, incoherent sand or fine gravel which continues downward for several feet. The color becomes gradually lighter with depth. Below a depth varying from 8 to 10 feet is gray and yellow sand. Dickinson loam and Dickinson fine sandy loam have been mapped in the county.

The surface layer of the Floyd soils is very dark grayish-brown or almost black, single-grained or finely granular material underlain, at a depth varying from 14 to 18 inches, by gray and drab clay loam or clay. When the material of this layer is gently shaken, the soil aggregates break down into granules about one-fourth inch in diameter. Below a depth of about 35 inches is yellowish-brown or yellow clay loam containing varying quantities of sand and fine sand. Floyd silt loam has been mapped in this county.

The 1-inch or 2-inch surface layer of the soils of the Clyde series consists of very dark-brown or black material composed almost entirely of organic matter and closely resembling muck. This rests on dark, fine, granular silty material which, at a depth of about 14 inches, grades into dark-brown, heavy clay loam or clay, very sticky and tough when wet and breaking down into aggregates about one-fourth inch in diameter on drying. Below a depth varying from 28 to 34 inches the soil becomes dark gray in color and is composed of a mixture of sand and clay particles. With increasing depth the percentage of sand increases slightly, and the soil mass becomes mottled gray and brown. This series is represented by the silt loam type, with a mucky phase.

The surface layer of the virgin or wooded Lindley soils consists of grayish-brown or brown loamy material underlain at a depth of 1 or 1½ inches by light-brown or grayish-brown loose, friable material. At a depth varying from 8 to 12 inches this grades into lighter-colored, soft, crumbly fine sandy loam which continues to a depth of about 30 inches and is underlain by gray, brown, and rust-brown mottled silty clay or clay loam containing some sand. On drying, this heavy material breaks down into subangular, irregular particles about one-fourth inch in diameter. The entire soil, to a depth of 5 feet, is

noncalcareous. Oxidation and weathering of the parent material have been thorough to a depth of several feet, as is revealed in exposures along highways. Lindley fine sandy loam was mapped.

The Tama series includes those soils having a surface layer of very dark grayish-brown smooth, silty, or single-grained material underlain, at a depth of 8 or 10 inches, by lighter-brown, soft, crumbly silty material, more compact than the surface soil but only slightly heavier in texture. Between depths of 18 and 50 inches the soil is yellowish-brown fine silt loam and is soft and crumbly. Below a depth of 50 inches the mass becomes faintly mottled gray, yellow, and brown. The entire soil, to a depth of more than 6 feet, showed no effervescence when treated with acid. Tama silt loam was mapped in this county.

The surface layer of the Fayette soils, to a depth of 1 or 2 inches, is brown, loamy material containing grass roots and partly decomposed vegetable matter. Underlying this and continuing to a depth of 5 or 7 inches, is light-brown or grayish-brown silty material. This grades rather abruptly into light-brown heavy silt loam or silty clay loam. Below a depth varying from 18 to 22 inches is yellowish-brown, soft crumbly silt loam which continues downward to a depth varying from about 30 to 34 inches. Below this depth the material is gray and brown soft crumbly silt loam, compact but friable. The soil, to a depth of more than 6 feet, is noncalcareous. Fayette silt loam is mapped.

The surface layer of the Dodgeville soils is dark brown or very dark grayish brown to a depth varying from 6 to 9 inches. It is underlain by reddish-brown residual clay which, on drying, divides into small, angular masses from one-fourth to almost one-half inch in diameter. Below a depth varying from 26 to 29 inches is a stratum of yellowish-brown disintegrated or rotten rock which rests on the consolidated limestone bedrock. Dodgeville silt loam, within the loessial area, and Dodgeville loam, within the drift area, have been mapped.

The soils of the O'Neill series have very dark grayish-brown loose or open surface layers from 8 to 12 inches thick. The next lower layer is light-brown sandy or gritty clay loam, heavier in texture than either the surface or the underlying layers. This grades rather abruptly into yellowish-brown stratified sand and gravel. The soil material consists principally of reworked glacial outwash. O'Neill loam and O'Neill fine sandy loam were mapped in the county.

The surface layer of the La Crosse soils, to a depth varying from 7 to 10 inches, is dark brown or very dark brown and has an open structure. It grades into brown heavy sandy loam containing slightly more silt and clay than the surface material. At a depth varying from 23 to 36 inches, the subsoil becomes more open in structure, consisting of loose incoherent sand and fine gravel which continues downward for several feet. These soils differ from the O'Neill soils in being underlain by sand and fine gravel instead of the coarse gravel characteristic of the O'Neill series. La Crosse sandy loam was mapped.

The Bremer soils have dark-brown or almost black granular surface soils underlain, at a depth varying from 8 to 12 inches, by dark-gray or slate-gray heavy silty clay loam or clay. When partly dry the soil mass is made up of large soil aggregates which give it a nut structure. Below a depth varying from 20 to 24 inches is gray and

drab, mottled brown and rust-brown coarsely granular clay loam or clay. This layer shows the effect of poor surface and subsoil drainage. Bremer silt loam has been mapped in this county.

The surface layers of the Wabash soils are very dark grayish brown or almost black and have a high content of organic matter. They are underlain, at a depth varying from 10 to 14 inches, by light-brown, coarsely granular heavy silt loam or light silty clay. The next lower layer consists of gray and brown, stained rust-brown and black, clay having a distinct nut structure. The soil aggregates are from one-fourth to one-half inch in diameter. These soils differ from members of the Bremer series in that they are younger and are subject to overflow. Wabash silt loam and Wabash loam have been mapped in Howard County.

The areas mapped as rough stony land include the rocky ledges along the streams and the slopes which are strewn with rock fragments or on which the fragments are mixed with the thin covering of loess or drift.

In the following pages of this report, the various soils are described in full and their agricultural importance is discussed; their distribution is shown on the accompanying soil map; and their acreage and proportionate extent are given in Table 4.

TABLE 4.—*Acreage and proportionate extent of soils mapped in Howard County, Iowa*

Type of soil	Acres	Per cent	Type of soil	Acres	Per cent
Carrington silt loam	77,696	25.9	Fayette silt loam	5,184	1.7
Carrington loam	65,536	21.9	Lindley fine sandy loam	4,672	1.5
Carrington fine sandy loam	2,368	.8	O'Neill loam	9,920	3.3
Clyde silt loam	48,000	16.1	O'Neill fine sandy loam	8,064	2.7
Mucky phase	384		Wabash loam	20,032	6.7
Floyd silt loam	19,456	6.5	Wabash silt loam	1,728	.6
Tama silt loam	4,032	1.3	Bremer silt loam	1,216	.4
Dickinson fine sandy loam	17,536	5.9	La Crosse sandy loam	64	.1
Dickinson loam	832	.3	Rough stony land	576	.2
Dodgeville loam	11,264	3.8			
Dodgeville silt loam	960	.3	Total	299,520	

CARRINGTON SILT LOAM

The surface soil of Carrington silt loam, to an average depth of 10 inches, is very dark grayish-brown silt loam. To a depth of 2 inches it is filled with grass roots, forming a turf. The soil mass is largely made up of fine, soft granules to which the grass roots cling rather tenaciously. There is also some fine material among the granules. In the lower part of this layer the grass roots are less abundant than in the upper part, and the granules are larger and are distinct and well formed. The next lower layer, which reaches a depth of about 18 inches, is transitional in color between the surface soil above and the layer below. The color changes downward from very dark grayish brown to brown. The dark color in this layer is imparted by organic matter that has seeped down from the surface layer and settled as a coating over the soil granules and along breakage planes, root holes, and insect and worm burrows. The texture also becomes heavier, changing from silt loam to silty clay loam. The next lower layer is brown or yellowish-brown silty clay

loam and is the heaviest layer in this soil. It is underlain by more friable yellowish-brown silty clay loam which continues to a depth of many feet. This is glacial drift, the parent material from which this soil has developed. At a depth of 4 feet the drift material may be splotched and variegated with gray, yellow, and brown, but this coloration is largely from the rocks in the parent drift. Rounded or subangular bowlders are scattered over the surface or in the soil. They are most abundant below a depth of 2 feet.

Variations within this soil are common throughout the county, but they are of minor importance. The surface layer, mainly within the undulating or gently rolling areas, contains a greater percentage of very fine sand. The color and thickness of the surface layer vary with the relief to a slight extent. Where Carrington silt loam has been mapped on the ridges the soil is not so dark brown as on the undulating plains and the dark humus layer does not exceed 8 inches in thickness. In a few isolated areas, principally in Afton and Howard Townships, the surface layer closely resembles loam in texture, and the boundary between the loam and the silt loam members of the series could not be sharply drawn. Also included with this soil are narrow strips of poorly drained soils, classified as Floyd silt loam wherever possible. Such areas were mapped with the Clyde soils, where the drainage was very poor. The surface layer of such areas is dark-brown or almost black silt loam to a depth varying from 12 to 18 inches. It grades into gray and drab compact clay. This in turn, at a depth of 35 inches, grades into yellowish-brown clay loam not unlike the underlying layers of typical Carrington silt loam.

Carrington silt loam occurs on the level or undulating plains on the divides between drainage courses. It is most extensive in the western half and the southeastern quarter of the county. It is closely associated with Floyd silt loam and Clyde silt loam, which penetrate areas of Carrington silt loam in fingerlike projections along the drainage courses. Carrington silt loam is the most extensive soil in the county.

In general, Carrington silt loam is level or undulating, and the natural drainage is fairly good. Where the surface is level, the surplus water runs off slowly, but the pervious subsoil allows the water to seep through the lower layers and escape readily.

This is one of the most important soils in the county, practically all of it being used for the production of corn, small grains, hay, and pasturage. Natural timber growth is absent, but a scattered growth of oaks, elms, willows, and maples is seen along fence rows and highways throughout the county. Practically all the farmsteads are surrounded by windbreaks or shelter belts as a protection from the cold winter winds and to serve as a source of fuel.

Corn, small grains, and hay, chiefly a mixture of clover and timothy, are the main crops grown on this soil. Oats are given the preference over the other small grains in the cropping systems. General farm practices are followed. Corn is the leading grain crop, followed closely by oats and hay. Crops of minor importance include wheat, barley, flax, and buckwheat.

The soils are easily managed when worked under optimum moisture conditions. Although silty in texture, the presence of a comparatively high percentage of very fine sand prevents these soils from clodding or puddling when the fields are cultivated when wet.

The fields are plowed in the spring or fall, depending on the crop grown previously and the crop to be grown. The seed bed is made smooth and uniform by thorough disking and harrowing. When preparing the land for oats or other small grain which follows the corn in the rotation, the remaining cornstalks are dragged down and cut by means of disk harrows or special stalk-cutting machines. The fields are then disked two or three times, and the seed is either drilled or broadcast and covered by harrowing. Timothy and clover seed are sown with the small grain, which serves as a nurse crop for the young hay plants. The small grains mature early in July, are cut and shocked in the field, and are later threshed. The fields are kept in timothy and clover two or three years, the time depending on the stand from year to year. Two hay crops are cut yearly for the first two seasons, and then the fields are pastured for one or two seasons. Modern machinery is used on all farms for plowing, cultivating, seeding, harvesting, and threshing the grain crop. Tractors supply the power on a few farms where the land is fairly level, especially on owner-operated farms. Horses are used on most farms to supply the power to operate the machinery in the fields.

Crop yields on Carrington silt loam in Howard County compare favorably with the yields obtained on this soil in the adjoining counties. Corn yields range from 30 to 50 bushels to the acre, with an average yield between 35 and 40 bushels. Although these yields seem small, as compared to yields in counties farther south, this is explained by the fact that the varieties of corn grown in this section of the State are smaller and therefore the total yield is lower. Oats are well adapted to this soil in this county. Yields as high as 80 or 90 bushels to the acre have been obtained, and the average yield for the county is between 50 and 60 bushels. Oat yields are influenced materially by seasonal conditions. Wheat yields from 20 to 25 bushels to the acre and hay from 1½ to 2 tons. The yields of hay vary with the seasonal conditions and the length of time the fields have been in this crop since seeding. Of the minor crops, barley, rye, flax, buckwheat, and potatoes are the most important. These crops are seeded irregularly and serve primarily as catch crops and occasionally as cash crops during the season. Truck and garden crops are grown only for home consumption.

Carrington silt loam is well adapted to the livestock system of farming. Corn and small grains can be produced in sufficient quantities to supply feed for the livestock, and the areas of Clyde and Floyd soils which are usually farmed in conjunction with Carrington silt loam in all parts of the county furnish excellent pasturage throughout the grazing season. Although hog raising is the principal livestock industry, dairying is now becoming popular. From 20 to 30 head of milk cows, primarily of the Holstein, Jersey, and Guernsey breeds, are kept on many farms. The cream and milk are sold to the various creameries throughout the county.

Commercial fertilizers are not applied to this soil in large quantities. On a few farms, experimental plots or strips through a main field have been treated with some form of phosphate to determine its value. Ground limestone has been applied to test plots in order to obtain stands of sweet clover or alfalfa. Barnyard and stable

manure are applied in quantities proportionate to the number of livestock on the farm. Crop residues and the timothy and clover sod supply some organic matter.

Land values at the present time (1925) are affected to a marked degree by prevailing economic conditions. Estimates on the value of Carrington silt loam range from $90 to $175 an acre, and the average is between $125 and $150 an acre, depending on the location and improvements. The lower-priced land is usually in a run-down condition or is poorly drained, and the fences or buildings are in a poor state of repair.

In order to maintain the fertility of Carrington silt loam it is necessary to adopt a rotation or cropping system which includes a legume. The common practice of mixing clover and timothy for hay should be discouraged, and instead a legume should be grown alone. Red clover, sweet clover, and alfalfa are excellent hay crops and good soil builders if a part of the crop is plowed under. It is necessary to give the fields an application of ground limestone, the quantity required to be determined by tests of the soil, when these legumes are to be grown to the best advantage. Inoculation of the sweet clover and alfalfa seed is recommended when new fields are seeded. Experiments conducted on this soil in other counties show that liming increases crop yields. Especially is this true when the lime is used in connection with manure and phosphates. Cropping the fields continuously to corn and oats will deplete any soil and reduce its crop-producing power.

Results of mechanical analyses of samples of the surface soil, subsurface soil, and two layers of the subsoil of Carrington silt loam are shown in Table 5. The organic matter was removed before the analyses were made.

TABLE 5.—*Mechanical analysis of Carrington silt loam*

No.	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*
336523	Surface soil, 0 to 8 inches	0.8	4.7	6.5	7.3	3.8	43.9	33.0
336524	Subsurface soil, 8 to 18 inches	1.4	5.3	7.0	8.2	4.2	43.5	30.4
336525	Subsoil, 18 to 34 inches	2.0	5.6	8.4	13.2	7.8	30.3	32.8
336526	Subsoil, 34+ inches	2 9	6.6	9.5	14.8	10.0	27.9	28.4

CARRINGTON LOAM

The surface soil of Carrington loam is very dark grayish-brown, loose or finely granular loam about 10 inches thick. To a depth of 2 inches the virgin soil is filled with grass roots which form a firm sod. Organic matter in various stages of decomposition is present. The lower part of the layer is slightly darker in color, heavier in texture, and more granular in structure than the upper part. The layers below these are not essentially different from the corresponding layers in Carrington silt loam. A slightly heavier layer, which changes in color downward, underlies the surface soil. The heavy yellowish-brown layer is similar to the heavy layer in the silt loam soil. The parent material is slightly altered glacial drift. Glacial gravel and bowlders are scattered over the surface and throughout

the soil. These coarser fragments are more common in the dark-colored upper layers than in Carrington silt loam. In the various layers of the soil, which was tested to a depth of 10 feet, there was no effervescence when the soil was treated with acid.

In a few isolated areas of Carrington loam the surface soil is more or less sandy. These areas, if of sufficient size to separate, would have been mapped as a different soil type. The general place of occurrence of this variation is on knolls or kame formations. Few of the areas exceed 3 or 4 acres in extent. As in Carrington silt loam, the boundaries between the loam and the silt loam soils can not be sharply drawn. The presence of varying quantities of very fine sand in both makes texture determination difficult under the varying moisture conditions existing throughout the field season. This is especially true in Howard Center, Saratoga, and Howard Townships, for under field conditions and with the field methods of identifying textures, the soil may appear to be silt loam when analysis may show it to be loam.

Carrington loam is most extensive in the central and east-central parts of the county. It is the dominant soil in a belt 8 or 10 miles wide lying on both sides of the Chicago, Milwaukee & St. Paul Railway, northwestward from Cresco. In this section, the areas occupy ridges and slopes and border the Clyde and Floyd soils along the stream channels. In the remainder of the county, most of the areas occupy slopes bordering the streams and knolls which rise above the general level or undulating plain where Carrington silt loam predominates. Most of the bands mapped along the streams are from one-fourth to three-fourths mile wide, and the knolls comprise less than 40 acres.

The areas of Carrington loam are rolling or sharply rolling, and drainage is good. Although the texture of the surface material is loamy, the high percentage of organic matter present makes the soil fairly retentive of moisture. The lower layers are sufficiently heavy to retain moisture but are also light enough in texture to allow the excess water to seep through to lower levels.

Approximately 90 per cent of the total area of this soil is under cultivation. General farm crops do well. A sparse growth of timber consisting of oaks, hickory, elm, and maple occupies the lower slopes along the main streams within the county. Trees are also planted around the farmsteads and in wood lots to serve as protection and to furnish the season's wood supply.

Carrington loam is recognized as one of the best soils in the county. The higher percentage of sand in the surface layers allows the soil to warm up earlier in the spring, a factor of great importance in this section of the State where the growing season is several days shorter than in the central and southern parts.

This soil is farmed in much the same manner as Carrington silt loam. Farming consists mainly of the production of corn, oats, wheat, and hay and of the raising of hogs and the maintenance of a herd of dairy cattle. A few beef cattle are raised, but the general practice is to purchase feeders on the livestock markets, pasture them through the summer, and feed them heavily in the fall on corn and concentrates. Practically all the grain produced on the farms is fed to the cattle, hogs, and work animals. Poultry is an important source of farm income in the vicinity of Cresco. The cash crops

which prove the most profitable are wheat, buckwheat, barley, and potatoes.

Crop yields on Carrington loam compare favorably with those obtained on the silt loam member of this series. Corn yields from 35 to 50 bushels to the acre, oats from 40 to 50 bushels, wheat from 15 to 20 bushels, and hay from 1 to 2 tons.

The methods of seeding, cultivation, and managing the various crops are similar to those described for Carrington silt loam. Barnyard manures, crop residues, and what remains of the timothy and clover sod after pasturing are turned under to maintain the fertility of the soil. No commercial fertilizers are used, but some limestone is used experimentally.

Land values range from $100 to $165 an acre, depending largely on the location of the farm, the improvements, and the general condition of the soil in respect to noxious weeds and fertility.

Carrington loam is naturally fertile, as is indicated by its dark color, but owing to the mellowness of the surface material, this fertility is more easily depleted than in soils of heavier texture. Applications of manure and the plowing under of some leguminous crop aid materially in supplying and maintaining the humus content. Crop rotations which include a leguminous crop are recommended. Timothy and clover is recognized as a good hay mixture, but for soil-building purposes clover grown alone, with the second crop plowed under, is far superior. The entire soil is acid in reaction, therefore ground limestone should prove beneficial in obtaining stands of clover and alfalfa. Applications of limestone and commercial fertilizers, particularly phosphates, are recommended, but for the purpose of observation, their use at first should be limited to small plots or strips through the main fields. If the fertilizing material applied proves profitable, large areas may be treated yearly until the entire farm is under a systematic fertilizing plan.

CARRINGTON FINE SANDY LOAM

The surface soil of Carrington fine sandy loam, to a depth ranging from 7 to 9 inches, is dark grayish-brown loose fine sandy loam. Immediately beneath this sandy material is yellowish-brown heavy silt loam or silty clay loam having a distinctly coarse granular structure and continuing downward to a depth of about 16 inches below the surface. At this depth it grades into a third layer consisting of gray and yellow sandy and gravelly clay. Small pockets of sand are present in this layer.

Carrington fine sandy loam is closely associated with Carrington loam and Dickinson fine sandy loam, occupying a position between the two soils and representing a gradation from one to the other. It occurs in small areas, the largest of which is in sections 6 and 7 of lower New Oregon Township and section 12 of lower Paris Township. Most of the small areas are on the plain east and north of Turkey River and its tributaries.

The surface of this soil is somewhat hummocky. Surface drainage is good, and owing to the sandiness of the soil crops often suffer during long periods of drought. The lower soil layers are fairly retentive of moisture but allow the excess waters to percolate through to lower levels readily.

Practically all the soil is under cultivation, being farmed and cropped in the same manner as the adjoining soils. Crop yields are decidedly lower on this than on the heavier soils of this series. Corn yields from about 25 to 35 bushels to the acre, oats from 30 to 40 bushels, and hay from 1 to 1½ tons. Seasonal conditions determine the quality and yields of the various crops to a marked degree; during dry seasons the yields are reduced, but during seasons of adequate or excessive rainfall the yields are approximately the same as on the silt loam and the loam members of the series.

Greater care is taken in managing these sandy areas than the heavy soils. The fields receive heavier and more frequent applications of manure, mainly because the soils respond readily to this form of treatment. No other fertilizers are used, except on special crops, such as melons.

No farm consists entirely of this soil, and its value depends on that of the adjoining soils. As a rule, these sandy areas tend to lower the value of the farm, especially when they have not been properly managed.

The sandiness of the surface material indicates its need of organic matter in order to increase its water-holding capacity so that crops will not suffer during the droughts which occur annually in July or August. Recommendations given for Carrington silt loam and Carrington loam apply also to Carrington fine sandy loam.

CLYDE SILT LOAM

The surface soil of Clyde silt loam, to a depth of 1 or 2 inches, is very dark-brown or black mellow material composed mainly of partly decomposed grass roots and stems. The second layer is dark grayish-brown or black, fine or coarse granular heavy silt loam which continues to a depth of 10 or 12 inches. The third layer consists of dark-brown, heavy clay loam, sticky and tough when wet and hard when dry. The soil mass breaks down into small, subangular particles from one-eighth to one-fourth inch in diameter. At a depth between 26 and 32 inches the color grades from dark brown to dark gray and the soil mass is made up of a mixture of silt, clay, sand, and fine gravel in varying percentages. As the depth increases, the percentage of sand increases until the material is sandy loam, and brown or rust-brown iron stains are present. Neither the surface soil nor subsoil is calcareous. Bowlders or niggerheads, ranging in size from a few inches to several feet, lie on the surface or are embedded in the lower soil layers in some parts of the county.

Clyde silt loam is closely associated with the Floyd and Carrington soils, and the line of separation between these soils can not everywhere be drawn accurately. Where Clyde silt loam joins with these soils, the subsoil is more yellow, indicating slightly better aeration and drainage conditions. These transitional areas are small and unimportant and illustrate how better drainage affects the lower soil layers. When Clyde silt loam has been artificially drained and placed under cultivation, a coating of white appears on the surface in many small areas. Such areas are known as alkali spots and result from the excess accumulation of basic salts during the period previous to the time the areas were drained.

This soil occupies the poorly drained depressions, marshy areas, or lake beds on the uplands and the area along the wide, U-shaped,

poorly established drainage courses within the drift area of the county. The surface is depressed or slightly sloping toward the stream channel, and drainage is poor. The subsoil allows the surplus water to run off rapidly when the areas are artificially drained by tiling.

Although Clyde silt loam occupies a large percentage of the total area of the county, in crop production it ranks as one of the less important soil types. A few small areas have been reclaimed and placed under cultivation, but most of the soil remains in its original wet, marshy condition, supporting a growth of wild slough grass, weeds, and in some localities a sparse growth of willows. The better-drained areas are farmed or are allowed to seed to bluegrass. Clyde silt loam is utilized principally as pasture land and is best adapted to this purpose. The grasses grow luxuriantly, and an abundant water supply is everywhere available. Dairying and hog raising are the chief livestock industries. The small acreages under cultivation are managed in the same manner as the Floyd and Carrington soils previously described, and during the years when the moisture conditions are normal or below the average, the yields exceed those obtained from the better-drained, lighter upland soils. Wet seasons lower the crop yields materially.

The value of Clyde silt loam depends largely on the soil adjoining it, its extent, and the drainage conditions. Considered separately, it is worth only as much as any typical pasture land, but when included with a farm where pasture land is necessary its value increases materially.

Drainage is of primary importance in reclaiming Clyde silt loam. With the establishment of good drainage, farming operations may proceed as on the other soils of the county. Working the soil when wet may cause puddling and clodding. Buckwheat and flax are usually sown on newly reclaimed fields for two or three years, and the fields are then placed in the regular rotation. When alkali spots appear, they require special treatment. They may be recognized by the white coating on the surface or, if this is absent, by the fact that corn grows only 2 or 3 feet high, turns yellow, and dies. Heavy applications of barnyard manure and the turning under of some green-manure crop aid in restoring this soil to its normal condition. Clyde silt loam easily becomes infested with quack grass when the fields are drained, and care should be taken to keep down its growth.

Clyde silt loam, mucky phase.—Clyde silt loam, mucky phase, differs from typical Clyde silt loam in having a layer, from 2 to 4 inches thick, of mucky material on the surface and in having a deeper, black subsurface layer containing much more organic matter than the top layer.

This phase of Clyde silt loam occupies depressions or areas where water has stood on the surface practically the entire season and where water-loving plants grow abundantly. The largest areas are mapped in sections 15, 16, and 25 of Saratoga Township. Smaller areas are mapped throughout the county, generally at the heads of the drainage courses.

This soil is of minor importance agriculturally, owing to its small extent. During dry seasons it is utilized as pasture land, but in wet years it is marshy and is of little value.

FLOYD SILT LOAM

The surface soil of Floyd silt loam is dark grayish-brown or almost black single-grained or finely granular silt loam to a depth ranging from 14 to 18 inches. This grades into gray and drab compact clay loam having a distinct nut structure. The third layer occurs at a depth of about 34 inches and consists of yellowish-brown or yellow clay loam containing some particles of fine sand. Iron stains are present in this layer. The material is structureless and breaks up into small lumps or clods. When observed closely these small lumps of soil appear to be coated with a gray substance, but the gray coloring is easily destroyed when the lumps are crushed between the fingers. Neither the surface soil nor the subsoil is calcareous, and no effervescence was noticed when the soil at a depth of 8 feet was treated with dilute acid.

Although this soil as a whole is uniform in texture, minor variations from typical occur in various parts of the county. Where Floyd silt loam lies between Clyde silt loam and the sandy soils of the uplands the surface soil has been modified to a slight extent by the wash from the upland slopes, resulting in the formation of small areas of Floyd loam. However, these are too small to indicate on the map with accuracy, and such variations were included with the silt loam. The boundary lines between Floyd silt loam and Clyde silt loam can not be sharply drawn in many places, owing to the gradation of one soil into the other. Bowlders several feet in diameter were noticed lying on the surface of this soil in some parts of the county.

Floyd silt loam occupies two distinct positions in Howard County. It most commonly borders streams, lying between Clyde silt loam, which occupies the broad swales, and the well-drained upland soils of the Carrington and Dickinson series. The areas thus mapped range in width from a few rods to three-fourths mile. This soil has been mapped in all parts of the glaciated section of the county. It also occurs on the flat upland divides, and many areas are completely surrounded by a better-drained soil of lighter texture. In such areas the surface is usually depressed, and drainage is not good.

The surface of Floyd silt loam is flat or gently sloping toward the stream courses, but the slope is so gradual that the surplus water is slow to run off and the entire soil is saturated during each rain. Natural drainage is fair or poor, and tiling or ditching is necessary to prevent damage to the crops. The poor drainage has had a marked influence on the surface material. Water-loving plants grow luxuriantly, and the residue accumulated from year to year results in the accumulation of a high percentage of organic matter which imparts to the soil a dark-brown or black color.

Most of the Floyd silt loam is under cultivation to the general farm crops. The uncultivated areas are utilized as pasture and hay land or are being improved by ditching or tiling preparatory to cropping. A scattered growth of willows has become established along many of the fence rows, but otherwise the soil is not forested. When the fields are properly drained high yields of corn and small grains are obtained. Corn yields from 35 to 50 bushels to the acre, oats from 40 to 50 bushels, and hay from 1 to 2 tons.

Floyd silt loam is naturally fertile, but it requires care in cultivation to avoid puddling and the formation of hard clods. When the fields

become puddled and cloddy, the cultivation of the crops is made difficult, and it requires the entire season to restore the soil to its original smooth, friable condition. Poor drainage conditions, resulting from the heaviness of the subsoil and the level surface, delay farming operations a few days in the spring, and following rains, it is necessary to allow the fields to dry before cultivation can be started. Small grains are apt to lodge during wind and rain storms. This damage is lessened, however, by growing early-maturing and stiff-strawed varieties. Unless small early varieties of corn are grown, the crop is not likely to mature well in seasons of early fall frosts. The delay in plowing and the preparation of the seed bed in the spring has a great influence on the crop in the fall. Areas used as pasture land support a luxuriant growth of wild hay or slough grass. The first crop is usually cut for hay, and then livestock is pastured in the fields. Dairying and hog raising are the chief livestock industries.

Aside from the precautions taken in plowing these soils under various moisture conditions, they are managed in the same manner as the adjoining, better-drained upland soils. The soil receives no fertilizer. The manure produced on the farm is applied to the well-drained soils of the upland which have been under cultivation for a long period of years and unless the supply is large, little, if any, is applied to Floyd silt loam.

The value of Floyd silt loam depends largely on the improvements, the location of the farm, the extent to which the soil is developed, and the character of the adjoining soils. Based on these considerations, values range from $60 to $125 an acre.

The first need, in order to obtain maximum returns from this soil, is adequate drainage. Thorough tiling is necessary to remove the surplus water from the fields as rapidly as possible to prevent injury to the crops and to allow earlier working of the soil in the spring. Liming would not only correct the acidity but would also improve the physical condition, thereby allowing greater ease in plowing and cultivation. Quack grass has badly infested large areas and is rapidly spreading over new areas. Checking the growth of this weed is a serious problem. Several means of eradication have been recommended, such as smothering out the weed with thickly seeded sorghum, covering infested areas with tar paper until the roots die, and hoeing the plants out and burning the refuse. Fields infested with this weed detract from the appearance of the farm and naturally make it less desirable.

TAMA SILT LOAM

The surface soil of Tama silt loam, to an average depth of about 10 inches, is friable, mellow silt loam. The color is very dark grayish brown when the material is dry and black when it is wet. The material for the most part is finely granular, most of the granules being less than one-sixteenth inch in diameter. Loose silt which has not entered into the granules is also present. To a depth of 2 inches the virgin soil is less perfectly granular than the lower part of the layer and has a slightly grayer color. The surface layer is filled in most places with grass roots, forming a sod, and the roots hold the fine granules in clusters. The soil is underlain, to a depth ranging from 18 to 24 inches, by heavy silt loam or light silty clay loam.

The color at a distance appears dark grayish brown. Closer examination reveals darker splotches and streaks, in which the dark organic matter has penetrated downward from the surface layer following cracks, root holes, and burrows of worms and insects. Worms have also brought up lighter-colored material from below. Below this layer and continuing to a depth of about 50 inches, is yellowish-brown heavy silt loam or silty clay loam. This material has no definite structure. This layer is underlain by the parent loess, consisting of grayish-yellow friable silt loam. This material has no definite structure but breaks up into soft irregular clods. Iron stains and concretions are numerous, and faint gray mottles may be seen below a depth of 5 feet. No lime or other carbonate is present in any part of this soil in sufficient quantity to effervesce with acid.

Tama silt loam occurs only in areas in the extreme northeastern part of the county and has developed over loessial material under good drainage conditions. The surface is gently or strongly rolling, and the drainage is good. The steeper slopes are somewhat subject to erosion and sheet wash. The largest and most typical area occupies the divide between Upper Iowa River and one of its larger tributaries in Albion Township. This area ranges in width from about 1 mile in the western part to less than one-fourth mile in the eastern part, where it finally gives way to Fayette silt loam in the adjoining county.

Tama silt loam was originally prairie land and supported a heavy growth of prairie grasses. It is regarded as one of the better soils of the county and is well adapted to all farm crops and to general-farming practices. The gently rolling relief allows cultivation of practically all the areas. Corn is the principal crop, followed closely by hay and oats and other small grains. Dairying and hog raising are the principal animal industries.

Crop yields on Tama silt loam in Howard County compare favorably with the yields obtained in other counties where this soil occurs. The usual yield of corn is from 45 to 50 bushels to the acre, of oats 40 or 45 bushels, and of hay 1 or 2 tons. The minor crops yield in proportion.

The fine, even, friable consistence of Tama silt loam is a very desirable characteristic, making cultivation of the crops easy. The soil warms up comparatively early in the spring, thereby allowing early seeding. It is managed in much the same manner as the other soils of the county. The cultivated crops are tilled as often as necessary to keep down the weed growth. Cropping systems are followed, but the maintenance of the soil fertility was not considered when the systems were adopted.

Tama silt loam is naturally a fertile soil, but continuous cropping is rapidly depleting its available plant food. Regular rotations, which include some legume crop, are recommended. The fields should be manured regularly, and at least one crop of the clover or other legume should be plowed under once in each 4-year rotation. The soil is acid in reaction and therefore, to obtain best results from the legume crop, applications of ground limestone, in the quantities shown by tests to be required, are recommended. Since dairying is one of the chief livestock industries of this section of the county, hay and

other forage crops are important. Alfalfa yields heavily, as compared to the common hay crops now grown. Small fields supply more and better hay and pasturage when seeded to alfalfa than when red clover and timothy are grown.

Tama silt loam is regarded as a valuable soil and is much sought for general-farming purposes. The current selling price varies from $140 to $175 an acre, depending on the location, improvements, and the size of the farm.

The results of mechanical analyses of samples of the surface soil, subsurface soil, and two layers of the subsoil of Tama silt loam, after the organic matter was removed, are shown in Table 6.

TABLE 6.—*Mechanical analysis of Tama silt loam*

No.	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*
336537	Surface soil, 0 to 8 inches	0.1	0.4	0.3	0.6	4.8	63.9	29.9
336538	Subsurface soil, 8 to 18 inches	0	.1	.1	.3	6.2	58.4	34.9
336539	Subsoil, 18 to 50 inches	0	.1	.3	.4	8.3	62.4	28.3
336540	Subsoil, 50+inches	0	.1	.2	.3	6.2	76.8	16.3

DICKINSON FINE SANDY LOAM

Dickinson fine sandy loam has a surface layer of dark grayish-brown, loose, fine sandy loam, 8 or 10 inches thick, underlain by brown, loose, open loamy fine sand or sand. At a depth ranging from 26 to 30 inches this gives way to a third layer consisting of yellowish-brown incoherent sand which continues downward several feet. A section of this soil observed to a depth of 15 feet in a road cut showed no change in the color or texture of the sand.

Variations from the typical soil are common throughout the county. Where Dickinson fine sandy loam borders Carrington fine sandy loam the second layer contains some silt and clay, giving the material a heavier texture and a greater moisture-holding capacity than the typical soil. The most important variations, however, are the gravel knolls which occur throughout the east-central part of the county where this soil is most common. The largest of these, in section 34 of Vernon Springs Township, is typical of the other areas as they occur within the county. The surface material consists of brown, loose sand containing some fine gravel. At a depth of 6 or 8 inches this grades into a yellowish-brown mixture of sand and fine and coarse gravel. Below a depth of 6 feet are pockets of irregularly stratified sand, fine gravel, or coarse gravel, illustrating the manner in which the material was deposited by the glacial waters. These gravelly areas occupy knolls or kames and are well above the surrounding plain level. Although these gravel knolls are most common within areas of the Dickinson soil, they have also been mapped with the various members of the Carrington series.

Owing to the porosity of the entire soil and to the rolling relief, natural drainage is in many places excessive, resulting in serious damage to crops during seasons of low rainfall.

Although this soil occurs in areas of less than a square mile in extent, the total acreage over the county makes it an important soil.

Approximately 75 per cent of it is under cultivation, mainly to corn, small grains, and hay. The remainder supports a growth of oaks, elms, ironwood, ash, and maple and a surface covering of grasses and weeds. Crop yields are lower than on the adjoining heavier soils, mainly because of moisture conditions. Under the average systems of farming corn yields from 25 to 35 bushels to the acre, oats from 20 to 35 bushels, and hay from three-fourths to 1½ tons. On farms where the dairy type of farming is practiced the yields of all crops are somewhat higher than on farms where the grains are sold and manure is scarcer. The main livestock industries are hog raising and dairying. From 30 to 70 hogs are raised and fattened on many farms annually. The number of cows kept is determined largely by the quantity of feed available throughout the year. The numbers range from 10 head on the smaller farms to 35 on the better-equipped farms. It is often necessary for the farmers to purchase feed to carry the cattle and hogs over the winter months.

Truck crops, mainly watermelons and cantaloupes, are grown in patches in the vicinity of Cresco. The entire crop is utilized by the local trade. The vegetables grown are sold to the stores or are peddled from wagons throughout the residential districts in the larger towns.

Dickinson fine sandy loam requires special care to keep it productive. The sandy texture of the entire soil makes it possible to work this soil early in the spring, and tillage operations are accomplished with a minimum amount of power. Sandy soils require large applications of organic matter to supply plant food and to increase the moisture-holding capacity. Manures and crop residues supply the organic matter. Commercial fertilizers are not in common use.

Dickinson fine sandy loam is less desirable than some of the heavier soils of the county and therefore has a lower value. Values range from $75 to $125 an acre, depending on the location, improvements, fertility of the soil, and the kinds of soil adjoining.

The incorporation of organic matter is one of the most important factors to be considered in building up the fertility of Dickinson fine sandy loam. Heavy applications of manure, in conjunction with regular cropping systems which include the growing of some legume, preferably sweet clover or red clover, are recommended. At least one crop of the legume should be plowed under to supply organic matter and to increase the moisture-holding capacity of the soil and insure the crop against damage during periods of drought. The dairy type of farming is recommended on this soil, and all crops should be fed on the farm and the manure returned to the soil. With such treatment many of these sandy soils can be made as productive as the heavier soils of the county. The manure should be carefully conserved and applied to the fields at regular intervals. Alfalfa furnishes excellent hay and pasturage for both cattle and hogs, and since the crop is deep-rooted and can obtain moisture when other plants would suffer from drought it is advisable for each farmer to attempt to obtain a stand of this valuable crop. In order to grow alfalfa or sweet clover successfully it is necessary to make applications of limestone in quantities shown to be needed by tests of the soil. If neither of the two crops has been grown on the soil, it is advisable to inoculate the seed before planting.

DICKINSON LOAM

The surface soil of Dickinson loam is dark grayish-brown, friable loam about 9 inches thick. It is underlain by grayish-brown or olive-brown clay loam containing a high percentage of fine sand. The structure is finely granular. This layer, at a depth of 18 or 20 inches, rests on yellowish-brown sandy loam lighter in texture than the overlying material. The fourth layer is brown, gray, and yellow, loose open sand.

Dickinson loam is closely associated with Carrington loam and Dickinson fine sandy loam, commonly occupying a position between these two soils. The largest area mapped in the county occurs in section 34 of Howard Center Township. Smaller areas are mapped in Paris, Vernon Springs, and Howard Center Townships.

This soil is slightly more retentive of moisture than the fine sandy loam member of this series, and crops suffer less severely during periods of drought. The relief is undulating or gently rolling, and drainage is good. Crop yields are slightly higher than on the fine sandy loam of this series, owing to the better moisture conditions. Dairying is the chief livestock industry.

The recommendations given to improve and maintain the fertility of Dickinson fine sandy loam also apply to this soil. The incorporation of organic matter in large quantities, liming, and the growing of suitable legumes will improve the soil and eventually increase the crop yields. Dairying should be the principal livestock industry, and care should be taken to conserve the manure produced and to apply it to the fields at regular intervals during the rotation. By adopting a system of soil management that will return to the soil as much plant food as has been removed by the crops, the fertility of the soil can be maintained and crop yields increased materially.

DODGEVILLE LOAM

Dodgeville loam, to a depth of 8 inches, is dark grayish-brown or black friable loam. Underlying this dark-colored layer is light-brown granular silt loam or silty clay loam underlain, at a depth of about 20 inches, by the reddish-brown subsoil which is residual from the underlying limestone bedrock and consists of waxy, stiff, compact clay having a coarsely granular or nut structure. It is underlain at a depth of 28 inches or less, by yellowish-brown rock flour or rotten rock. Bedrock is found below a depth of 30 inches.

This soil varies greatly in the thickness of the surface soil and of the material covering the rock. The texture of the dark surface layer may vary from loam to sandy loam within a radius of a few feet, and therefore no differentiation has been made on the soil map between the loam and sandy loam soils. Rock fragments are common on the surface, especially on the steep slopes, and outcrops of the parent rock are common at the base of the slopes along the streams in the vicinity of Cresco. The largest areas mapped as Dodgeville loam are north and south of Cresco, along Turkey River and its tributaries. Small tracts are mapped along the course of Upper Iowa River and its large tributaries within the drift area near the town of Limesprings. Two small areas are shown along Wapsipinicon River near the north edge of the town of Elma.

Areas of this soil range from undulating on the one hand to hilly or broken on the other. Drainage is good or excessive. Serious erosional damage occurs on many of the slopes during heavy rains.

Where the soil is sufficiently deep and the relief allows cultivation, the fields are cropped and managed in the same way as the adjoining soils. The looseness and openness of the surface soil, combined with the shallowness of the deposit, often cause firing of the crops, and low yields are obtained during dry seasons. The deep, tillable lands are fairly fertile, and all the staple crops yield well during seasons of abundant moisture. Dodgeville loam, however, is regarded as one of the poorer soils of the county.

The incorporation of organic matter to aid in increasing the water-holding capacity of the soil would tend to increase crop yields in dry seasons. The rough, stony areas are suitable only for pasture and hay land and should never be cultivated.

DODGEVILLE SILT LOAM

The surface soil of Dodgeville silt loam is dark grayish-brown, smooth, friable silt loam about 9 inches thick. It is underlain by reddish-brown residual clay, tough and plastic when wet and hard when dry. The partly dried soil mass breaks down into subangular particles or aggregates about one-fourth inch in diameter. At a depth varying from 26 to 29 inches, this stiff, plastic clay passes abruptly into a thin stratum of yellowish-brown, disintegrated rock or rock flour. This material in turn rests on the limestone bedrock. This soil has been formed from two sources, the silty surface material wholly or in part from the wind-blown or loessial deposits and the residual clay from the underlying limestone.

The surface material of Dodgeville silt loam ranges in thickness from 4 or 6 inches on the eroded lower slopes to 14 inches on the flat divides. The deeper silty covering is on the crest of the hills, and the slopes have only a thin covering over the reddish-brown clay and rock. On the steeper slopes the reddish-brown clay is exposed in many places, rock fragments are strewn over the surface, and the rock crops out at the base of the hill.

This soil occurs within the loessial areas of the county and is closely associated with the Tama and Fayette soils. The largest tracts mapped are in sections 19 and 20 of Albion Township and in sections 11 and 12 of Forest City Township. Minor areas occur within the loessial region. The surface is strongly rolling or hilly, and natural drainage is good or excessive.

Owing to the small total extent of Dodgeville silt loam, it is unimportant agriculturally. Approximately 50 per cent of it is under cultivation and the remainder is utilized as pasture or hay land. Cultivated crops yield well, but most of the fields are irregular and small, and there is danger of serious damage from erosion on the slopes. No farms consist entirely of this soil. The fields receive only light applications of manure at irregular intervals and are heavily cropped wherever the surface features allow.

Dodgeville silt loam is best adapted for use as pasture or hay land. The steep slopes should not be plowed or allowed to remain without some cover crop for any length of time. Bluegrass grows luxuriantly, and since it is excellent pasture grass the fields should be allowed to seed down with this grass.

FAYETTE SILT LOAM

The surface layer of virgin Fayette silt loam, to a depth of 1 or 2 inches, is rather dark grayish-brown silt loam, containing a small percentage of more or less decomposed organic matter. Below this layer and reaching an average depth of 10 inches is grayish-brown friable silt loam. The next lower layer consists of light-brown or yellowish-brown light silty clay loam. This layer is firmer when in position than the layers above but is not compact. It is underlain, at a depth of about 18 inches, by more friable brown or yellowish-brown silt loam. The parent material, below a depth of about 30 inches, is grayish-yellow silt loam. The material in position is very slightly coherent, but it breaks up into soft clods that are easily reduced to powdery silt. Rust-brown stains are present below a depth of 4 feet. Neither the weathered layers nor the silty material below contain much lime.

In surface appearance and principal characteristics this soil is similar to the Lindley soils. It occurs, however, over loess instead of coarser glacial drift. In the cultivated state, the dark humus layer of the surface has been destroyed or mixed with the underlying light-brown material and the soil has a uniform grayish-brown color to a depth of 8 or 10 inches. On the steeper slopes the surface soil has been affected somewhat by erosion and is not so deep as where surface wash is less severe.

Fayette silt loam is closely associated with Tama silt loam in the loessial area of the county. It occupies the more rolling or hilly areas adjacent to streams. The largest area has been mapped along Upper Iowa River in Albion Township. The steeply rolling or hilly surface is favorable for good drainage. A few of the cultivated fields occupying the steep slopes are subject to surface wash during heavy rains.

This soil was originally forested with oak, elms, hickory, basswood, and maple, but at present approximately 70 per cent of it has been cleared and utilized for general farming. The timbered areas support a growth of timber and an undercover of bluegrass. The general farm crops are grown, and although the yields are not so high as on the Tama or Carrington soils, they are above the average for the county.

Fayette silt loam is managed in the same manner as the other soils of the county. Corn, oats, and other small grains and hay are grown. The steeper slopes are devoted principally to hay or small grains, and the intertilled crops are grown on the smoother areas. Contour plowing of the slopes has been adopted as an aid to prevent erosion.

Fayette silt loam is not so desirable a soil as Tama silt loam and is valued slightly below it.

The chief need of this soil is the addition of organic matter. This may be supplied by turning under green-manure crops, preferably legumes, barnyard manure, and crop residues. An increase in the humus content would increase crop yields, aid in reducing surface washing, increase the water-holding capacity, and make the surface material less compact and more friable.

Results of mechanical analyses of samples of the surface soil, subsurface soil, and two layers of the subsoil of Fayette silt loam, after the organic matter has been removed, are given in Table 7.

TABLE 7.—*Mechanical analysis of Fayette silt loam*

No.	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*
336533	Surface soil, 0 to 5 inches	0.0	0.3	0.2	0.6	5.6	69.1	24.2
336534	Subsurface soil, 5 to 18 inches	.0	.0	.0	.2	7.0	59.9	33.0
336535	Subsoil, 18 to 29 inches	.0	.0	.0	.1	7.7	64.9	27.2
336536	Subsoil, 29 to 70 inches	.0	.1	.1	.2	7.6	67.1	25.0

LINDLEY FINE SANDY LOAM

The surface soil of Lindley fine sandy loam is grayish-brown friable fine sandy loam. In the virgin areas the material to a depth of 1 or 2 inches is slightly darker than the remainder of the layer, owing to the presence of more or less decomposed organic matter. The entire layer varies in thickness with the relief, being thinner on steep slopes where erosion is rapid. On smoother areas the soil may have a thickness of 8 inches, but it thins from this to a mere film on the steeper slopes. The average is probably not more than 4 inches. The soil is underlain, to a depth of 12 inches, by yellowish-brown fine sandy loam which grades into loam or sandy clay loam. At a depth of 30 inches, this is underlain by the parent material of glacial till consisting of clay or silty clay. The color is yellowish brown, faintly mottled with gray, and occasional iron stains are present. Coarser material consisting of glacial gravel and small bowlders is found in places in the upper layers of the soil but is more abundant in the parent material. The soil material to a depth of 6 or more feet contains no lime.

The texture of the surface soil is extremely variable, but owing to the small extent of the areas the separation of the loam and silt loam soils from the fine sandy loam was deemed unnecessary.

Lindley fine sandy loam occurs in the wooded areas along the older streams. The larger areas are mapped along Wapsipinicon River and Crane Creek in the southwestern part of the county. The soil is most extensive 2 miles north and 1 mile south of Riceville and 2 miles southwest of Elma. These areas comprise approximately 1 square mile each, and the smaller areas mapped within the county are less than one-half square mile in extent.

The relief is rolling or hilly, and drainage is well established. The steeper slopes are subject to erosion and sheet wash which often removes the surface layer, exposing the yellowish-brown subsoil.

Lindley fine sandy loam is unimportant agriculturally. It was originally covered by a growth of oaks, elm, maple, ash, walnut, and hickory, and an undergrowth of hazel brush and scrub oak. The tillable areas are at present cleared and utilized for the production of the staple crops, and the uncultivable sections are utilized as pasture land. Approximately one-half the soil is timbered at present. Corn and small grains, the chief crops, yield well when the fields are properly managed. The usual yield of corn is from 30 to 45 bushels to the acre, of oats from 40 to 50 bushels, and of hay from 1 to 2 tons. With good pasture land available on farms on this soil, dairying is one of the chief occupations. Sufficient land is available for grain and hay production, and the timbered areas furnish excellent pasturage throughout the grazing season.

Light applications of manure are made to this soil, but no commercial fertilizers are used.

Land values range from $50 to $100 an acre, depending on the location, extent of development, improvements, and acreage of tillable land.

The light color of the surface soil indicates the need of organic matter. This can be supplied by turning under manure and some green-manure crop, such as red clover or sweet clover. Such treatment will not only increase the organic-matter content but will add nitrogen to the soil and increase the yield of the succeeding crops. Care should be taken in cultivating the steeper slopes to prevent washing and the formation of gullies. If ditches or gullies begin to form, the hills should be seeded down to grass as soon as possible. Timber aids in holding the soil in place, and its growth should be encouraged on uncultivable slopes.

O'NEILL LOAM

The surface soil of O'Neill loam is dark grayish-brown, friable or mellow loam containing some coarse sand to a depth of 8 or 10 inches. This grades into light-brown sandy clay loam containing a small percentage of coarse sand and fine gravel. At a depth of about 22 inches, this layer grades rather abruptly into yellowish-brown, loose, porous sand and gravel. In exposures of the soil in cuts along the roads the stratification of the lower sand and gravel may be seen.

O'Neill loam, being an alluvial soil, varies greatly in texture and in the thickness of the loamy surface material. The areas of this soil indicated on the map include small tracts of silt loam or sandy loam. In section 19 of Afton Township an included area is not typical of the O'Neill soils. The lower part of the subsoil is yellowish-brown silty clay loam, and the gravel layer does not occur above a depth of 40 or 45 inches. The areas are small and are therefore mapped as O'Neill loam. Had they been of sufficient size they would have been separated as Waukesha loam.

This soil occupies a terrace position, lying from 15 to 40 feet above the present flood plain of the streams. Some of these terraces have the appearance of being old glacial-outwash plains and others indicate that they were laid down by flood waters during the time of the melting and recession of the ice sheet when the streams were larger and at a higher level than at present. The streams have cut their channels deeper and have left this sandy and gravelly material well above overflow. The most extensive areas are along Upper Iowa River between the towns of Oakdale and Chester, along Wapsipinicon River near Riceville, along Crane Creek south of the villages of Saratoga and Mapleleaf, and along North Branch Turkey River.

The surface of this soil is level or sloping toward the first bottom. Owing to the porosity of the subsoil, drainage is good or excessive. Crops often suffer during periods of drought on the areas where the gravel is close to the surface. These terraces receive wash and surface drainage from the adjoining uplands.

Approximately 80 or 85 per cent of the O'Neill loam is under cultivation to corn, oats, and hay. The remainder of the soil supports a sparse growth of various species of trees, with an undergrowth of bluegrass, and is utilized as pasture land. Crops yield well during

seasons of abundant rainfall, when the droughty periods are short, but suffer from lack of moisture in seasons of extended drought. Corn, the chief crop, yields from 25 to 40 bushels to the acre, depending on the moisture conditions, oats from 30 to 45 bushels, and hay from 1 to 1½ tons. The hay crop consists of a mixture of timothy and clover.

O'Neill loam, although inferior to the well-drained upland soils, is regarded as desirable for general farming and is valued at a figure varying from $75 to $125 an acre, depending on the location, improvements, and the adjoining soils. This soil is well adapted to the dairy type of farming, since sufficient corn and small grain can be produced on the terraces and uplands and excellent pasture is available on the adjacent first-bottom tracts.

To improve O'Neill loam it is necessary to increase the humus content by the addition of large quantities of manure or vegetable matter in order to increase the water-holding capacity of the soil, thereby insuring a moisture supply to the crops during the dry periods of the growing season. Early-maturing varieties of the small grains are recommended. The fields should be placed under a regular cropping system which includes a legume. One crop of the legume should be plowed under during each 4-year rotation.

O'NEILL FINE SANDY LOAM

The surface soil of O'Neill fine sandy loam is dark grayish-brown, porous fine sandy loam containing some coarse sand and fine gravel. This grades, at a depth of 7 or 8 inches, into light-brown, fine, granular, heavy silt loam containing some sand and fine sand. Below an average depth of 26 inches is the yellowish-brown, loose, porous, stratified sand and gravel subsoil. The texture and thickness of the surface material are variable. The soil ranges from sandy loam to loamy fine sand within short distances. The depth at which the gravel layer occurs generally varies from 16 to 30 inches and is everywhere less than 3 feet.

O'Neill fine sandy loam is closely associated with O'Neill loam, commonly occupying a position on the terraces between the loam areas and the first bottoms. The terraces are well above overflow, being from 30 to 50 feet above the present flood plains of the streams. The largest single area is in sections 7, 8, and 17 of lower Paris Township, along the west bank of Crane Creek. The other tracts mapped are scattered along the various streams of the county.

The areas are generally nearly level or slightly sloping toward the first bottoms, but on some areas the fields have a hummocky appearance, probably the result of wind action on the loose sand.

Approximately three-fourths of this soil is cultivated and used for general-farming purposes. The remainder supports a sparse growth of timber and is utilized as pasture land.

This soil is less desirable than O'Neill loam, owing to its droughtiness. Crops do fairly well during seasons of abundant rainfall, but yields then are lower than on O'Neill loam. A minimum of power is required for plowing and cultivating the crops, and the fields can be worked almost immediately following rains. Recommendations given for the improvement of O'Neill loam apply to this soil also.

WABASH LOAM

The surface soil of Wabash loam, to a depth of 10 or 12 inches, is dark grayish-brown or almost black friable loam. Beneath this is brown or mottled rust-brown and black heavy silt loam or silty clay loam, granular in structure. At a depth of 26 inches, the soil grades rather abruptly into dark-gray, coarse, granular clay loam. Mottles or stains of brown, rust brown, and black increase with depth.

Included with Wabash loam, as mapped, are soils of varying textures. The areas occur as narrow bands along the streams, and the separation of the various textures along the minor streams could not be accomplished accurately. Therefore, areas of sandy material adjacent to the stream and silty areas joining the terraces or uplands are mapped as Wabash loam. Sand is common in the subsoil, especially in areas occupying pockets irregularly scattered over the bottoms. These sandy-subsoil areas are included in the Cass series in counties where they are extensive.

Wabash loam occurs in narrow bands along practically all the larger streams of the county. The largest area is along Wapsipinicon River in Afton Township. Other important areas are along Crane Creek, Turkey River, Little Turkey River, and the larger creeks of the county.

The land is level or hummocky, and drainage, owing to the first-bottom position of the areas, is poor. The lighter-textured soils, however, are better drained than the silt loam. Wabash loam is subject to overflow at frequent intervals, and water stands on the fields for long periods unless artificial means are supplied to carry off the surplus.

This soil is mainly utilized as pasture land, only a negligible percentage of the total area being under cultivation. Timber covers a large part of it. The open, better-drained areas support an excellent growth of bluegrass, and wild hay grows abundantly on the poorly drained areas.

Drainage is necessary before these soils can be cropped successfully. Accompanying drainage, provision must be made to prevent overflow. The construction of dikes and the straightening or deepening of the channel are necessary for this purpose. When well drained these soils are very productive and will withstand cropping to corn for several years with little or no decrease in yields.

WABASH SILT LOAM

Wabash silt loam, to a depth of 10 inches, consists of dark-brown or dark grayish-brown, smooth, friable silt loam. Below this and extending to a depth of about 26 inches, is light-brown, coarsely granular, heavy silt loam or silty clay loam. This passes into gray and brown mottled rust-brown or black clay.

Wabash silt loam is not so extensive as the loam member of this series. The areas are small and scattered. The largest single area is mapped in sections 17 and 18 of lower Afton Township.

The surface is nearly level, and drainage is poor. The fields are wet for long periods during spring and early summer and in the fall. The soil is subject to frequent overflow and receives the surface wash from the adjoining uplands.

Less than one-fourth of this soil is under cultivation, the remainder supporting a growth of bluegrass in the better-drained areas and slough grass on the wet areas. The areas are small and are utilized to good advantage in conjunction with the upland soils as pasture for the livestock.

When sufficiently drained to allow cropping, corn yields from 40 to 60 bushels to the acre. Small grains usually lodge and are more severely damaged than corn when the streams overflow and water covers the fields.

BREMER SILT LOAM

The surface soil of Bremer silt loam, to a depth of 8 or 10 inches, consists of dark grayish-brown or nearly black heavy silt loam having a granular structure. This is underlain, to a depth of 20 or 24 inches, by dark-gray or slate-gray, heavy, sticky silty clay or clay. The structure of this material is distinctly granular, the mass breaking down into particles about one-fourth inch in diameter. Below a depth of 20 inches is gray and drab mottled brown and rust-brown clay loam. This material is compact and heavy but is lighter textured than the soil overlying it. The structure is coarsely granular. The mottled appearance of the lower part of the subsoil increases with depth and indicates poor drainage and aeration of the lower soil layers. The surface soil and underlying layers are noncalcareous.

Bremer silt loam occurs on low, flat or slightly sloping terraces. Four small areas are shown along Upper Iowa River between the towns of Oakdale and Chester; the remaining areas are mapped along Wapsipinicon River in Afton Township. The natural drainage is poor or fair. Water from the uplands spreads over the surface and often stands for several days following rains. Exceptionally high water may inundate the terraces for short periods.

Approximately 50 per cent of this soil is cultivated. The remainder serves as pasture or hay land.

When well drained this soil is very fertile. The usual yield of corn is from 45 to 50 bushels to the acre, of oats from 30 to 45 bushels, and of hay from 1 to 2 tons. Wild hay or slough grass grows luxuriantly on this soil and is utilized as roughage during winter.

The small extent of Bremer silt loam within Howard County makes it an unimportant soil. No farms consist entirely of it, and its presence does not decrease the value of the remainder of the farm.

Adequate drainage and dikes to prevent overflow during high flood stages of the streams are of primary importance to insure good crops each season.

LA CROSSE SANDY LOAM

The surface material of La Crosse sandy loam is dark-brown or dark grayish-brown loose, open sandy loam about 9 inches thick. Beneath this and continuing downward to a depth of about 23 inches is sandy loam, lighter brown in color and containing a small percentage of silt. The third layer from the surface consists of yellowish-brown loose fine and coarse sand. This loose material was present at a depth of 6 feet.

La Crosse sandy loam occurs in this county in only two small areas, one in section 8, Albion Township, and the other in section 32,

Afton Township. It occupies a terrace position well above overflow. It is a poor soil, and as it occurs in such small areas it is usually utilized as pasture land.

ROUGH STONY LAND

The areas mapped as rough stony land include the limestone bluffs and rocky slopes of no agricultural value. The bluffs, in most instances, rise almost perpendicularly from the stream bed and are inaccessible even to livestock. The largest area occurs along Upper Iowa River near and east of the town of Granger. The rocky slopes support a growth of oaks, elm, hickory, basswood, birch, maple, walnut, ironwood, and cherry. Scrubby red cedar trees have obtained a foothold on the rocky ledges and steep, rock-covered bluffs east of Granger.

SUMMARY

Howard County is in the northeastern part of Iowa. It comprises 468 square miles or 299,520 acres. The relief varies from undulating or gently rolling in the western and central parts within the drift-covered area to sharply rolling or hilly in the northeastern part within the loessial area.

The 1920 census reports the population of the county as 13,705 persons, 10,510 of whom are classed as rural. Cresco, the county seat, has a population of 3,195. Numerous small towns scattered over the county serve as shipping points. Branch railroads supply the county with transportation facilities.

The climate is healthful and suitable for the production of the crops common to the Corn Belt. The average frost-free season is about 148 days. About 71 per cent of the annual rainfall comes during the growing season.

Dairying, hog raising, and the feeding of beef cattle are the chief livestock industries. Corn is the principal grain crop, followed closely by oats and hay. Wheat, barley, rye, flax, and potatoes are crops of minor importance.

The soils of the county may be divided into a dark-colored and a light-colored group. The soils of each of these groups vary on account of changes brought about in their character by differences in the supply of soil moisture. The soils of the smooth uplands, which make up the greater part of the county, have been formed under prairie conditions and are therefore dark colored. The light-colored or timbered soils occur only in small areas of rolling land along the larger streams. The dark-colored soils derived from the silty material known as loess are classified in the Tama series, and the dark-colored glacial soils in the Carrington, Dickinson, Clyde, and Floyd series. Two members of the Dodgeville series include the residual soils formed from the limestone rock and later covered by a mantle of drift or loess. The dark-colored terrace soils are classified in the O'Neill, Bremer, and La Crosse series, and the first-bottom soils in the Wabash series. The light-colored soils are those of the Fayette series developed over loess, and of the Lindley series developed over glacial drift. Rough stony land is a miscellaneous classification of nonagricultural soils.

○

[Public Resolution—No. 9]

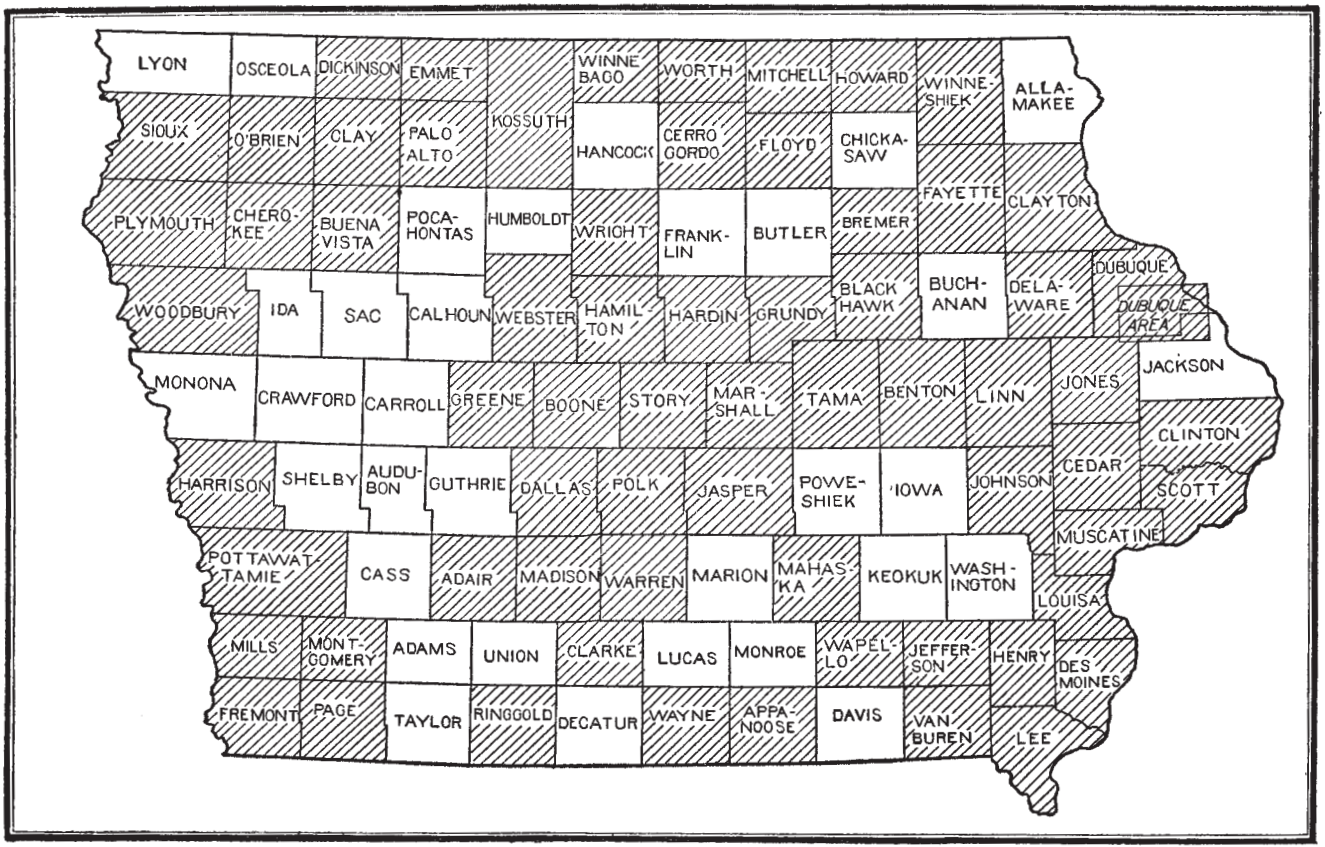
JOINT RESOLUTION Amending public resolution numbered eight, Fifty-sixth Congress, second session, approved February twenty-third, nineteen hundred and one, "providing for the printing annually of the report on field operations of the Division of Soils, Department of Agriculture."

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, and on July 1, 1927, the Bureau of Soils became a unit of the Bureau of Chemistry and Soils.]



Areas surveyed in Iowa, shown by shading

U. S. GOVERNMENT PRINTING OFFICE: 1929

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 (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 against its customers. If you believe you experienced discrimination when obtaining services from USDA, participating in a USDA program, or participating in a program that receives financial assistance from USDA, you may file a complaint with USDA. Information about how to file a discrimination complaint is available from the Office of the Assistant Secretary for Civil Rights. USDA prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex (including gender identity and expression), marital status, familial status, parental status, religion, sexual orientation, political beliefs, genetic information, reprisal, or because all or part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.)

To file a complaint of discrimination, complete, sign, and mail a program discrimination complaint form, available at any USDA office location or online at www.ascr.usda.gov, or write to:

USDA
Office of the Assistant Secretary for Civil Rights
1400 Independence Avenue, S.W.
Washington, DC 20250-9410

Or call toll free at (866) 632-9992 (voice) to obtain additional information, the appropriate office or to request documents. Individuals who are deaf, hard of hearing, or have speech disabilities may contact USDA through the Federal Relay service at (800) 877-8339 or (800) 845-6136 (in Spanish). USDA is an equal opportunity provider, employer, and lender.

Persons with disabilities who require alternative means for communication of program information (e.g., Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD).