

U. S. DEPARTMENT OF AGRICULTURE.

BUREAU OF SOILS—MILTON WHITNEY, Chief.

IN COOPERATION WITH THE UNIVERSITY OF NEBRASKA; G. E. CONDRA,  
DIRECTOR, NEBRASKA SOIL SURVEY.

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SOIL SURVEY OF DODGE COUNTY,  
NEBRASKA.

BY

B. W. TILLMAN, OF THE U. S. DEPARTMENT OF AGRICULTURE,  
IN CHARGE, AND H. C. MORTLOCK, OF THE  
NEBRASKA SOIL SURVEY.

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THOMAS D. RICE, INSPECTOR, NORTHERN DIVISION.

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[Advance Sheets—Field Operations of the Bureau of Soils, 1916.]



WASHINGTON:  
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1918.

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## LETTER OF TRANSMITTAL.

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U. S. DEPARTMENT OF AGRICULTURE,  
BUREAU OF SOILS,  
*Washington, D. C., June 15, 1917.*

SIR: Field operations of the Bureau of Soils for 1916 included a soil survey of Dodge County, Nebraska, undertaken in cooperation with the University of Nebraska. The selection of Dodge County for survey was made after conference with State officials.

I have the honor to transmit herewith the manuscript and map covering this work and to recommend their publication as advance sheets of Field Operations of the Bureau of Soils for 1916, as authorized by law.

Respectfully,

MILTON WHITNEY,  
*Chief of Bureau.*

HON. D. F. HOUSTON,  
*Secretary of Agriculture.*

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### MAP.

Soil map, Dodge County sheet, Nebraska.



# SOIL SURVEY OF DODGE COUNTY NEBRASKA.

By B. W. TILLMAN, of the U. S. Department of Agriculture, In Charge, and H. C. MORTLOCK, of the Nebraska Soil Survey.—Area Inspected by THOMAS D. RICE.

## DESCRIPTION OF THE AREA.

Dodge County, Nebr., lies in the eastern part of the State, about 30 miles west of the Missouri River. The bordering counties are Cuming and Burt on the north, Burt and Washington on the east, Douglas and Saunders on the south, and Colfax on the west. Dodge and Saunders Counties are separated by the Platte River. The county is roughly rectangular, with an extension in the southeastern part between the Platte and Elkhorn Rivers. The area of the county is 531 square miles, or 339,840 acres.

About one-third of the county consists of uplands and the remainder of terrace and bottom lands. The upland occurs in four separate areas, three in the northern half of the county and one in the south-central part. The largest area is in the

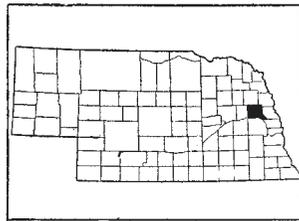


FIG. 1.—Sketch map showing location of the Dodge County area, Nebr.

northwestern corner of the county and extends 12 miles along the western county line and 9 miles along the northern line. On the east lies the valley of the Elkhorn River, here about 4 miles wide. East of this valley is a second upland area separated by the somewhat narrower valley of Logan Creek from a third upland occupying the northeast corner of the county. The fourth area lies south of the valley of Maple Creek. These upland areas consist of more or less eroded portions of the loess plain that once covered much of southeastern Nebraska.

In general the upland topography is rolling to hilly, but there are some gently undulating areas, and other small comparatively flat areas, representing remnants of the original surface of the plain. The elevation is greatest in the northwestern part of the county where it averages about 1,300 feet. The upland is in many places bordered by high terraces, but in many others abuts directly on the first bottoms. In the northwestern area the slopes are steep, especi-

ally where the upland drops to the alluvial flood plains. In the area south of Maple Creek the slope from the upland to the terraces is gradual and from the upland to the first bottom precipitous. In the northeastern area the slopes are more gentle, and include no land too steep for cultivation.

The terrace or second-bottom lands of Dodge County are about as extensive as the uplands. They include a high second terrace and a low first terrace. The high terrace of the Platte River is cut into several irregular areas by the larger tributary streams, bordered by strips of flood plain. One terrace area nearly 11 miles long and 2 to 3 miles wide extends from the western county line to the western end of the central loessial area. Small remnants of this terrace occur east of the loessial area. The most extensive development of high terrace is a triangular area lying between the Elkhorn River and Maple Creek. This terrace area and those to the south lie about 60 feet above the flood plains of the Platte and Elkhorn Rivers. Another high-terrace area, 1 to 2 miles wide, extends in a general north and south direction along the west side of Logan Creek, and smaller ones occur along the Elkhorn River and its larger tributaries in the northwestern part of the county. These terraces do not stand quite as high above the streams as the larger terraces to the south.

The first, or low, terraces lie about 15 feet above the first bottoms. The town of Nickerson, in the eastern part of the county, is situated on a typical low terrace, and others occur along Maple Creek and other streams. There are no areas of low terrace along the Platte River.

The topography of the terraces varies from gently undulating or in places slightly rolling to flat, with many depressions. The slopes from the terraces to the first bottoms are usually gentle and cultivable. In some places the slopes grade into colluvial areas which lie 8 to 10 feet above the first bottoms.

Approximately one-fourth of the county consists of first-bottom land, most of which is in the flood plains of the Platte and Elkhorn Rivers. The bottom lands along the Platte vary in width from 5 to 12 miles, but those of the Elkhorn seldom exceed 3 miles in width, averaging only about 2 miles. The flood plains of the smaller streams, such as Maple, Pebble, and Logan Creeks, vary in width from a fraction of a mile to a few miles. The streams all follow meandering courses. They usually flow near the center of the valleys, but the Platte River flows along the south side of its valley. The bottom lands are all flat except where interrupted by abandoned channels, overflow sloughs, and sandy ridges.

The elevation of the bottom land in the vicinity of Fremont, in the southeastern part of the county, is about 1,200 feet above sea

level, according to data of the United States Geological Survey, while that of the bottom areas in the northwestern part is about 1,300 feet. It is estimated that the upland lies about 120 to 150 feet above the first bottoms on the average, and the total range in elevation in the county is probably not over 250 feet. There is a general slope toward the southeast.

Dodge County is drained by the Platte and Elkhorn Rivers. The Platte River borders the county on the south. It is a broad, shallow stream, overburdened with sediment. Although all the drainage ultimately reaches this stream, only about one-fourth of the total area of the county drains directly into it. The northwestern and northeastern parts are drained by the Elkhorn River and its tributaries. Rawhide Creek drains the lowland of the Platte Valley.

In general, the upland is thoroughly to excessively drained, while drainage on the terraces and first bottoms is deficient. All sections of the upland are reached by drainage ways except the flat areas of Marshall silt loam. As a rule, the divides are rather narrow and stream branches numerous, but in some places the relief is not so pronounced, the surface being more undulating. The most imperfectly drained areas are the terraces and first bottoms. Very frequently the channels of upland streams are filled with sediment where they issue onto the lowlands, and the water collects in depressions or spreads over the lowland before it evaporates.

The first permanent settlement in this territory was made about 1854, near the mouth of Maple Creek. The county was organized in 1854, and the county seat established at Fontanelle, which is now in Washington County. Fremont was made the county seat in 1860.

The early settlers in this region came largely from Iowa, Illinois, Missouri, Indiana, and Eastern States. About 1870 there was a great inflow of Swedish and Danish settlers, who made their homes largely in the central part of the county. Many German families also arrived about this time and settled in various sections. A Bohemian colony was established in the northwestern part of the county. The southwestern part, in the vicinity of North Bend, was settled largely by Scotch-Irish.

White persons of native birth constitute 82.5 per cent of the total population. Dodge County in 1910 had a population of 22,145, of which 60.6 per cent was classed as rural, averaging approximately 25 persons to the square mile. The rural population is quite evenly distributed, but is sparsest in the bottoms.

Fremont, the county seat, had a population of 8,718 in 1910. It is situated in the southeastern part of the county, in a rich agricul-

tural section. Fremont has important manufacturing and commercial interests, and is the chief distributing point for farm implements and supplies. Other thriving towns, with populations of less than 1,000 in 1910, include North Bend, on the Union Pacific Railroad in the southwestern part of the county, and Scribner and Hooper, on the Chicago & North Western Railway, in the central part. Winslow, Nickerson, Uehling, Dodge, Snyder, and Ames are other small railroad towns.

The northern, eastern, and southern parts of Dodge County have good transportation facilities. The Union Pacific Railroad traverses the county east and west along its southern border. A line of the Chicago & North Western Railway crosses the county in a northwest-southeast direction, with branches extending west from Scribner and east from Fremont. The Lincoln, Fremont & Sioux City branch of the Chicago, Burlington & Quincy Railroad extends north and south across the extreme eastern part of the county. These various lines afford direct connection with Omaha, Lincoln, and Sioux City, which constitute the principal markets for the farm products of the county. Fremont furnishes a good local market for dairy and poultry products.

Dodge County is well supplied with public roads, which follow land lines regardless of topography. The Lincoln Highway, a transcontinental road, crosses the southern part of the county. There are a few miles of gravel road in the vicinity of Fremont, but most of the highways are not surfaced. The more important ones, such as the Lincoln Highway and the main road from Fremont to Hooper and other towns, are well graded and are dragged after each rain. Little attention is given to the upkeep of some of the less important roads, particularly those in the hilly section in the northwestern part of the county. There are some very substantial bridges, such as the two long steel structures across the Platte River, but the crossings of the smaller streams are frequently in very poor condition. The building of concrete culverts is receiving increased attention. Rural mail-delivery routes and telephone service reach all parts of the county.

#### CLIMATE.

The climate of Dodge County is well suited to grain farming and stock raising. The following table shows the normal monthly, seasonal, and annual temperature and precipitation as compiled from the records of the Weather Bureau station at Fremont:

*Normal monthly, seasonal, and annual temperature and precipitation at Fremont.*

Month.	Temperature.			Precipitation.		
	Mean.	Absolute maximum.	Absolute minimum.	Mean.	Total amount for the driest year.	Total amount for the wettest year.
	° F.	° F.	° F.	Inches.	Inches.	Inches.
December.....	25.4	66	-24	1.05	2.60	0.69
January.....	19.6	61	-31	.87	.40	1.68
February.....	22.1	68	-31	1.02	1.48	2.74
Winter.....	21.7	68	-31	2.94	4.48	5.11
March.....	35.2	89	-16	1.59	.70	1.73
April.....	50.5	98	14	2.59	2.22	1.54
May.....	60.3	101	22	4.25	3.08	6.97
Spring.....	48.7	101	-16	8.43	6.00	10.24
June.....	70.3	99	39	5.13	1.59	5.99
July.....	75.0	110	36	4.21	2.39	8.95
August.....	73.1	106	38	3.98	1.34	9.65
Summer.....	72.8	110	36	13.32	5.32	24.59
September.....	65.1	106	24	2.90	1.10	3.67
October.....	52.8	93	11	2.13	1.88	.56
November.....	37.3	79	-16	1.00	.15	.98
Fall.....	51.7	106	-16	6.03	3.13	5.21
Year.....	48.9	110	-31	30.72	18.93	45.15

The mean annual precipitation is given as 30.72 inches, of which 13.32 inches, or 43.4 per cent, falls during the months of June, July, and August, which constitute the principal part of the growing season. The mean annual precipitation in the driest year on record was 18.93 inches, as compared with 45.15 inches in the wettest. The driest months are November, December, January, and February, each of which has a normal precipitation of about 1 inch. May, June, and July have the heaviest precipitation. In summer the rain usually comes in the form of thundershowers during which the precipitation is heavy for short periods of time. Torrential rains, however, are rare. Droughts are almost unknown in May and June, but during the latter half of July and in August the rainfall is considerably lighter and less evenly distributed, so that long dry periods occasionally occur.

The mean annual temperature is 48.9° F. The warmest month is July, with a maximum recorded temperature of 110° F. The mean temperature for the summer months is 72.8° F., and for the winter

21.7° F. The coldest temperature recorded is -31° F., which has been reached in both January and February.

The average date of the first killing frost in the fall is October 4, and that of the last in the spring April 28, making the average growing season 159 days in length. The earliest recorded killing frost in the fall occurred September 11, and the latest in the spring on May 27. Fruit is sometimes injured by late spring frosts, especially when frosts follow unusually warm periods during which the fruit buds have developed.

Periods of excessive heat accompanied by warm winds occasionally cause injury to corn, oats, and pasture grasses. Tornadoes and hailstorms, although uncommon, sometimes do damage.

#### AGRICULTURE.

The basic industry of Dodge County is agriculture. The prairie land was broken soon after settlement began and devoted to the production of farm crops. Few of the first settlers attempted to cultivate more than enough land to supply the immediate needs of the family. Wheat was the first cash crop. Agricultural progress was rapid until the Civil War, following which there was a short period of depression. The completion of the Union Pacific Railroad in 1867 marked the beginning of a period of rapid agricultural development. Corn soon became the principal cash crop. Flax and barley were important crops until about 1870, when the extension of transportation facilities in other parts of the West opened up large areas of land better suited to the production of these crops.

By 1879 corn had surpassed wheat in acreage, the census reporting 53,095 acres in corn as compared with 45,584 acres in wheat. Hay was third in acreage, its extensive production being due to the large areas of bottom land from which wild grasses were harvested. Oats were extensively grown for feed, the census reporting 10,262 acres in this crop, with a production of 311,410 bushels. Rye was grown on 1,253 acres and barley on 1,731 acres.

Spring wheat began to decline in acreage about 1880, as it was found less profitable than either corn or oats. About 1895 wheat again became important, the growth in popularity being indicated by the increase from 13,419 acres planted in 1889 to 30,206 acres in 1899. This revival of interest in wheat production was due largely to experiments carried on by the Nebraska Agricultural Experiment Station, in which were demonstrated the superior qualities of a variety of winter wheat known as Turkey Red. This variety continues to be grown extensively in this and adjoining counties. After 1900 wheat gradually decreased in acreage, concurrently with in-

creased production of the other small grains, hay, and alfalfa, but at the present time (1916) the acreage in wheat is larger than ever before. Oats have steadily increased in acreage and now hold second place in acreage among the small grains. This crop was grown on 51,511 acres in 1909, as compared with 10,262 acres in 1879. Alfalfa increased in acreage from 129 acres in 1899 to 1,420 acres in 1909. The area in wild hay decreased from 40,871 acres in 1899 to 27,176 acres in 1909. This change is due to the fact that much of the bottom land has been sufficiently well drained for the production of grain crops.

The changes in the relative importance of the various crops have been accompanied by equally important changes in the agricultural methods. Farming at first was crude and wasteful, little attention being given to proper seed-bed preparation, seed selection, crop rotation, and fertilization, with the result that yields steadily decreased. As the cause of the lowering in yields became apparent more attention was given to remedial measures, and at present there is a general tendency among the farmers to improve the crops by careful selection of seed and to increase the productive capacity of the soil by crop rotation, manuring, and growing leguminous crops such as alfalfa and clover.

Grain growing is the leading type of agriculture in Dodge County, with live-stock farming, including the raising of beef cattle and hogs and dairying as an important adjunct. The principal crops are corn, oats, wheat, wild hay, timothy, clover, and alfalfa. The value<sup>1</sup> of all cereals produced in 1909 was \$2,561,333. The income from animals sold or slaughtered amounted to \$1,462,568. Dairy products were produced to the value of \$166,429, and poultry and eggs to the value of \$200,852. The value of the corn, wheat, and oats produced in 1915 is reported as \$2,895,281.

Over 27 per cent of the total area of the county was devoted to corn in 1909, there being 92,500 acres in this crop, with a production of 3,283,401 bushels, averaging 35.5 bushels per acre. In 1915 there were 91,838 acres in corn, yielding 37.1 bushels per acre. The production reached 3,407,189 bushels, valued at \$1,703,595. Dodge County ranks as one of the leading counties in the State in average yield of corn. Some of the corn produced is sold, but most of it is fed to cattle and hogs. Silage corn is grown to some extent in connection with dairying. That part of the crop not used for silage or fodder is husked in the field, and the stalks after being pastured in the winter are cut in the spring and plowed under. Corn is grown on all the soils in the county, but does best on the Wabash and Cass

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<sup>1</sup>The agricultural statistics quoted in this chapter are taken from reports of the Federal census, except those for 1915, which are taken from the annual report of the Nebraska State Board of Agriculture.

silt loams of the bottoms and the Waukesha silt loam of the terraces. Both yellow and white Dent varieties are grown. Reids Yellow Dent, Improved Leaming, and Iowa Silver Mine are the leading varieties.

The cultural methods for corn are practically uniform throughout the county. Very little fall plowing is done. Most of the crop is listed, the single-row lister ordinarily being used, but part is check-rowed. Besides being more quickly planted, listed corn is thought to withstand drought better and is more easily kept free from weeds, but the results obtained with listing over a period of years do not compare favorably with those obtained with more thorough seed-bed preparation. On many farms corn is grown five or six years in succession on the same land. Better yields are obtained where the crop is grown in rotation with small grains and a legume. In recent years increased attention has been given to corn breeding, and varieties adapted to the local conditions are easily obtained. Over the county as a whole, however, seed is indifferently selected, and the yields in general could be greatly increased by greater care along this line. Varieties of corn recommended by the Nebraska Experiment Station as being well adapted to this county are Reids Yellow Dent, Nebraska White Prize, and Iowa Silver Mine.

Oats were grown on 51,511 acres in 1909. The acreage devoted to this crop has steadily increased since 1879, when only 10,262 acres were grown. At the present time it is estimated that about 15 per cent of the area of the county is devoted to this crop. In 1915 there were 49,128 acres in oats, yielding 37.4 bushels per acre, or a total of 1,837,387 bushels. Red Rustproof and Kherson are the leading varieties, the latter being better adapted to the bottom soils, on which the crop is likely to lodge and rust. Very little effort is made to control smut, notwithstanding the fact that yields are sometimes lowered as much as one-sixth by this disease. The average yield of oats in 1909 was less than 26 bushels per acre. This yield is greatly exceeded on many farms. In the season of 1916 some fields yielded as much as 65 bushels per acre, and reports from farmers indicate an average yield for the county of about 40 bushels per acre. As a rule oats follow corn in the rotation. They are very seldom sown twice in succession on the same land. The crop is usually cut with a binder and either thrashed from the shock or stacked. The straw is used for roughage, very little of it being baled and shipped. The grain is used extensively as feed for horses and other stock, but some is sold on the market. Seed is frequently imported from other sections, as the opinion prevails that the local seed deteriorates.

As already noted there has been much fluctuation in the production of wheat since the settlement of the county, and among other

changes there has occurred the substitution of winter for spring wheat. The area in this crop in 1915 was 35,251 acres and the average yield 22.8 bushels an acre, the production reaching a total of 826,523 bushels. Spring wheat was grown on only 1,250 acres, with a yield of 16 bushels per acre. The acreage in wheat in 1915 was slightly larger than in the preceding year, owing to the expectation of an advance in prices. Turkey Red, a strain of Russian winter wheat, is the predominant variety. Several other varieties of wheat are grown, but the names are generally unknown and little effort is made to keep the strains pure.

Wheat usually follows oats or corn, but on some farms it is grown continuously for several years. When the crop follows oats the ground is plowed in the late summer and thoroughly disked to prepare a compact seed bed. Where it follows corn, the latter crop is usually cut for silage or fodder and the ground disked thoroughly. Excellent yields are obtained in this way. Wheat often is used as a nurse crop for clover and timothy. The crop is usually thrashed from the shock. Most of the grain is sold direct from the thrashing machine, but there is a tendency in some sections of the county to store the grain and hold it for advanced prices. Some damage is caused by smut, but not much effort is made to control this disease. Rust rarely causes damage to winter wheat, but is very destructive to spring wheat.

Hay is an important crop in Dodge County. The acreage in wild hay is still quite large, as large areas of bottom land are untilled on account of deficient drainage. Practically none of the upland remains in wild grass. Wild hay is now produced mainly on the Lamourey clay and the Wabash clay, but there are considerable areas on other heavy soils of these series as well as on the Cass and Sarpy soils. No doubt all the bottom land, except that which is very deficient in drainage, owing to its extremely low position, will in a few years be devoted to grain growing. The yields of wild hay range from 1 to 2 tons per acre. The crop is stacked in the field and either baled for market or hauled to the feed lots as needed. The production of wild or prairie hay in 1909 is reported as 46,637 tons. Omaha is the principal market for the hay. It commands a price of \$6 to \$12 a ton, depending on the quality and demand.

Alfalfa is receiving increased attention in Dodge County. In 1915 there were 8,652 acres in alfalfa, with a total production of 31,147 tons. The crop does well on all the well-drained soils, both bottom and upland. It is grown mainly on the terrace soils, but there are many productive fields on the upland as well as on the higher lying bottom soils. Three cuttings and sometimes four are obtained each year, giving a total yield of  $3\frac{1}{2}$  to  $5\frac{1}{2}$  tons per acre. Most of the hay

is fed to live stock on the farms, but some is marketed. The stand of alfalfa is usually left for a number of years. The seed is usually sown in August, at the rate of about 15 pounds per acre. In some cases a nurse crop of wheat or oats is grown successfully with alfalfa. Owing to its high feeding value for all kinds of live stock and its adaptation to the soils of the county, alfalfa promises to become one of the leading crops.

The State board of agriculture reports 6,191 acres in clover in 1915. The soils, particularly the Waukesha and Marshall silt loams, are highly adapted to clover where maintained in proper condition. There have recently been some failures to obtain stands, but these have been due largely to unusually dry seasons. The seed is usually sown with a nurse crop of wheat or oats in early March, at the rate of 6 to 8 pounds per acre. If rain falls at the critical time following the removal of the nurse crop, clover does well and makes a luxuriant growth. Frequently, however, little rain falls from the middle of July to the middle of September, and the delicate young clover plants die upon being subjected to the hot, dry winds after removal of the nurse crop. If the seeding withstands this unfavorable period it quickly revives after the fall rains. The crop supplies excellent fall pasturage for hogs and cattle, and is cut for hay the following spring, with yields of 1 to 2 tons per acre. The second crop is sometimes harvested for seed, but more often it is used for fall pasture. The following spring the land is planted to corn, which on clover sod gives yields far above the average. In some cases the second crop of clover is plowed under and the land seeded to winter wheat. The growing of clover invariably results in increased yields of succeeding crops.

When mixed timothy and clover are grown the first crop is almost pure clover, the second about an equal mixture of the two, and the third almost pure timothy. The census reports a production of 18,086 tons of mixed clover and timothy hay in 1909. This is apparently all fed to live stock on the farms, and it is held in high esteem for work horses.

The acreage in barley has steadily decreased in recent years. This crop is grown to be sold to breweries. Rye and millet or Hungarian grass are crops of minor importance.

Potatoes were planted on 1,406 acres and produced 121,574 bushels in 1909. This crop is grown mostly on the lighter textured soils of the bottoms in the vicinity of Fremont. Trucking has been given little attention in Dodge County, but some vegetables are grown on a commercial scale near Fremont and certain smaller towns.

A considerable number of farms have small orchards of apples, cherries, and pears which, with proper care, produce excellent fruit,

but as far as known there is only one commercial apple orchard in the county. The trees in this orchard are carefully pruned and sprayed, and the orchard is reported to be profitable. The Marshall silt loam, Waukesha silt loam, and Knox silt loam are excellent fruit soils. Varieties of apples grown successfully in adjoining areas are the Early Harvest, Red June, Wealthy, Jonathan, Winesap, and Black Twig. The total production of apples in 1909 was 126,813 bushels. There are a few small vineyards in the county. The census reports 9,393 grapevines in 1909, producing 70,952 pounds of grapes. Like apples, grapes require special care in cultivation, pruning, and spraying to control the prevalent fungous diseases and insects. The excellent shipping facilities and the adaptation of the soils favor an extension of fruit growing. Small fruits grown to some extent include strawberries, blackberries, and raspberries. These fruits are grown for local consumption only.

As a source of income the live-stock industry is important. As already stated, the total receipts from the live-stock sources in 1909 amounted to \$1,820,632. A total of 17,078 cattle were sold or slaughtered in that year. There are several large herds of purebred beef cattle in the county, and many purebred bulls have been introduced in recent years to improve the grade stock. The quality of the beef cattle in general is very good. The Hereford, Shorthorn, and Galloyway breeds lead in the order named. The beef cattle are usually fed for market, but some are sold as stockers and feeders. A few farmers feed cattle purchased at the stockyards in Omaha.

Dairying is gradually being extended in conjunction with general grain farming. The number of purebred dairy cattle is small, but sufficient to serve as a basis for the development of the dairy industry. The abundance of rich nitrogenous feeds, such as clover and alfalfa, to balance the corn crop, and the good marketing facilities combine to favor the extension of dairying. From 8 to 10 cows are kept on the average farm, and practically every farmer has a cream separator. Some milk is disposed of at skimming stations. In the vicinity of Fremont milk and cream are taken up by collectors, who charge 20 to 25 cents per hundredweight for hauling. Few farmers are engaged in dairying exclusively. Many farmers milk grade beef cows, and there is a great need for the introduction of more purebred bulls of dairy breeds. At present the Holstein is the prevailing breed in the improved dairy herds.

Hog raising is an important branch of the live-stock industry. Nearly every farmer fattens 30 to 60 hogs a year, and large numbers are raised in connection with the feeding of beef cattle. Although there are few purebred herds, the quality of the stock in general is very good. Poland China and Duroc Jersey seem to be

the most popular breeds, but Chester White and Berkshire are also common. Practically all the stock is raised and fattened on the farm. Hog raising has been disastrously affected at times by the prevalence of hog cholera. Much attention is now given to hog-cholera vaccination, and there is an awakening to the value of sanitary measures in combating this disease.

There are only a few flocks of sheep in the county, and sheep raising does not receive the attention it deserves. Some farmers buy a carload or more of sheep in the fall, fatten them on corn and pasturage, and sell them when market prices are favorable. The census reports 2,082 sheep in the county in 1910.

Poultry is kept on all the farms, and constitutes an important source of income. There is a good local demand for poultry products, and increased attention is being given to improvement of the stock. There are no highly specialized poultry farms in the county. The Leghorn, Barred Rock, Rhode Island Red, Orpington, and Wyandotte are the most important breeds.

The breeding of draft horses receives attention on nearly all farms and some mules are raised, but the local demand for mules is greater than the supply. The quality of the horses is excellent. The Percheron is the most popular breed, followed by the Clydesdale and Belgian. Much improvement in the quality of the horses has been made within the last 10 years.

The adaptation of the different soils to crops receives almost no recognition, and practically all the ordinary crops are grown indiscriminately on most of the soil types. Corn, oats, and wheat do well on the silt loams as well as on the heavier types. In general, the crops grown are well adapted to the soils and climatic conditions.

Only the more progressive farmers follow a definite rotation. The one ordinarily followed consists of corn for one to three years, oats or wheat, timothy, and corn. The most successful farmers do not grow corn more than two years in succession. When corn is followed by oats, the latter crop is succeeded by wheat and the wheat is followed by clover and timothy. On the bottom lands corn is often planted for three years or more in succession, and good yields are maintained. On some farms crops are not rotated until the yields begin to decrease. Clover frequently fails to catch, and the value of the rotation is largely lost when there is no leguminous crop to build up the soil. In some cases alfalfa is taking the place of clover, but owing to the desirability of keeping the stand of alfalfa for three or four years or longer this crop does not fit so well in the rotation. Frequently alfalfa is grown five to seven years in the same field.

The importance of proper cultural methods and fertilization is not fully appreciated. Wheat land is generally plowed in the fall just

before seeding and the seed bed prepared with a harrow and disk. Little time is allowed for proper aeration of the soil between plowing and seeding time. Corn land is usually listed, and sometimes double listed where the crop succeeds itself. Where wheat or oats follow corn the land is usually disked. The methods vary with differences in the soils. The better practice in growing fall wheat is to plow the ground in early summer, as soon as the preceding crop is removed, and to keep the soil well mulched until the time of seeding, in September and October.

Considerable barnyard manure is produced, but in most cases little care is taken to preserve it. No manure pits have been constructed, and on some farms the manure is piled outdoors without protection, where much of its fertilizing value is lost by leaching. The more progressive farmers remove the manure in the barns and lots about twice a year, applying it mainly to wheat land, but sometimes to corn land. The plowing under of green crops is not extensively practiced. Practically no commercial fertilizers are used, the expenditure in 1909 being only \$578 for the entire county.

Farm improvements in Dodge County, with few exceptions, are substantial. Many farms have gravity water systems to supply the house and other buildings. The farm machinery is of the most improved type. Four-horse to six-horse gang plows are common, and power tractors are used on many farms. The work stock is usually of heavy draft types.

Farm labor is scarce. Wages range from \$25 to \$40 a month, with board and room. Day labor commands from \$1.50 to \$2 a day, with board. Harvest hands are frequently paid \$2.50 to \$3 a day, with board. Many farmers hire labor by the year, and in this way insure against lack of help at critical periods.

Dodge County in 1910 contained approximately 310,693 acres of farm land, amounting to 91.4 per cent of its total area. The average size of the farms is 177 acres. In 1880, according to the census, the average size was 165 acres. Only 50.5 per cent of the farms are operated by owners, the remainder being farmed by tenants. Both the cash and share systems of leasing are followed. Under the prevailing system the owner gets two-fifths of the crops, the tenant furnishing implements, work stock, and labor. Where the owner furnishes the implements and work stock, he and the tenant share all crops equally. In a few cases the tenant pays rent for the pasture land and grows the grain crops on shares. In nearly all cases the tenant is required to deliver the owner's share of the grain at the elevator. Cash rent ranges from \$4 to \$6.50 an acre for the best land, depending on the kind of soil. Rents for farming land are highest in the vicinity of Fremont.

The average value of all farm property per farm in Dodge County in 1910 was \$20,334, of which the land constituted 79.8 per cent, buildings 10.3 per cent, implements 1.7 per cent, and live stock 8.2 per cent. From 1900 to 1910 the average assessed value of the land increased from \$38.46 to \$91.66 an acre. The selling price at this time (1916) ranges from \$90 to \$200 an acre, depending on the improvements, soil, and location. The poorly drained bottom lands are the lowest in value. Upland farms can rarely be bought for less than \$150 an acre.

#### SOILS.

The soils of Dodge County may be divided on the basis of physiography into three broad groups, upland, terrace, and first-bottom soils. The upland group includes the Marshall and Knox series and a colluvial soil, classed in the Judson series. The terrace soils are classed in the Waukesha and Scott series, and those of the first bottoms in the Wabash, Lamoure, Cass, and Sarpy series and Riverwash. The upland soils are loessial in origin. The terrace soils represent former valley-filling deposits, in which the lower lying material is sand and the upper part mainly reassorted loesslike material. The first-bottom soils represent alluvium, derived from the bordering uplands.

The underlying rocks, as determined by well records and by outcrops in adjacent counties, consist of alternating beds of limestones, shales, and sandstones of Pennsylvanian and Cretaceous ages. These formations are not exposed at the surface in Dodge County and are of no economic importance. According to State surveys, the basal rocks are covered in adjoining areas by three distinct drift sheets, of which the Kansan is the uppermost, the Aftonian the intermediate layer, and the Nebraskan the lowermost. In Dodge County only the Kansan sheet is exposed. One exposure occurs about 6 miles northwest of Fremont at the foot of the slopes from the central upland area. Other exposures are in the deeper cuts of streams in the northwestern part of the county. This drift sheet is characterized by irregular masses of gravel, pebbles, and small stones, mixed usually with much clay, silt, and sand. It evidently underlies all the upland, and it seems also in places to underlie the terraces and flood plains. It has contributed very little or nothing to the soils of this county.

Overlying the basal Kansan drift and covering it to a depth of 80 to 100 feet is a deposit of silt. Similar deposits along the Missouri have been classed as loess. Geological evidence indicates that the wind has been the principal agent of distribution of this material along the river. The mode of formation of the silt deposit in Dodge

County, however, has never been satisfactorily explained. According to State surveys the extensive occurrence of this material at great distances west of the river does not favor the hypothesis of eolian origin. Furthermore, the subsequent invasion of the area by water, forming the extensive terraces occupied by the so-called valley loess, would seem to support the view that the material was carried to its present position by slowly moving water at the time of the invasion of the ice sheet. On account of its similarity in physical characteristics, lithologic character, and stratigraphic position to the loess of the Missouri River this material is classed as loessial. It is possible that soil material derived from glacial deposits in situ may subsequently, through the action of chemical and physical soil-forming processes, develop true loessial characteristics. The loess formation gives rise to the extensively developed Marshall silt loam and to the less important Knox silt loam and a colluvial type, the Judson silt loam. The formation covers about one-third of the total area of the county and occurs in four distinct areas, remnants of the loess plains. The loess soils are characterized by an unusual uniformity in the size of soil particles and by a tendency to split into vertical planes, producing perpendicular bluffs along watercourses and roads and in other places subject to erosion.

Terrace or second-bottom soils are very extensive in Dodge County. They consist of reassorted soil material derived from the upland and deposited by slowly moving water in former ages. The terraces consist of a first or low terrace and a second or high terrace. The soil material of the higher terrace varies in thickness from 5 to 30 feet or more and is underlain by light-gray alluvial sand and gravel. The low terrace lies about 15 feet higher than the first bottom. It is not underlain by the basal sand formation. The surface material of the terraces gives rise to the Waukesha and Scott silt loams, and the basal sandy material to the Waukesha fine sandy loam.

The present stream alluvium, or first-bottom soil material, comes from two main sources. That along the smaller streams, including the Elkhorn River, is derived from local upland material. That in the flood plain of the Platte River has been formed from heterogeneous deposits brought down by that stream, including material derived not only from the local uplands but also from other soil provinces.

The streams are continually changing their channels, eroding on one side and depositing the reassorted material on the other. Frequently the current changes to a new channel and the old bed of sandy or silt material is covered with a thin deposit of silty clay. This condition has given rise to areas of soil of widely varying texture. At times of overflow, very fine sand, silt, and clay have been deposited in immense quantities, changing the soils in texture

and other characteristics. Along the smaller streams the alluvium is generally more uniform, consisting largely of stratified clay and silt. The alluvial soils are classed in the Wabash, Lamoure, Cass, and Sarpy series.

The Marshall series includes types with dark-brown to black surface soils and a lighter yellowish brown subsoil. It is characterized by and distinguished from the lighter colored Knox series by the large quantity of organic matter in the surface soil.

The Knox soils are light brown, and the subsoil yellow to grayish yellow. These soils occur mainly in the Central Prairie States. They have a prevailing rolling to hilly topography.

The Judson series represents colluvial accumulations of terrace material derived from the Knox and Marshall soils of the upland. It is characterized by a prevailing dark brown color in the surface soil, grading into light brown in the subsoil. The Judson soils occur at the foot of upland slopes.

The Waukesha soils are dark brown to brown in the surface layer, and have yellowish-brown to brown subsoils. They are derived from water-assorted loessial and glacial deposits. The topography is mainly flat to undulating. The Waukesha soils differ from the Marshall in origin and in being more compact in the subsoil and lighter colored in the surface layer.

The surface soils of the Scott series are brown to drab; the subsoil is light drab to grayish. These soils consist of lake-laid material eroded from the higher lying surrounding soils and deposited by sheet surface waters in temporary lakes or ponds occupying local undrained, sinklike depressions. The soils are poorly drained.

Four types of the Wabash series, the silt loam, clay loam, silty clay, and clay, are represented in Dodge County. The soils of this series are black, ranging to dark brown, and have a high organic-matter content. The subsoils are drab to grayish drab. The material has been derived by wash from the loessial and associated uplands.

The Lamoure soils differ from the Wabash in being less perfectly drained and in having a highly calcareous subsoil. The subsoil is prevailing lighter colored than that of the Wabash series. The Lamoure soils contain more saline areas than the other soils of the county. The series is represented in Dodge County by three types, the silt loam, silty clay, and clay.

The Cass series is represented by the fine sandy loam, very fine sandy loam, loam, silt loam, and silty clay types. These soils are black in the surface portion and differ from the Wabash soils in having brownish-gray, sandy subsoils. Drainage is good where the land is free from overflows.

The soils of the Sarpy series differ from the Cass soils in the light-brown to grayish-brown color of the surface layer. They differ from

the Wabash and Lamoure soils in having a loose, silty or fine sandy subsoil, distinctly lighter in texture than the surface soil. Owing to their low position in this county the Sarpy soils are in general rather poorly drained. The topography is flat except where modified by slight ridges and depressions. The series is represented by two types, the very fine sand and the very fine sandy loam.

The following table shows the actual and relative extent of each soil type mapped in this county :

*Areas of different soils.*

Soil.	Acres.	Per cent.	Soil.	Acres.	Per cent.
Marshall silt loam.....	86,016	25.6	Lamoure clay.....	4,864	1.4
Flat phase.....	960		Cass loam.....	4,352	1.3
Wabash silt loam.....	78,848	23.2	Lamoure silty clay.....	4,288	1.3
Waukesha silt loam.....	64,192	20.3	Lamoure silt loam.....	4,160	1.2
Low-terrace phase.....	4,672		Knox silt loam.....	4,096	1.2
Cass very fine sandy loam..	16,128	4.7	Sarpy very fine sand.....	2,368	.7
Wabash silty clay.....	14,336	4.2	Cass fine sandy loam.....	2,048	.6
Wabash clay.....	11,072	3.3	Judson silt loam.....	2,048	.6
Cass silt loam.....	10,752	3.2	Riverwash.....	1,920	.6
Sarpy very fine sandy loam .	8,512	2.5	Wabash clay loam.....	1,536	.4
Waukesha fine sandy loam..	6,336	1.9	Cass silty clay.....	1,088	.3
Scott silt loam.....	5,248	1.5	Total.....	339,840	.....

MARSHALL SILT LOAM.

The Marshall silt loam consists of a dark-brown, friable silt loam, with an average depth of 15 inches, underlain by a subsoil of lighter brown, slightly heavier silt loam, changing below 22 inches to a yellow to yellowish-brown compact silty clay loam. This either continues through the 3-foot section without change or becomes heavier with depth, until at 30 inches it consists of a compact, yellow silty clay, sometimes mottled with gray. From 30 to 36 inches and lower the subsoil frequently grades into a yellow, friable silt loam. On gradual slopes to streams the color of the surface soil in places is black and the material is prevailingly deeper, often extending to 24 inches without change in color or texture. The deeper subsoil, at about 40 inches, is calcareous, the lime occurring in the form of concretions which vary from one-sixteenth to one-eighth inch in diameter.

The depth of the surface soil depends largely on the topographic position. On flat divides and slopes it is usually 15 to 20 inches in depth, while on sharp divides and shoulders of hills the yellowish-brown subsoil is frequently encountered at a depth of 10 to 12 inches. The type in these shallow areas really represents an extreme variation toward the Knox silt loam, which is not mapped separately

where it occurs in areas of less than 10 acres. Shallow, light-colored areas occur in the northeastern and northwestern parts of the county. Freshly plowed fields in these areas have a spotted appearance, as the subsoil is brought to the surface in spots where erosion has thinned down the darker surface layer. In a few places these light-colored areas are noticeably heavier in texture than the typical soil, approaching a silty clay. If allowed to continue, erosion will ultimately seriously impair the productiveness of such areas.

The Marshall silt loam is one of the important soil types of Dodge County. It forms the several upland divisions already described, and occupies the highest stratigraphic position.

The Marshall silt loam differs from the Knox silt loam in its darker color, due to a higher organic-matter content, and in having a smoother topography.

The Marshall silt loam is regarded as one of the best upland corn soils in the Mississippi Basin. It originally supported a thick sod of prairie grasses and was used extensively for grazing. All the type is now under cultivation. About one-half of it is in corn and the remainder largely in oats and wheat. Excellent yields of corn are obtained in normal years, and in dry years the yields are usually greater than the average for the State. The average yield for the last six years is estimated by farmers to be as high as 37 bushels per acre. Yields of 60 to 65 bushels an acre are common under good management, and show the possibilities in corn production. Oats ordinarily yield about 40 bushels per acre. The acreage in winter wheat is being increased. The average yield is between 22 and 25 bushels per acre, but many farms produce as much as 40 bushels per acre. The acreage in clover, timothy, and alfalfa is comparatively small, but has increased in recent years. Clover frequently fails to catch, and in recent years alfalfa has to some extent taken its place. In favorable years clover yields 1 to 2 tons per acre. Alfalfa normally gives a total yield of  $3\frac{1}{2}$  to 5 tons per acre. All the hay produced is fed to live stock.

Corn on this soil is usually listed. Where oats or wheat follows corn the land is disked. Plowing for wheat is usually done in the late summer or in early fall just before sowing. Owing to its extremely favorable structure the soil is easily handled and can be cultivated under a wide range of moisture conditions. Where properly tilled it resists drought for long periods. Little or no commercial fertilizer is used, but manure is applied by the more progressive farmers, usually to the wheat land before plowing.

The usual rotation consists of corn one or two years, followed by oats and wheat one year. This is varied by growing an occasional crop of clover or timothy. Alfalfa following wheat is usually

allowed to stand five or six years before the land is returned to corn. Many farmers grow the same crop continuously for several years.

Increased attention is being given to the raising of live stock, principally beef cattle and hogs, and there are quite a number of dairy cows on farms on this type. A few farmers import feeders from the Omaha market.

Land of the Marshall silt loam sells for \$135 to \$175 an acre, depending on the improvements and the nearness to towns.

The present system of extensive grain growing without adequate provision for maintaining the organic content of the soil is resulting in decreased yields. In the absence of an adequate supply of stable manure the productiveness of the soil can not be maintained unless a leguminous crop, such as alfalfa or clover, is grown at least once in every four years. The soil is ideally adapted to both these crops, and they should be made the basis of the rotation, the hay to be fed to live stock and the manure returned to the land. Occasionally a crop of clover may be plowed under. Another method of adding organic matter, practiced in other States with success, is to sow sweet clover in wheat, to be plowed under in the fall or in the following spring. In this way it is possible to have two leguminous crops to plow under in each rotation and yet to grow three grain crops in the four-year period. Where it is difficult to grow red clover, as on some of the run-down land, applications of bone meal will prove beneficial. Where live stock is not kept in considerable numbers clover should be plowed under for green manure the year following the season of seeding. The entire crop should be plowed under where the soil is very deficient in nitrogen. Clover seldom fails to make a stand when seeded alone.

The yield of winter wheat can be materially increased by early plowing. The oat or clover sod should be plowed as soon as possible after harvest and a fine, firm seed bed prepared. Fall plowing should be more extensively practiced for spring plantings where there is no danger of erosion. Experience on many farms has shown the superiority of thorough seed-bed preparation for corn over the prevailing method of listing the crop.

The control of erosion is one of the most important problems in the management of this soil. The losses from erosion have not been sufficiently realized in the past because of the fact that with the addition of decaying organic matter and exposure to the air the sub-surface soil to great depths produces as good crops as the present surface soil. With the gradual depletion of organic matter and the continual washing away of the surface material the soil will ultimately be left in an unproductive condition and the land will be gullied and rendered uncultivable. Erosion is already serious in the

northwestern part of the county. To counteract the tendency to wash, the soil should be deeply cultivated, so as to facilitate the absorption of water. Erosion can also be checked by keeping the surface covered with a crop as much of the year as possible.

After ditches have been formed the prevention of erosion becomes more difficult. A method practiced with considerable success in other areas consists of building a dam of earth or stone across the ditch in the lower part of the field to check the run-off. A drain-pipe passes through the dam and connects with an upright pipe on the upper side. The sediment held by the dam gradually fills the ditch. The drain pipe disposes of the water left standing below the upright pipe.

*Marshall silt loam, flat phase.*—The Marshall silt loam includes two small areas of soil having a flat topography, which are shown on the accompanying soil map as a flat phase of the type. The soil differs from the typical Marshall silt loam in the darker color and greater depth of the surface soil. Prevaingly the phase consists of a black silt loam, 22 inches deep, grading into a yellowish-brown, compact silty clay. It represents remnants of the original loess plain which have not lost any of their surface features through erosion. Both surface drainage and internal drainage are good. The agricultural value of this phase does not differ greatly from that of the typical Marshall silt loam.

#### KNOX SILT LOAM.

The soil of the Knox silt loam is a yellowish-brown or light-brown, heavy silt loam, 8 or 10 inches deep. Below this a yellow, heavy silt loam to silty clay loam is encountered, extending to a depth of 20 to 25 inches. The lower subsoil, to 36 inches, is a yellow, friable silt loam, much lighter in texture than the layer immediately overlying it. Reddish-yellow iron stains and lime concretions are common in the subsoil. The surface soil varies slightly in color with difference in topographic position. On sharp divides and steep slopes the lighter colored material is exposed, while on broad divides and moderate slopes the soil is brown to dark brown in color, resembling the Marshall silt loam. Areas of such brownish soil occur in the northeastern part of the county. The line of demarcation between the Knox silt loam and the Marshall silt loam is indefinite, as the two soils grade imperceptibly into each other. In the northwestern part of the county small areas of Marshall silt loam on the steeper slopes are as light in color as some of the Knox silt loam in the northeastern part of the county, but owing to the absence of any areas of typical Knox silt loam in this section the soil is mapped as Marshall.

The largest areas of Knox silt loam occur in the northeastern part of the county. Small developments are encountered in both the

northwestern and central upland areas. Along the slopes of the central upland area adjacent to the Platte Valley there are some outcrops of the Kansan drift. This material has not influenced the soil to any great extent, but a few small areas contain a sufficiently large amount of fine sand particles of drift material to give the soil a loamy structure. Such areas actually represent the Shelby loam, but owing to their small extent they are not mapped separately.

The Knox silt loam is confined to the slopes and steep ridges between the areas of Marshall soil and the bottom lands. It is thoroughly dissected by short streams, and drainage is naturally excessive. The type is subject to severe erosion during periods of heavy rainfall, but since the subsoil material is productive after aeration and the incorporation of organic matter, the effect of erosion has not been keenly felt.

The common staple crops of the county are grown on this type, and good yields are obtained. The soil is particularly well suited to alfalfa, on account of its thorough drainage and high lime content. Yields of 3 to 4½ tons an acre from three cuttings are frequently obtained. Corn yields 35 to 45 bushels an acre, and wheat and oats 20 to 45 bushels. Practically all the type is under cultivation.

Owing to its small extent and irregular occurrence, no definite selling value can be assigned to this soil. It is usually held in association with the Marshall silt loam, and slightly reduces the value of farms, owing to the steepness of its slopes and the generally unfavorable topography.

The Knox silt loam is naturally low in organic matter, and owing to this deficiency and to its rougher topography it is not as well suited to grain growing as is the Marshall silt loam. Its productivity is gradually decreasing under the present methods of farming. A much larger acreage should be devoted to leguminous crops, to which the soil is so well adapted. Erosion is serious on this soil, and every effort should be made to lessen its damaging effects by growing winter cover crops and by following the other methods suggested for the Marshall silt loam.

In other counties of Nebraska and in surrounding States this soil is extensively used for the production of small fruits, vegetables, and orchard products. It is recognized as one of the strongest fruit soils in the United States. In Douglas County, Nebr., and Buchanan County, Mo., the growing of small fruits, principally grapes, strawberries, and blackberries, is becoming a very important industry on this soil.

It would seem that fruit growing could be profitably extended on both the Knox and Marshall soils in Dodge County, as very little fruit is grown and the market facilities are excellent. Potatoes also

are grown on this type in other areas, and yields of 150 to 175 bushels per acre are obtained.

JUDSON SILT LOAM.

The Judson silt loam typically consists of a dark-brown silt loam 2 feet deep, resting on material slightly heavier in texture and light brown in color to a depth of 36 inches. In some places the soil contains enough fine sand, derived from glacial drift and from the basal layer of the terrace, to have a loam texture.

This soil is the result of colluvial action. It occurs at the foot of slopes reaching from the uplands and from the terraces, and separates these from the first bottoms. It is not subject to overflow and suffers little from erosion, having a gradual slope to the lowland. It lies about 8 to 10 feet above the first bottom.

This type occurs in small areas in various parts of the county. Both the surface drainage and underdrainage are good. The soil is rich in organic matter, and owing to this and to its favorable texture it is very productive and easy to maintain in proper tilth. It does not bake or crack and withstands drought for long periods. All the type is under cultivation, and it ranks as one of the best agricultural soils in the county. Corn, wheat, oats, alfalfa, and red clover are the principal crops grown. Corn yields 40 to 60 bushels per acre, and the yields of the other crops are well up to the average for the county.

In general, the type is well adapted to the crops grown upon it. The soil needs only good farming methods, including the growing of leguminous crops, to be maintained in a productive condition. No definite selling value can be assigned to this type, as it occurs in narrow, irregular areas and is held in association with other types of both the bottoms and the uplands. It enhances the value of farms in which it is included.

In the following table are given the results of the mechanical analyses of samples of the soil and subsoil of the Judson silt loam:

*Mechanical analyses of Judson silt loam.*

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>						
772239.....	Soil.....	0.2	0.6	0.6	1.8	13.7	63.5	19.3
772240.....	Subsoil.....	.2	1.1	1.4	5.3	12.1	55.4	24.6

WAUKESHA FINE SANDY LOAM.

As developed in the northern part of the county along the Cuming County line, the Waukesha fine sandy loam consists of a brown to dark-brown fine sandy loam, 10 inches deep, grading into a light-

brownish to yellowish-brown fine sandy loam, which extends to 15 inches. Below this the material changes in texture and color, becoming a grayish-brown fine sandy loam, somewhat more sandy than the surface soil, and passing into a grayish fine sand or fine sandy loam mottled with yellow. In depressions the surface material is often dark brown to black in color and a loam to silt loam in texture, underlain by a brownish fine sandy loam subsoil. On ridges the surface material in places is a brownish or grayish fine sand, grading into a light gray to gray, loose, incoherent sand to fine sand.

As developed on the slopes leading from the Waukesha silt loam, the soil consists of a light-brownish to brown fine sandy loam 10 inches deep, underlain by yellowish-brown fine sand, which grades at any depth between 18 and 24 inches into a loose, grayish fine sand, mottled with yellow and brown. It includes small areas of fine sand, one-fourth to one-half acre in extent, in which the soil is very similar to typical sand blows. Such areas occur on the slopes of the terrace one-fourth mile west of Nickerson. They are usually bare. In other places the type includes small areas of brownish silt loam underlain by very fine sand, the heavier surface material consisting of soil of the Waukesha silt loam, which has accumulated by washing and creeping down the slopes.

The principal area of the Waukesha fine sandy loam occurs on the terrace north of Scribner between the flood plains of Cuming Creek and the Elkhorn River, extending into Cuming County on the north. Here the type consists of the surface formation of the terrace. In other parts of the county it occupies the slopes leading from terraces occupied by the Waukesha silt loam, as in the vicinity of Nickerson and to the east along the border of the Fremont terrace. It separates the Waukesha silt loam from the lower lying bottom soils.

The topography of the principal area of this soil northeast of Scribner varies from smooth to gently rolling or rolling. The terrace slopes occupied by the type range from gentle to steep, and are thoroughly to excessively drained, being eroded in many places.

The Waukesha fine sandy loam is of secondary agricultural importance in Dodge County. It is devoted to the common farm crops. The soil is less productive than the upland loessial types and the Waukesha silt loam. Corn yields 30 to 35 bushels per acre, wheat about 15 bushels, and oats 30 bushels. Little clover or alfalfa is grown, although alfalfa does well on most of the type where the soil has been kept in a fair state of productiveness. The small spots of fine sand are not adapted to either clover or alfalfa. In general the type is droughty, and crops suffer quickly in dry periods. Crops are not as systematically rotated on this type as on the upland soils and the other terrace types.

Some of the land in the main body of the type sells for \$75 to \$100 an acre. The narrow strips on the terrace slopes are held in conjunction with the Waukesha silt loam, and reduce the value of farms in which they are included.

Under a system of grain farming without the growing of leguminous crops in the rotation this type deteriorates in productiveness faster than any other soil in the county, owing to its naturally low content of organic matter and its extremely porous nature, which permits the leaching of plant food. The organic content of the soil should be increased through the rotation of crops, the use of animal manure, the growing of legumes, and green manuring, preferably with legumes. Trucking could evidently be profitably engaged in, as the warm, porous nature of the soil makes it well suited to crops of this kind, especially potatoes.

#### WAUKESHA SILT LOAM.

The Waukesha silt loam consists of a brown to dark-brown silt loam, 15 inches deep, gradually changing to a light-brown to yellowish-brown, heavy silt loam which extends to a depth of 20 inches. A yellow, very compact silty clay loam underlies this to a depth of 30 inches, below which the subsoil again approximates a heavy silt loam in texture, and is much more friable and loose than the compact layer above it. This lower stratum is yellow, with occasional mottlings of gray. Gray mottlings may also occur in the subsurface soil. There is no change in color or texture of the brown silt loam subsoil to depths of 6 to 12 feet or more, below which the basal layer of fine gravel and sand is encountered. The heavy, compact, yellow subsoil layer is the result of the action of percolating water, which has washed down the finer particles from the surface soil. The subsoil of the Waukesha silt loam contains numerous lime concretions below depths of 3 feet, but the interstitial material does not effervesce with acid. On the tops of knolls the soil is lighter brown in color and heavier in texture than in flat areas, being a heavy silt loam. The surface soil in these more elevated areas is shallow, being only about 10 to 12 inches deep, as compared with 15 to 20 inches in the slightly depressed areas. The color of the surface soil in the smooth and the slightly depressed areas is very dark brown to black. Where the soil is exposed in road cuts, it has a structure similar to that of the loess, but it is heavier in texture, and the subsurface stratum is more compact. In places where weathering has been active, as on the slopes extending to the first bottom, the soil profile is very similar to that of the brown loess, or Knox silt loam. There are included with the type some areas of Scott silt loam, 1 to 2 acres in extent.

The topography of the Waukesha silt loam varies from prevalently flat to gently undulating or slightly rolling. South of Hooper

some areas contain distinct knoblike elevations, rising 10 to 15 feet above the general level. Frequently the higher lying areas are in the form of long, narrow ridges rising 6 to 8 feet above the surrounding land. Scattered throughout the Waukesha silt loam are small depressions, the soil of which is separated as the Scott silt loam. Very little of the Waukesha silt loam has been subjected to stream erosion. There is almost an entire absence of drainage ways in the areas covered by this soil, but it is nevertheless well drained, the surface water finding its way into the depressions occupied by the associated Scott silt loam.

The Waukesha silt loam is one of the most extensive soils in Dodge County. Its distribution is coincident with that of the high terraces. These terraces lie 50 to 60 feet above the flood plains of the streams in the southern part of the county, but their relative elevation decreases slightly as the northern and northwestern parts of the county are approached. They have the same elevation as the terrace in Todd Valley, in Saunders County.

All the Waukesha silt loam is in cultivation. It constitutes the most valuable agricultural land in the county. Originally it supported a dense growth of prairie grass. Corn, oats, wheat, alfalfa, clover, and timothy are the most important crops. Corn and wheat occupy the largest acreage. The total area in clover and alfalfa, although increasing, is still small. This is regarded as the best corn and wheat soil in the county. Estimated yields of corn are 45 to 50 bushels per acre, and of wheat 25 to 28 bushels. Winter wheat, of the Turkey Red variety, is grown almost exclusively. One 40-acre field of beardless wheat was observed in the course of the soil survey, but this variety does not seem to do as well as the Turkey Red. Oats give very good returns, yielding an average of 50 bushels per acre. In some cases corn has yielded 65 bushels per acre, oats 60 bushels, and wheat 35 bushels. Some of the corn and oats and all the wheat are sold.

On nearly all farms some cows are kept, the cream being sold to the local creameries. Few cows of the dairy breeds are kept, although the number of Holsteins is increasing. Most of the animals are good grades of the beef breeds, principally Shorthorn and Hereford. Nearly all the farmers fatten a few steers each year. Probably more hogs are fattened than cattle. The hogs raised are of very good quality and include some purebred animals. The Poland China seems to be the favorite breed.

This soil is easily cultivated on account of its favorable topography and good structure. It seldom bakes or cracks when cultivated under ordinary moisture conditions, and it is naturally retentive of moisture and resistant to drought.

The prevailing rotation on this soil consists of corn 2 years, oats 1 year, and wheat 1 year. This is occasionally varied by growing clover or mixed clover and timothy for two or three years after the wheat. In some instances alfalfa is grown five or six years or more before the land is returned to corn. Corn is usually listed when it succeeds itself and generally checked on sod or stubble land. Clover yields  $1\frac{1}{2}$  to 3 tons per acre and alfalfa 3 to 5 tons.

Four to six horse teams are generally used on this type. There is a tendency to employ the most efficient machinery and increased horsepower in order to economize on manual labor. Farm tractors are used to an increasing extent. Practically no commercial fertilizer is used, and green manuring is not practiced, but the use of barnyard manure is increasing on most farms. An application of manure results in increased yields for several seasons. There is considerable difficulty in obtaining a stand of clover on this soil, and alfalfa is being substituted where a leguminous crop is desired. The general tendency is to grow less corn and more alfalfa and to keep more live stock, but not more than 1 acre in 30 is at present devoted to the production of leguminous crops.

Land of this type in the vicinity of Fremont and Hooper and other towns sells for \$175 to \$200 an acre. Farms more remote from towns sell for \$150 to \$175 an acre, the price depending on the improvements, the nearness to transportation lines, and the included acreage of Scott silt loam.

For the improvement of this soil under the present system of extensive grain production, there must be a more liberal use of manures. Clover and alfalfa should be grown on one-fourth of the farm land each year. The soil is ideally adapted to both clover and alfalfa owing to its favorable structure, good drainage, and high lime content. Where the organic-matter content has become seriously depleted, so as to make the growing of clover difficult, applications of a phosphatic fertilizer, such as bone meal, should be made. Both alfalfa and clover should be used as green manures where the nitrogen content of the soil is low. Another method of improving the soil is to sow sweet clover in wheat, to be plowed under in the fall after the wheat is harvested. In this way two leguminous crops can be grown in the four-year rotation.

*Waukesha silt loam, low-terrace phase.*—As mapped, the Waukesha silt loam includes a low-terrace phase. The phase consists of a dark-brown to almost black silt loam 15 inches deep, grading into a yellowish-brown, compact, heavy silty clay loam which extends to 22 inches. Below this, to a depth of 30 inches, the subsoil is a yellowish-brown silty clay loam, underlain by friable silt loam of the same color. The basal sandy layer encountered in the high terrace

occupied by the typical Waukesha silt loam is lacking. A typical area of this low-terrace phase occurs at Nickerson. Other small areas are encountered north and west of Nickerson, along the Elkhorn River and Maple Creek and their tributaries. The phase lies at the foot of the higher terrace, at an elevation of 10 to 15 feet above the first-bottom soils. It separates the bottoms from the Waukesha fine sandy loam, which occurs on the slopes of the higher lying terrace. In drainage conditions, crop adaptation, and value this phase does not differ greatly from the typical Waukesha silt loam.

#### SCOTT SILT LOAM.

The Scott silt loam consists of a very dark gray to black, floury silt loam, usually about 15 inches deep, underlain by a very compact, brownish-gray to gray silt loam, which frequently rests at about 30 inches on a heavy, impervious, brownish-drab clay, mottled with rusty brown. If this impervious layer does not occur within the 3-foot section, it almost invariably lies at slightly lower depths. The black silt loam surface soil frequently continues to depths of 25 inches without change. In some small areas the surface soil is prevailingly a brown silt loam, 15 inches deep, and grades into a gray, heavy silty clay loam, mottled with brown and yellow, underlain by a light brownish gray to dark-gray silty clay or clay. The soil when dry becomes almost light gray in places, and the subsoil ashen gray, mottled with rusty-brown spots. The lower subsoil is calcareous and usually contains iron concretions. The mellow surface soil is probably of much more recent origin than the impervious stratum in the deeper subsoil.

The Scott silt loam occurs in small developments throughout the main area of the Waukesha silt loam. It is extensively developed on the Fremont terrace, bordering the Platte Valley from a point north of Fremont to Maple Creek, and numerous areas are encountered on the terrace south and west of Hooper. Many areas 1 to 2 acres in extent have been included with the Waukesha silt loam in mapping. Only a few areas of the Scott silt loam exceed 45 acres in extent, and most of them cover less than 15 acres.

This soil is mainly of lacustrine origin, consisting of material washed from the higher lying Waukesha silt loam and deposited in shallow water collecting in depressions. Very few streams flow from one area of this soil to another. The surface is flat or slopes very gradually toward the center of the area. Drainage is very deficient. Depressions which receive the run-off from large areas of surrounding land are frequently covered with water for days following heavy rains. This is particularly true of areas underlain with the imper-

vious silty clay or clay layer within the 3-foot section. In wet years crops are badly damaged by standing water. Very few outlet ditches have been dug. In many of the areas which are rather distant from natural drainage courses the cost of construction of ditches is prohibitive under present economic conditions, but most of the type can be readily improved both by ditching and tiling.

The Scott silt loam is nearly all in cultivation. A few of the areas in which drainage is deficient are still in virgin prairie grass. Corn, wheat, and oats are grown, with corn as the predominant crop. In years when the rainfall is not excessive corn gives heavy yields, 45 to 50 bushels an acre being obtained. In wet years, however, the crop frequently fails, and there is always considerable difficulty in obtaining a stand of corn. This is partly due to the occurrence of the type in small areas surrounded by the Waukesha silt loam, which is usually in condition for planting when the Scott silt loam is still much too wet. The type is not as well adapted to wheat and oats as to corn, on account of its cold, wet nature in the spring. Wheat yields 20 bushels or more an acre in the best years, but is frequently a failure. The yield of oats fluctuates as much as that of wheat. This soil can not well be cropped separately, on account of its irregular occurrence.

This land is held in conjunction with areas of the Waukesha silt loam, the selling value of which it depreciates.

Better drainage is the most important need of the Scott silt loam. Its irregular distribution in small, isolated areas throughout the better drained Waukesha silt loam make it almost impossible to follow special cultural methods or to grow special crops on much of the type. Yields can be greatly increased by delaying planting until the soil has become sufficiently dry and warm to insure proper germination of the seed.

The soil is well supplied with organic matter, but owing to the difficulty of growing either clover or alfalfa the maintenance of the organic content is difficult. Alsike clover, according to extensive experiments in other areas, is extremely well suited to this soil and should take the place of red clover in the rotation, since the latter crop does not do well under poor drainage conditions existing at present.

Much of the type near drainage ways can be adequately drained by ditching. Where ditching is impossible good results may be accomplished by digging wells or openings through the impervious subsoil into the basal sandy layer which occurs at depths of 6 to 12 feet or more. Frequently three or more areas can be drained into one such opening. With adequate drainage the soil could be handled in much the same manner as the surrounding Waukesha silt loam, thus minimizing the present difficulty of providing separate cultural methods and crops for a soil so irregular in occurrence.

The results of the mechanical analyses of samples of the soil and subsoil of the Scott silt loam are given in the following table:

*Mechanical analyses of Scott silt loam.*

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>						
372237.....	Soil.....	0.4	0.6	0.6	0.9	10.8	63.1	23.3
372238.....	Subsoil.....	.2	1.5	1.3	1.5	7.7	71.2	16.5

WABASH SILT LOAM.

The Wabash silt loam consists of a black silt loam, 15 inches deep, grading into a dark-brown, slightly heavier silt loam which extends to a depth of 20 inches, where it rests upon a light-brown to brownish-drab silty clay loam to silty clay marked with rusty mottlings. When very dry the soil is dark gray to brownish gray.

The type presents many variations. These are of irregular occurrence and not sufficiently conspicuous or extensive to warrant separate mapping. In many places the soil shows no appreciable difference in color or texture throughout the 3-foot section. An important variation occurs along Maple Creek south of Hooper, where the soil consists of a brown to dark-brown, friable silt loam, 12 inches deep, underlain by a lighter brown silt loam which continues to 20 inches, where it gives way to a light-brown to yellowish-brown silty clay loam to silty clay. Some small areas of light-brown silt loam occur at the foot of slopes leading from the Waukesha silt loam. The soil here consists of terrace material washed down and deposited as a surface covering over the alluvial Wabash silt loam. Where the washed or colluvial material has been derived from the loessial upland and is developed in sufficiently large areas the soil is shown as the Judson silt loam. Adjacent to stream channels the Wabash silt loam is usually brownish in the surface 18 inches, grading into a light-brown to yellowish-brown heavy silt loam below. Throughout the type there occur small areas with a typical surface soil, but underlain at 20 to 25 inches by a heavy, plastic silty clay to clay. Another subsoil variation occurs in which the material below 20 inches consists of alternating layers of silty very fine sandy loam and clay. Where the heavy material predominates the soil is classed as the Wabash silt loam, and where there is a predominance of light-textured strata it is included in the Cass silt loam. The subdrainage of areas with the light-textured material is better than that of the areas with clay substratum. In sec. 8, T. 17 N., R. 7 E., the subsoil of the Wabash silt loam below 28 inches grades from a heavy silty clay into a fine sandy clay.

In some irregularly distributed small areas the surface soil consists of a grayish-black heavy silt loam to silty clay loam, underlain by an almost black silty clay mottled slightly with yellowish brown. Such areas are locally referred to as "alkali spots." The surface material quickly dries out to a hard, white or grayish crust. Crops usually fail on such areas or give low yields. The more conspicuous of these areas support little vegetation other than a species of salt grass. These alkali areas occur on all the silt loams and heavier soils of the bottoms, but are rarely if ever encountered on the sandy types. They are increasing in extent on the heavy clay soils. Analysis of a typical sample of soil of this character showed the salts to be composed largely of sodium sulphate, with important quantities of sodium chloride. The saline condition is caused by a concentration of salts in the surface soil, to which they are carried in solution through capillary action of the soil water.

The Wabash silt loam is the most extensive bottom-land type in Dodge County. It occupies approximately one-half the area of the Platte River bottoms and practically all the first bottoms along Maple Creek and other smaller streams, as well as large but irregularly distributed areas along the Elkhorn River. In the Platte Valley it occurs, as do all the other bottom soils, in strips one-half to three miles wide running parallel with the river. The largest area is encountered north of a line connecting Fremont and North Bend, but important developments occur in the southeastern and western parts of the valley. In general the Wabash silt loam occurs farther from the stream channel than the lighter textured sandy soils and nearer than the heavy clays.

The surface is flat, except where relieved by old cut-offs or slight elevations. The type lies 3 to 6 feet above the level of the Cass and Sarpy soils adjoining the Platte River, there being a sort of natural levee at a distance of one-half mile to 2 miles from this stream. This levee roughly parallels the Lincoln Highway from near the Colfax County line on the west to a point 1 mile west of Fremont. From this place an artificial levee has been built to the Chicago, Burlington & Quincy Railroad line, and the natural levee continues southeast from this point to the Douglas County line.

Drainage on the Wabash silt loam is variable. Originally some of the land was poorly drained, but this condition has been remedied by ditching. Most of the ditches have been cut through areas of Wabash clay and the Lamoure soils, but the adjacent types, including the Wabash silt loam, have incidentally been improved. Some small areas of the type are still poorly drained. These could easily be reclaimed by an extension of the lateral ditches or by tiling. Most of the areas of this soil are very rarely inundated, but run-off from the

upland frequently collects in small depressions which have no outlet. Certain areas of this soil, which are reported to have been practically worthless for farming owing to their periodic inundation by run-off from the upland, have been drained by ditching and give higher average yields of corn and wheat than the surrounding land.

The Wabash silt loam is one of the most important soil types in the county. About 90 per cent of it is in cultivation or temporarily in pasture to be plowed up later. Originally it supported a growth of timber consisting mainly of cottonwood, elm, linden, and willow. Corn, oats, wheat, alfalfa, clover, and timothy are the principal crops, ranking in acreage in the order named. Corn yields 50 to 60 bushels per acre, depending on the season. Average yields of 30 bushels of wheat and of 40 to 50 bushels of oats are obtained in favorable years. Short-strawed varieties of oats are grown, as the crop has a tendency to lodge. Turkey Red is the principal variety of wheat. The average yields of all crops exceed those for the county as a whole. The Wabash silt loam is the strongest corn soil in the county, and it stands continuous cropping to corn better than any other soil except the Wabash clay. Alfalfa and red clover are produced on only the better drained areas, but the drainage of all the type can be so improved as to make the growing of these leguminous crops highly profitable. Where the water table comes within 4 feet of the surface a stand of alfalfa can not be kept as long as on the higher lying areas. Alsike clover does well on poorly drained areas of this soil, but the crop has received little attention. The live-stock industry is becoming more important. A considerable number of hogs and beef cattle are fed on this and associated types of bottom soil, particularly where areas of the poorly drained Wabash clay, which can be utilized as pastures, are held in conjunction with the silt loam. The type in most places is rich in organic matter. Fertilizers are not used, and are not needed under proper management.

Crops are not rotated as systematically on this and associated bottom-land soils as on the upland types. Many fields have been in corn for 10 to 12 years. Straw stacks are frequently burned. The continued cropping to corn has resulted in decreased productiveness on most farms, but yields have not declined to such an extent that the production of corn is unprofitable. The injurious results following a one-crop system are becoming more generally understood, but on account of the large percentage of farms operated by tenants on short-time leases it is exceedingly difficult and often impossible to introduce leguminous crops into the rotation for the purpose of building up the plant-food supply of the soil.

The price of farms on this type in general varies from \$135 to \$185 an acre, depending on the drainage conditions, the improve-

ments, and the nearness to towns. Near the city of Fremont land values are higher than those mentioned.

Under the present system of cropping this soil is not capable of maintaining its productive capacity. Leguminous crops should be introduced into the rotation. These should be fed to live stock and the manure carefully preserved and returned to the land. All the straw and vegetable matter available should be plowed under. The addition of organic matter will incidentally retard the accumulation of injurious salts in the depressions. Better drainage is one of the foremost needs of this soil.

#### WABASH CLAY LOAM.

The surface soil of the Wabash clay loam is a black clay loam, from 12 to 15 inches deep, containing a relatively large proportion of fine sand. Below this the material becomes lighter in color and heavier in texture, consisting in the upper part of a grayish-black to drab plastic clay, which grades at 25 to 27 inches into a grayish-drab, heavy plastic clay. The type is variable in texture of the subsoil. In some places it is sandy clay loam to sandy clay. Nearly always below 40 to 46 inches it is a sandy loam to sandy clay. In the deeper subsoil the sand becomes coarser and the content increases. In some places the subsoil contains lime concretions.

This type is relatively unimportant in Dodge County. It occurs in four small areas about  $4\frac{1}{2}$  miles north of North Bend. The surface is prevailingly flat. Surface drainage is usually fair, but the internal drainage is more or less deficient, depending on the texture of the subsoil.

Nearly all this soil is in cultivation, principally to corn and wheat. Oats and clover are grown to some extent. Part of the type is in wild grass which yields  $1\frac{1}{2}$  to 2 tons of hay per acre. Corn is usually listed. Yields of all crops are about equal to the average obtained on the other soils of the bottoms. In general this soil ranks between the Wabash silt loam and the Wabash clay in agricultural value. It has not decreased in productiveness under cultivation.

#### WABASH SILTY CLAY.

The Wabash silty clay consists of about 12 inches of very dark gray to black silty clay, underlain to a depth of 36 inches by a plastic, drab, or mottled drab and yellowish-brown clay. In some places the heavy clay subsoil is not encountered above 18 inches. The soil is somewhat lighter in color and more friable than the Wabash clay and does not crack as badly upon drying. The type is variable in texture near the margin of the areas, grading into the Wabash silt loam on the one hand and into the clay on the other. As the color indicates, it is very high in organic matter.

This soil occurs throughout the flood plains of the Platte and Elkhorn Rivers and the smaller streams. The areas are quite variable in size and irregular in distribution. The type characteristically occurs between the Wabash silt loam and clay types. It has a flat surface and is inadequately drained, owing partly to its low position and partly to its heavy subsoil.

The Wabash silty clay is one of the less extensive soils of the county, its total area being approximately 22 square miles. About 60 per cent of the type is under cultivation, the remainder being in pasture or hay land. It is a very strong corn soil and yields of 50 bushels per acre are frequently obtained. Wheat and oats also do well, but these crops have a tendency to grow too rank in favorable years and during wet seasons some of the land is too poorly drained to produce the best yields. Some red clover and alfalfa are grown. The soil is not well suited to these crops under present conditions, but with improved drainage they would thrive. The acreage of these and other crops is kept down, owing to the high yields of corn obtainable. Not much attention is given to crop rotation, fields being devoted to corn for five or six years or more. No fertilizer is used, and none is needed under careful management. The type supplies excellent pasturage. The stand consists mostly of bluegrass and white clover, the latter making a very luxuriant growth. Where land of this type is owned in conjunction with the better drained Wabash silt loam and Cass soils it is usually left in grass. It produces 1½ to 2 tons of hay per acre. The hay is either fed from the stack to work stock as needed, or is baled for market. It sells for about \$8 to \$9 a ton in Omaha.

Owing to its high clay content this soil can not be cultivated under a very wide range of moisture conditions. If plowed when wet it puddles and remains in poor physical condition until granulation is restored by freezing and thawing or by the drying out of the soil after it becomes wet. Cracks frequently form and permit excessive loss of moisture from the surface and subsurface soil. In forming they sometimes injure the roots of the growing crop. The type is greatly benefited by fall plowing, but this is not practiced to any considerable extent.

Owing to its irregular distribution in small areas no definite selling price can be quoted for this type, but in general it ranges between the Wabash silt loam and Wabash clay in agricultural value.

The greatest need of this soil is more adequate drainage. Alsike clover does better on the poorly drained areas than red clover or alfalfa. Areas of saline soil should be thoroughly drained and manured, in order to allow the soluble salts (mainly sodium sulphate) to leach out and to be neutralized by chemical changes.

## WABASH CLAY.

The Wabash clay, to an average depth of 12 inches, consists of a black, heavy, plastic clay. Below the depth of 12 inches the soil gradually becomes lighter in color and is a dark gray to drab to a depth of 18 inches. Below this the subsoil changes to a drab, heavy, plastic clay which contains iron-oxide concretions or rusty-brown stains resulting from their oxidation. In places the black clay of the surface soil continues without change throughout the 3-foot section. The type includes small areas in which the soil is a silty clay in texture, but is typical in soil and subsoil color. In some irregularly distributed areas the subsoil is a brownish sandy clay, mottled with gray. In places the subsoil contains a few lime concretions, but the subsoil material itself is not calcareous.

The heavy clay soils of the Platte Valley to the southeast of Fremont contain a materially smaller number of calcium-carbonate concretions in the 3-foot section than most of the areas of heavy clay soil to the north of North Bend, in the western part of the county. It has been decided, therefore, to classify the first-bottom clay soil east of Fremont and along the Elkhorn River as Wabash clay and that in the southwestern part of the county as Lamoure clay. A few typical areas of Wabash clay have, however, been separated from the Lamoure clay.

The surface of the Wabash clay is flat. The type occupies the lower lying first-bottom areas, and drainage is deficient both on account of the low position and an impervious subsoil. Extensive drainage ditches have been constructed and great improvement has resulted, but there is still need for the extension of lateral ditches leading into the mains. Small areas have been improved by tile drainage, which has been found highly profitable and could easily be extended over much of the type.

It is estimated that about 50 per cent of this soil is in cultivation, the rest being in grass. Grain farming is the predominant type of agriculture, but considerable attention is given to live stock by farmers who use this soil in conjunction with upland types or with the better drained bottom soils. Corn, oats, wheat, and hay are the most important crops. Corn does very well except in wet years. Yields of 60 bushels are frequently obtained on the better areas. The oats grown are mainly of the short-strawed variety known as Kherson. Yields depend upon the season, but are usually very satisfactory, ranging from 45 to 55 bushels per acre. Wheat yields 20 to 30 bushels per acre in the most favorable years, but frequently the land is too wet and the crop suffers. Clover and timothy are successfully grown in small fields. Alsike clover is better adapted to a wet soil of this character than red clover, but it is grown to only a small extent.

Wild hay yields  $1\frac{1}{2}$  to 2 tons of hay per acre. Most of the hay is stacked in the field and hauled to the barn in the winter as needed. Some of it is baled and sold. Prices ordinarily range from \$6 to \$9 a ton, depending on the quality. It is popularly believed that the hay grown on this soil in the Elkhorn Valley is superior in feeding value to that grown in the Platte Valley.

No effort is made to rotate crops systematically, and corn often succeeds itself for years. The crop is usually listed. The rotation most commonly practiced consists of three or four years of corn, one year of oats, and one year of wheat. No fertilizer is used, and there is no need of fertilization, as the soil contains an abundant supply of plant food. The Wabash clay is difficult to handle. When wet it puddles badly and requires subsequent freezing and thawing before it assumes a good structure. It can be properly cultivated under only a very narrow range of moisture conditions. When the moisture conditions are good the soil breaks up into small granules, which form a mulch, and it is subsequently easy to keep in good tilth. It cracks badly when dry, causing injury to roots as well as excessive loss of moisture through evaporation from the surface and subsurface soil.

Land of this type sells for \$90 to \$150 an acre, depending on the nearness to towns and the drainage conditions.

The productiveness of this land has not deteriorated under cultivation. For its best development more adequate drainage is the first need. This can be largely accomplished by tiling. The soil can be much improved in structure by plowing in the fall, and more fall plowing should be done, particularly for corn. Alsike clover should be introduced in the rotation where the drainage is so inadequate as to make the production of red clover or alfalfa uncertain. Listed corn gives relatively poor results on this type, as on the other heavy soils of the county.

#### LAMOURE SILT LOAM.

The Lamoure silt loam consists of a black silt loam 12 to 15 inches deep, changing gradually to a brownish-black silt loam which extends to 20 inches. Below this the subsoil becomes a brownish-gray, compact silty clay, grading into a gray silty clay to clay in the lower part of the 3-foot section. Frequently the subsoil below 25 inches is a drab to dark-drab clay. In many places a 3-inch stratum of white, floury silt loam is encountered at a depth of about 18 inches, immediately overlying a heavy, compact silty clay. In some areas the subsoil below 30 inches is a grayish sandy clay, mottled with brown and yellow. In the better drained areas the soil frequently

consists of black silt loam extending without change to a depth of 20 inches and underlain by a light-colored silty clay loam.

In the marginal areas grading into the Wabash clay loam and the Cass loam the soil contains a relatively large percentage of fine sand particles, imparting a loamy structure to the surface soil. In marginal areas adjoining the Lamoure clay and other heavy types the surface soil ranges from a black silty clay loam to a silty clay, while the subsoil is typical. Both the soil and subsoil of the type contain a high percentage of lime, occurring in the form of shells and concretions.

The Lamoure silt loam occurs in close association with the Wabash silt loam in the western half of the Platte Valley. One small area occurs along the Cuming County line north of Crowell, and another lies 1 mile southeast of Fremont. The type differs from the Wabash silt loam in having a light-gray, highly calcareous subsoil below a depth of 25 inches. It occupies comparatively high situations, but is less perfectly drained than the rest of the higher lying bottom types. The surface is prevailingly flat, with a slight slope toward the lower lying heavy soils. In places the surface is modified by slight ridges and depressions.

The Lamoure silt loam is a very inextensive soil, but about 75 per cent of it is in cultivation. Some small areas near North Bend are in wild hay. Corn, the principal crop, gives yields of 35 to 40 bushels an acre. Wheat and oats also do well in the better drained areas. Most of the land is too poorly drained for alfalfa or red clover. Alsike clover does well and could be made the basis of a profitable rotation. The principal need of this soil is better drainage, which can easily be accomplished by an extension of lateral ditches to the mains or by tiling. When drained the soil should be as productive as the Wabash silt loam, and its productiveness could be maintained by the growing of alfalfa and clover in rotation.

#### LAMOURE SILTY CLAY.

The Lamoure silty clay consists of a black silty clay, 12 inches deep, underlain by a somewhat lighter colored clay which grades at 18 inches into a brownish-black to drab clay. Below 25 inches the subsoil is a grayish-drab to gray clay containing lime concentrations and shells.

The type is quite variable. Along the Colfax County line, in sec. 6, T. 17 N., R. 5 E., the soil profile is practically the same as that of the Wabash silt loam, the type differing only in having a slightly more compact subsurface layer and a large content of lime in the form of concretions. In other areas the subsoil is a mottled brown, gray, and yellow sandy clay, underlain below 3 feet by sandy loam to coarse sandy clay loam material. Frequently gray to white silty

clay overlies the heavy, plastic clay subsoil of the type. The lime content varies considerably in different areas. In some places the lime content is the only characteristic in which the Lamoure silty clay differs from the corresponding Wabash type.

Like the Lamoure clay, this type is confined to the vicinity of North Bend, in the Platte Valley. It forms narrow strips usually lying between the Lamoure or Wabash silt loam and a heavy clay type. The surface is flat, with a very gradual slope toward the clay soil in the lower lying depressions. Drainage is deficient, although somewhat better on areas in which the sandy clay subsoil lies within 40 inches of the surface.

The Lamoure silty clay is of minor importance agriculturally, owing to its small extent. About 50 per cent of it is in cultivation, the remainder being in wild grasses. Corn is the leading crop. It does well under favorable climatic conditions, and gives an average yield of 35 bushels per acre. Wheat and oats do better than on the heavy Lamoure clay, but yields in general are low, owing to the poor drainage.

The soil bakes and cracks badly and is difficult to handle, on account of its high clay content. Alkali spots are numerous and lower the farming value of the type. When dry, such areas often form a hard, white crust, which it is very difficult or impossible to pulverize by cultivation. Little effort is made to correct this saline condition by the use of manure or by improving the drainage, owing to the fact that fairly profitable crops of wild grass for hay and pasture can be grown under the existing conditions. The hay is fed largely to live stock, which is kept on the associated better drained soils. Feed lots on this soil are difficult to maintain.

In the following table are given the results of the mechanical analyses of samples of the soil and subsoil of the Lamoure silty clay:

*Mechanical analyses of Lamoure silty clay.*

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>						
372229.....	Soil.....	0.4	1.6	2.2	8.9	11.7	44.9	29.8
372230.....	Subsoil.....	.6	2.6	3.4	18.2	7.2	27.2	40.7

The following sample contained more than one-half of one per cent calcium carbonate ( $\text{CaCO}_3$ ): No. 372230, 4.52 per cent.

#### LAMOURE CLAY.

The Lamoure clay, to a depth of 16 inches, consists of a black, compact clay. This is underlain by a drab to black clay, and below a depth of 28 inches by a gray to bluish-gray plastic clay, mottled

with brown and yellow. At 20 to 22 inches the subsoil contains numerous lime concretions, varying in size from one-sixteenth to one-eighth inch and increasing with depth.

The subsoil presents many variations. In places it is a black, plastic clay, very similar to the surface soil except for occasional mottlings of rusty brown. In some less extensive areas the lower 6-inch stratum of the 3-foot section contains an appreciable amount of coarse and fine sand and consists of a brownish-gray clay loam mottled strongly with rusty brown and yellow. Usually such areas are underlain at depths of 40 to 45 inches by coarse sandy loam containing some gravel. The substratum at 5 to 6 feet is prevailingly a coarse sandy clay loam containing numerous lime concretions. In some places the type consists of a grayish-black clay in the surface 15 inches, grading into a light-gray or white subsoil which contains such a high percentage of small lime concretions as to give it a gritty feel. In such areas the lower subsoil is usually mottled with brown and yellow and the underdrainage is very deficient, owing to the plastic clay material underlying it and to the low topographic position.

The Lamoure clay is closely related to the Wabash clay. It differs mainly in the highly calcareous nature of the subsoil. The type has somewhat poorer surface drainage and subdrainage than the Wabash clay, and oxidation has been more retarded, as is shown by the lighter gray to white subsoil which is frequently encountered.

The Lamoure clay occurs in discontinuous areas in the southwestern part of the Platte Valley, beginning in sec. 31, T. 18 N., R. 5 E. and extending parallel with the river to sec. 31, T. 18 N., R. 7 E. It occurs in low-lying areas, and the low position and the heavy, plastic structure of the soil make the surface and subsoil drainage deficient. This is the most poorly drained soil type in the county.

The Lamoure clay is not of much importance agriculturally. About 20 per cent of it is in cultivation, the remainder being used for pasture land or devoted to the production of wild hay. Most of the cultivated areas are drained by ditches constructed either through them or through adjoining types. Drainage work has proceeded slowly, as crops are largely grown on the higher lying and better drained surrounding land, this type being used for pasturage and hay production. Wild hay yields 1 to 2 tons an acre. Most of the hay produced is fed to live stock kept on adjoining well-drained soils. In recent years there has been a growing appreciation of the value of this soil for grain where adequately drained. Corn is the leading crop, followed by wheat and oats. Corn gives heavy yields where the drainage has been fairly well improved. The type ranks with the Wabash clay in productiveness.

The Lamoure clay is very difficult to handle, owing to its plastic structure. If it is stirred while too wet it forms hard clods which are difficult to pulverize. It can be plowed safely under only a narrow range in moisture conditions. The soil cracks badly, causing much loss of moisture from the surface and subsurface soil and injuring the roots of crops. If plowed while in the proper condition the soil breaks up into lumps about the size of an egg and can be easily kept mulched thereafter until heavy rains fall.

This type includes many alkali areas, in which nothing but a species of wild salt grass grows. Frequently such spots are numerous enough to make areas of 3 to 4 acres valuable for pasture. Analysis of a sample of soil showed the same salts as in the areas already mentioned. These saline spots seem to be increasing. To remedy the saline condition the soil must be drained adequately by ditching or by tiling. After drainage is established the salts gradually leach out. The process may be aided by heavy applications of manure, and manuring alone will sometimes be sufficient in places where the natural drainage is fairly adequate. Alfalfa and red clover are not well suited to this soil, but alsike clover may be successfully grown and should be made the basis of the cropping systems.

Land of this type is usually sold in conjunction with other bottom soils.

In the following table are given the results of the mechanical analyses of samples of the soil and subsoil of the Lamoure clay:

*Mechanical analyses of Lamoure clay.*

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>						
372227.....	Soil.....	0.1	0.7	1.1	8.0	7.5	47.9	34.7
372228.....	Subsoil.....	.9	1.4	1.0	3.9	4.8	41.5	46.5

The following samples contained more than one-half of one per cent calcium carbonate ( $\text{CaCO}_3$ ): No. 372227, 4.84 per cent; No. 372228, 6.52 per cent.

CASS FINE SANDY LOAM.

The Cass fine sandy loam consists of a dark-brown fine sandy loam, 15 inches deep, underlain by a light-brown to grayish-brown fine sandy loam which with depth grades into a loose, incoherent, gray fine sand. In places the lower subsoil contains alternating strata of silt loam and fine sandy loam. When dry and in places low in organic matter, the surface soil has a light-gray to gray color. Occasionally fine gravel is encountered within the 3-foot section, but it usually occurs at lower depths. In some small depressions the soil is slightly heavier in texture and of darker color than typical. In

general this soil is very similar to the Sarpy fine sandy loam as mapped in other areas, and it is included in the Cass series largely on account of its close association with the Cass very fine sandy loam.

The Cass fine sandy loam is irregularly distributed in small areas throughout the Platte and Elkhorn Valleys. The largest area occurs just southwest of the town of Fremont. For the most part the surface is level, but slight ridges and depressions occur in places. The surface soil is well drained, owing to its extremely porous nature, but underdrainage is deficient in the lower lying situations. In the higher places both the surface drainage and underdrainage are adequate.

This type is all in cultivation. Most of it near Fremont is used for potatoes and other truck crops, but all the staple crops of the county produce profitable yields. It is ideally adapted to trucking on account of its porous, friable structure, which makes it a warm soil in early spring. For truck crops large quantities of manure should be applied, but this is seldom done, and the organic matter has been depleted until yields have fallen off considerably. Where manure is not available in sufficient quantities for the profitable growing of truck crops, it should be supplemented by a combined nitrogenous and phosphatic fertilizer. The soil becomes extremely droughty in dry seasons, and the yields of corn are frequently less than 30 bushels per acre. Applications of manure or other organic matter to the soil greatly increase its water-holding capacity.

The results of the mechanical analyses of samples of the soil and subsoil of the Cass fine sandy loam are given in the following table:

*Mechanical analyses of Cass fine sandy loam.*

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>						
372215.....	Soil.....	0.0	0.2	0.9	53.4	18.8	20.6	5.9
372216.....	Subsoil.....	.0	.2	.6	34.9	24.8	30.0	9.4

CASS VERY FINE SANDY LOAM.

The Cass very fine sandy loam to a depth of 20 inches consists of a very fine sandy loam, black in the surface 10 to 15 inches and very dark brown below. From a depth of 20 inches the subsoil consists of a brownish-gray fine sand to very fine sand, grading below 27 inches into a gray fine sandy loam to fine sand, which in most places contains rusty-brown streaks.

In many places alternating layers of silt, very fine sand, and clay occur in the lower subsoil. Where the heavy subsoil material pre-

dominates throughout the 3-foot section the sandy layer invariably underlies it at 40 inches or less. Lime concretions occur in the heavy subsoil layer, but are usually lacking in the lighter textured material. In places the subsoil of the type consists of a gray to almost white fine sand to fine sandy loam, which may continue from a depth of 25 inches to the bottom of the 3-foot section or may be underlain by strata of silt loam and very fine sandy loam.

When dry the surface material assumes a dark grayish brown color, and under such conditions it is difficult in places to separate the type from the Sarpy soils, as the color of the surface soil is the chief basis of distinction. Areas of Cass fine sand and fine sandy loam 1 to 2 acres in extent are irregularly distributed throughout the type. The marginal areas grading into the associated Cass silt loam and Wabash silt loam contain a relatively high percentage of silt particles.

The Cass very fine sandy loam from a point 1 mile west of North Bend to a point 4 miles east of the same town really represents an area of Wabash very fine sandy loam, a type which is not mapped separately in Dodge County on account of its small extent. The soil here consists of 20 inches of black, rather heavy, very fine sandy loam which grades through a black silt loam and gives way to a very dark brown moderately friable silty clay at 30 to 36 inches. This soil is held in very high esteem by farmers, who regard it as more drought resistant than the typical Cass very fine sandy loam. It comprises some of the very best soil in the bottoms and exceeds the upland soils in productiveness.

The Cass very fine sandy loam occurs in a continuous strip along the Lincoln Highway from the Colfax County line west of North Bend to the vicinity of Fremont. Small, irregularly distributed areas are mapped throughout the Platte and Elkhorn Valleys. The type does not occur in the flood plains of the smaller streams. It marks the boundary of the natural levee along the Platte River, lying 3 to 6 feet above the soils adjacent to the river.

The surface is prevailingly flat except where relieved by small ridges and sloughs. In a few places along the Elkhorn River the type is rather extensively dissected by sloughs and deserted stream channels. It is well drained, owing to its porous structure and comparatively high position.

The original tree growth on this type consisted of cottonwood, willow, elm, and ash. Practically all of it has been cleared off and the land put in cultivation. A few of the small dissected areas near the Elkhorn River have never been broken and are used for pasture. Grain growing is the principal type of farming engaged in. A few cows and hogs are raised on farms which include some less desirable

land suitable for use as pasture. Corn is the most important crop, followed closely by oats and wheat. Corn yields 35 to 50 bushels an acre, wheat 20 to 25 bushels, and oats 50 to 60 bushels. Alfalfa and red clover do well, particularly the former, and the acreage in this crop is increasing. More hogs are kept on farms producing alfalfa than on those where the crop is not grown. Most of the alfalfa is cut for hay and fed to cattle and work stock, but some is used as pasturage for hogs. This has been found to be a very profitable use of the crop. The rotation followed on this soil consists of corn two or three years, oats one year, and wheat one year. Some of the land is occasionally put in alfalfa or clover.

Very little manure is used on this soil. Corn is almost invariably listed. Owing to the extremely favorable structure, this method of planting is more successful on this soil than on the heavier soils. Heavy draft stock is used, and most of the work is done with labor-saving machinery. The type can be cultivated soon after rains and is one of the first soils in the county to warm up in the spring. It is ideally adapted to fruits and vegetables, but they receive very little attention. Excellent markets are available for these crops and their production could be profitably extended.

The continuous growing of grain has depleted the organic-matter supply of the greater part of this soil, and yields have decreased. The incorporation of green manures, preferably leguminous crops, should receive more attention. Commercial fertilizers are not needed with careful soil management.

This land ranges in price from \$100 to \$150 an acre.

#### CASS LOAM.

The Cass loam consists of a black loam, prevailing 18 inches deep, underlain by a light brownish gray loam which grades at about 24 inches into a grayish fine sandy loam to fine sand, usually mottled with rusty brown in the lower 6 inches of the 3-foot section. The surface soil is a fine sandy loam in places, particularly near the margin of areas grading into the Cass very fine sandy loam. An example of this variation occurs 1 mile northeast of Ames, where the Cass loam grades through a fine sandy loam into Cass very fine sandy loam. A similar variation is encountered 2 miles northeast of Nickerson, in areas too small to be shown separately on the map. Some small areas have a brown surface soil and would be separated as Sarpy loam if more extensive.

The largest two areas of the Cass loam occur 3 miles north of North Bend and 3 miles north of Fremont, respectively. Smaller areas are irregularly distributed throughout the flood plains of the

Platte and Elkhorn Rivers. The type occurs in close association with the Wabash silt loam and the Cass very fine sandy loam and silt loam, and comprises some of the best drained land of the bottoms. The surface is flat, but both surface drainage and underdrainage are usually adequate.

The type is all under cultivation. It is one of the best corn soils in the county. The yield of this crop in the season of 1916 averaged over 45 bushels per acre. Corn is mostly listed. Wheat yields 20 to 30 bushels and oats 50 to 60 bushels per acre. Turkey Red wheat and Kherson oats are the principal varieties grown. No effort is made to control smut on these crops, although the disease causes some damage. No systematic rotation of crops is practiced, but corn is generally grown 2 or 3 years and followed by oats and wheat. Both red clover and alfalfa can be grown, but these crops receive little attention, owing largely to the abundance of hay land on the Lamoure soils, which are held in conjunction with this type. Yields have not materially depreciated on this type in spite of the heavy cropping to grain, owing to the unusually high content of organic matter. It is not probable, however, that the present system of exclusive grain growing can be continued much longer without a decline in yield.

Like the fine sandy loam, the Cass loam is usually held in such small areas that no fixed selling price can be assigned to it. It usually enhances the value of bottom-land farms.

Legumes, which are well suited to the type, should be grown to maintain the present high organic-matter content of this soil. The number of live stock kept on this soil is very small, and should be increased so as to make a larger supply of manure available.

#### CASS SILT LOAM.

The Cass silt loam consists of a black, mellow silt loam grading at 12 inches into a dark-brown to brownish-black silt loam which extends to 18 inches. From this depth to 24 inches the material is a brown to dark-brown loam. At 24 inches a light-brown to grayish-brown very fine sandy loam occurs, and below 30 inches a gray, porous fine sandy loam to fine sand, streaked with rusty-brown, though frequently mottling does not occur within the 3-foot profile.

The type presents some variations. In places the subsoil below 24 inches consists of alternating strata of silt and very fine sand, ranging in thickness from 1 to 6 inches. Occasionally a layer of silty clay to clay material is encountered in the subsoil. Where the heavy material predominates in the subsoil in areas adjoining the Wabash silt loam the soil is classed with the latter type. The difference between the Wabash silt loam and the Cass silt loam is en-

tirely one of subsoil structure, the former being prevailingly underlain by a heavy, more or less plastic subsoil.

Another variation of the type occurs in small areas along the Elkhorn River, where the soil is distinctly lighter in color than typical, being brown to dark brown. Some of this soil is light colored enough to be classed with the Sarpy silt loam. The Cass silt loam grades through a wide transitional zone into the adjoining Cass very fine sandy loam on the one side and the Wabash silt loam on the other. The soil contains a relatively large percentage of very fine sand, as the very fine sandy loam type is approached, and is extremely variable in subsoil structure where it gives way to the Wabash silt loam. In general the Cass silt loam lies between the areas of Cass very fine sandy loam and Wabash silt loam.

The Cass silt loam is not as extensive as the closely associated very fine sandy loam, but it occupies some rather large areas in the vicinity of Fremont and to the west, toward North Bend. It also occurs in many small, irregularly distributed areas in the Elkhorn River flood plain.

The surface is prevailingly flat, but a few areas along the Elkhorn River are somewhat dissected by sloughs and cut-offs. As a rule the type lies at the same elevation as the higher lying bottom soils, being situated 3 to 5 feet above the poorly drained types. Owing to this favorable topographic position and comparatively open structure, it is well drained.

Like other bottom soils, this type is largely devoted to the production of corn, wheat, and oats, ranking in importance in the order named. Practically all the type is under cultivation. Only some small areas lying at a lower elevation or isolated by old stream channels remain in native grasses.

Where corn follows corn the crop is usually listed. This crop gives very good yields, probably averaging more than 45 bushels per acre. Wheat does exceptionally well, yielding ordinarily about 30 bushels an acre. Oats frequently lodge badly, and as a consequence the short-strawed varieties are usually grown. The soil is ideally suited to alfalfa and clover. Alfalfa yields 5 to 6 tons an acre per season. Clover yields from  $1\frac{1}{2}$  to 2 tons per acre. This legume is much better suited to short rotations than is alfalfa, but little effort is made to include either of these crops in a carefully planned rotation for the purpose of improving the soil. In general the type has declined little in productiveness under cultivation. It is easily handled, on account of its mellow structure and thorough drainage. Good draft stock is commonly used on this soil, in four and six horse hitches. Farm tractors are used to an increasing extent on this and associated bottom-land types, not only for plow-

ing and disking the seed bed but also to some extent in harvesting wheat and oats. Some hogs and beef cattle are kept. As a rule the stock is fattened on the farms. Little manure is returned to the land, notwithstanding the fact that one application results in increased yields of all crops for several seasons. Some of the straw is burned, resulting in a great waste of plant food.

Land of this type is valued at \$150 to \$175 an acre, depending on the distance from towns. Near Fremont prices are higher. The Cass silt loam is one of the best general-farming soils in the county.

In the following table are given the results of the mechanical analyses of samples of the soil and subsoil of the Cass silt loam:

*Mechanical analyses of Cass silt loam.*

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>						
372221.....	Soil.....	0.0	0.1	0.1	4.1	13.5	64.1	17.9
372222.....	Subsoil.....	.0	.9	1.2	12.7	36.5	36.9	11.6

CASS SILTY CLAY.

The surface soil of the Cass silty clay consists of 15 inches of black silty clay. This grades into a brown loam, mottled with gray, which extends to 22 inches. Below this the subsoil grades through a grayish-brown fine sandy loam and at 30 inches changes to a gray fine sand which is mottled with yellow and brown. Frequently the fine sandy loam material continues to 36 inches or more.

The surface soil frequently is a clay loam, with a relatively high content of fine sand, and underlain by the typical subsoil. This variation occurs in sec. 20, T. 17 N., R. 9 E. In some other places the subsoil below 20 inches consists of alternating layers of fine sand and silty clay. In patches the subsoil is calcareous.

As mapped this type includes a small area of Cass clay in the central part of sec. 28, T. 17 N., R. 9 E. This consists of a black clay, 15 inches deep, grading into a lighter colored silty clay which extends to 20 inches. Below this the subsoil grades into a grayish fine sandy loam mottled with brown and yellow.

The Cass silty clay is an inextensive soil. The largest area occurs 4 miles southeast of Fremont, in secs. 28 and 29, T. 17 N., R. 9 E. Smaller, irregularly distributed areas occur in the Platte and Elkhorn Valleys. The type occupies lower positions than the adjacent Cass silt loam and has a flat surface. Drainage, although inadequate, is better than on the heavy soils of the Wabash and Lamoure series, owing to the porous nature of the subsoil.

The Cass silty clay and the included area of clay are largely in cultivation. Originally all this land was in grass, but since the construction of ditches all the important crops of the county, especially corn, wheat, and oats, have been grown, and satisfactory yields are obtained. Some small areas remaining in wild grass yield 1 to 2 tons of hay per acre.

The Cass silty clay is difficult to handle on account of its plastic structure. Its prime need is better drainage. This can be provided by ditching. Where effort is made to maintain the present high content of organic matter large yields of the staple crops should be obtained indefinitely. This soil is somewhat less desirable than the lighter textured soils of the Cass series.

#### SARPY VERY FINE SAND.

The Sarpy very fine sand consists of 20 inches of grayish-brown to gray very fine sand, underlain by a light-gray, loose, incoherent fine sand. The subsoil usually becomes coarser with depth, and in places it contains some small gravel. It is frequently mottled with yellow and brown.

The Sarpy very fine sand occurs in discontinuous strips, varying from a few rods to one-half mile in width, along the Platte and Elkhorn Rivers. Usually it occupies low situations next to the stream. The largest area occurs in the Platte Valley 2 miles east of Ames.

The surface of the type is billowy, as a result of the irregular deposition of sediment that has taken place. Drainage is in most places deficient, and part of the type is subject to overflow.

The greater part of this soil is covered with a tree growth consisting of cottonwood, elm, box elder, and willow. A small part is used for the production of the staple crops. Only fair yields are obtained. In droughty seasons the soil dries out quickly, owing to its low content of organic matter, and crops fail entirely. Most of the type is covered with a growth of wild grasses which is used for both hay and pasturage. Wild clover thrives in seasons of abundant rainfall. Pasture grasses quickly fail in the dry seasons. The type is of little agricultural importance.

#### SARPY VERY FINE SANDY LOAM.

The Sarpy very fine sandy loam consists of a light-brown very fine sandy loam changing at 15 to 22 inches to a grayish-brown very fine sandy loam, which frequently becomes a very fine sand to fine sand in the lower strata. When dry the soil is grayish in color.

In some places, including the area southeast of North Bend along the Platte River, in secs. 13, 14, and 15, T. 17 N., R. 6 E., the surface soil has a dark-brown color, due to the accumulation of organic

matter. The soil here approaches the Cass very fine sandy loam in color. Some small areas of Sarpy fine sandy loam and fine sand are included with the type. The fine sand occupies narrow ridges suggestive of wind action. As a rule the subsoil of the Sarpy very fine sandy loam increases in coarseness and porosity with depth, but in some places alternate layers of silt and clay are encountered in the subsoil. The type differs from the Cass very fine sandy loam only in having a lighter colored surface soil. It is low in organic matter. The main area of the type between Fremont and North Bend lies about 4 feet below the level of the Cass and Wabash soils.

Typical areas of Sarpy very fine sandy loam occur in secs. 17 and 18, T. 17 N., R. 7 E. The included areas of fine sandy loam occur in secs. 4 and 10, T. 17 N., R. 9 E. The type is developed in more or less isolated areas along the Platte and Elkhorn Rivers. On some small islands in the Platte Valley, such as Fremont Island, the soil varies from typical to fine sand or very fine sand, and includes some Riverwash.

The surface of the type ranges from flat to billowy. Drainage is variable. The areas along the Elkhorn River being better drained than those along the Platte. The latter stream at times overflows much of the type.

A large proportion of the Sarpy very fine sandy loam is used for the production of wild hay or as pasture land. Only a small part is under cultivation. Corn, the leading crop, gives excellent yields. Wheat and oats are not extensively grown, but do well. Some truck crops are grown, and the type is ideally suited to these where it lies above overflow. Alfalfa and red clover can be successfully grown in the well-drained areas, but owing to the high water table much of the type is not suited to these crops. Some of the areas along the Elkhorn River support a tree growth, composed mostly of cottonwood, elm, walnut, and willow. This soil is usually pastured where it is held in conjunction with other higher lying types. It is extensively used for trucking in other States.

This land is valued at \$50 to \$100 an acre, depending on the flood conditions and the nearness to towns.

#### RIVERWASH.

Riverwash occurs in numerous small areas adjacent to the channels of the Elkhorn and Platte Rivers. The largest development is mapped just south of North Bend. Riverwash is composed of alternating sand bars, sand flats, and narrow depressions occupied by silty clay. It is undergoing formation, as each inundation brings an additional deposit of alluvium, and there will ultimately be developed soils similar to the other bottom-land types.

## SUMMARY.

Dodge County, Nebr., lies in the eastern part of the State. It contains 339,840 acres, or 531 square miles. About one-third of its total area is upland, one-third bottom land, and the remainder terraces. The topography varies from flat to slightly hilly.

The bottom lands lie mainly between 1,200 and 1,300 feet above sea level and the uplands rise only about 120 to 150 feet higher.

Drainage is well established, except in depressed areas in the bottoms. The Platte and Elkhorn Rivers carry off the drainage waters.

Dodge County was organized in 1854. The early settlers came largely from the Central and Eastern States. Over 82 per cent of the total population consists of white persons of native birth. The population of the county in 1910 was 22,145, of which 60.6 per cent was classed as rural. Fremont, the county seat, had a population of 8,718 in 1910. It is an important marketing and distributing point for the farm products of the county.

The northern, eastern, and southern parts of Dodge County have good transportation facilities, and the markets of Omaha, Sioux City, and Lincoln are within easy reach of the farmers. A comprehensive public-road system reaches all the farming communities.

The climate of Dodge County is well suited to general farming. The mean annual temperature is 48.9° F., and the mean annual precipitation 30.72 inches. The rainfall is generally quite favorably distributed, but droughts occasionally occur in the late summer. The average length of the growing season is 159 days.

Agriculture is the basic industry of Dodge County. Grain production has always been the leading type of farming. The principal crops are corn, oats, wheat, wild hay, timothy, clover, and alfalfa. Over 27 per cent of the total area of the county was planted to corn in 1909. The corn and oats produced are mainly used on the farm, but wheat is grown largely as a cash crop. The value of all crops grown in 1909 amounted to \$3,163,089, and the receipts from live-stock sources to \$1,820,632. Stock farming is increasing in importance and dairying is gradually being extended. Large numbers of beef cattle and hogs are sold or slaughtered annually. The breeding of draft horses receives some attention on nearly all farms.

The natural soil adaptation of the different crops receives almost no recognition by the farmers of Dodge County. The common crops are grown indiscriminately on all the soils. Only the more progressive farmers follow a systematic rotation. The methods of farming are gradually being improved.

Twenty-one soil types are mapped in Dodge County. The upland soils are classed in the Marshall, Knox, and Judson series; the

terrace soils in the Waukesha and Scott series; and the bottom-land soils in the Cass, Wabash, Sarpy, and Lamoure.

The upland covers about one-third of the total area of the county. The predominating upland soil is the Marshall silt loam. The soils of the upland are all silt loams in texture and they are classed as loessial. They are well drained and are very productive. The prevention of erosion is the most important problem in their management. Topographically the upland is rolling to hilly, rather than undulating, but there are included some small areas of comparatively flat land.

The terrace lands of Dodge County have an extent about equal to that of the uplands. The surface is flat to gently undulating. The soils are the Waukesha fine sandy loam and silt loam and the Scott silt loam. The Waukesha fine sandy loam occurs on the terrace north of Scribner and on terrace slopes. It is well drained but low in organic matter and needs careful farming, including the incorporation of organic manures, to be maintained in a productive condition. The Waukesha silt loam is very productive and is well drained, and ranks with the upland loessial soils in agricultural value. The Scott silt loam is very deficient in drainage but productive. It occurs in depressions in the Waukesha silt loam.

The bottom land is an important division of Dodge County. The bottom soils in general are very productive. Some of these types, including the Wabash clay loam, silty clay, and clay, the Lamoure silty clay and clay, and the Cass silty clay have poor surface drainage and underdrainage. The Sarpy soils have deficient surface drainage during wet seasons. All the bottom soils can be greatly improved by ditching and tiling, and those types most deficient in drainage require systematic improvement in this respect for their most profitable utilization.



[PUBLIC RESOLUTION—No. 9.]

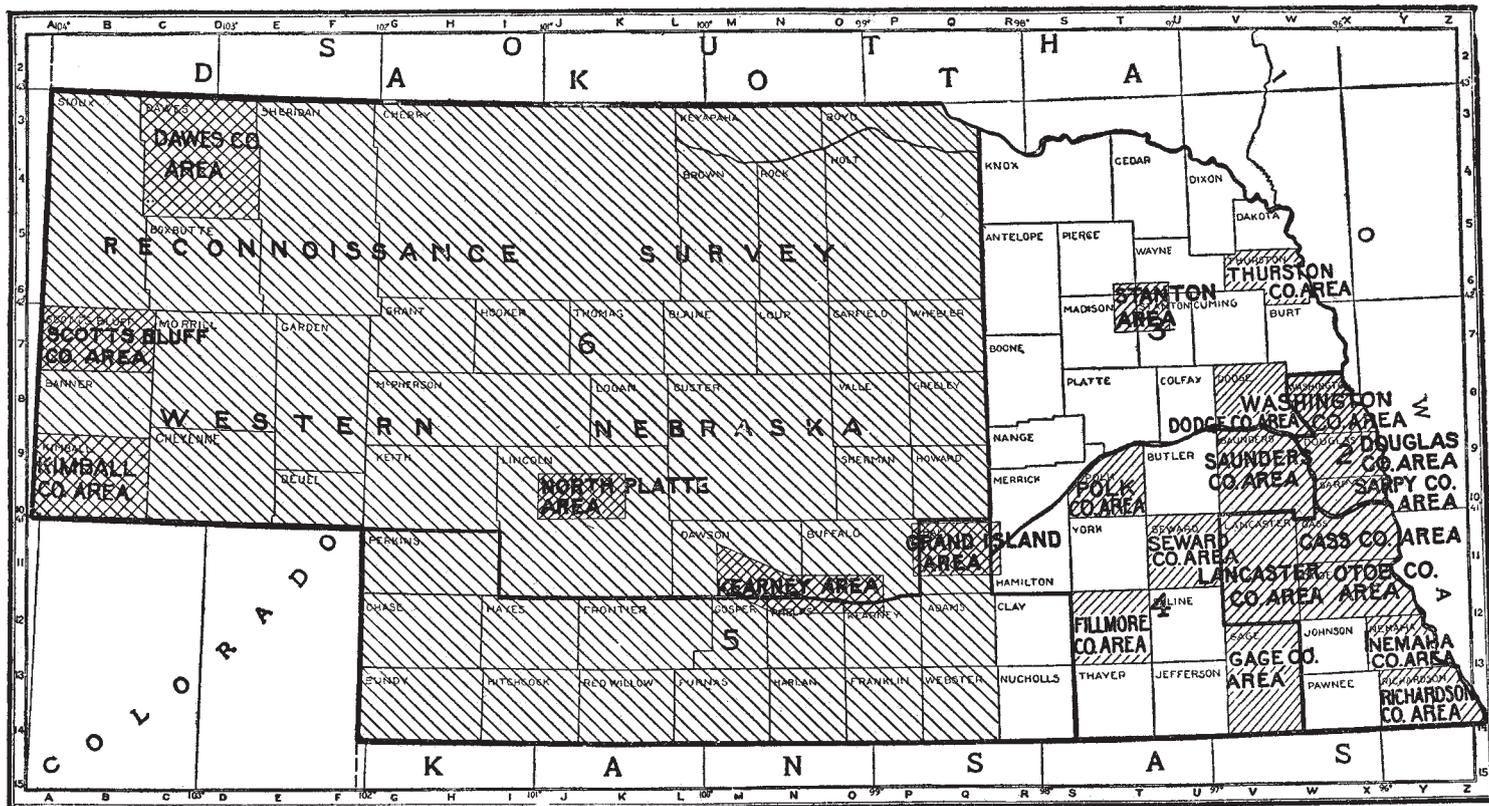
JOINT RESOLUTION Amending public resolution numbered eight, Fifty-sixth Congress, second session, approved February twenty-third, nineteen hundred and one, "providing for the printing annually of the report on field operations of the Division of Soils, Department of Agriculture."

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

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

Approved, March 14, 1904.

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



Areas surveyed in Nebraska.

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