

SOIL SURVEY OF BURT COUNTY, NEBRASKA

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DESCRIPTION OF THE AREA

Burt County is situated in the eastern tier of Nebraska counties bordering the Missouri River and slightly north of the east-west central line of the State. It is separated from Douglas County, in which Omaha is located, by Washington County. The area, which is roughly square in outline, contains 475 square miles or 304,000 acres.

The county lies in the hilly part of the State, including the bluff belt of the Missouri River Valley. In general it is a rolling upland country. There are four distinct topographic divisions—(1) the relatively smooth upland, (2) a hilly belt bordering the Missouri River Valley, (3) the Missouri River Valley lying west of the channel, and (4) the Logan Creek Valley.

The smooth upland consists of part of the smooth upland of eastern Nebraska. It lies approximately 1,300 feet above sea level, or 300 feet above the Missouri River flood plain. In Burt County a relatively small part of it remains undissected. It has been modified not merely by the small ravines that have been cut back into it from the Missouri Valley, but also by the dissection of large tributaries of the Missouri River and the subordinate drainage of these. Although the remaining relatively undissected upland is described as a belt, it is evident from what has just been stated that it is an irregular one.

Geologically this plain is built up of a series of mesozoic rocks, mainly shales, covered with a thick layer of unconsolidated silty material, part of which is supposed to have been accumulated as wind-blown material. The older paleozoic rocks are rarely exposed, so that the plain is essentially a silty deposit called loess.

The hilly belt is the ragged dissected edge of this upland bordering the Missouri River Valley, where it has been cut into a series of narrow valleys and ravines alternating with narrow intervening ridges.

The Missouri River and Logan Creek Valleys are merely the flat lands along these streams subject to occasional flooding, including certain areas lying a few feet above the flood level.

The Missouri River and Logan Creek are the principal drainage ways. Their tributaries ramify all sections of the county and are adequate to carry all surplus run-off. The divide is parallel to the bluff line and follows a central course through the county. South

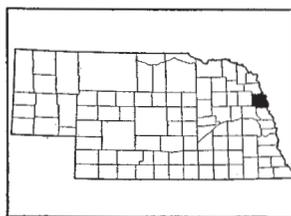


FIG. 46.—Sketch map showing location of the Burt County area, Nebraska

Blackbird, Wood, Elm, Silver, and Mud Creeks are the principal tributaries of the Missouri River, and Bell and Little Logan Creeks empty their waters into Logan Creek. The drainage trend is dominantly southward, though South Blackbird and Elm Creeks flow in a northerly direction. The stream courses generally are parallel to the Missouri River and Logan Creek Valleys for short distances before entering the bottom lands.

At the time of the settlement by the white people Burt County was occupied by the Omaha Indians, who were removed to the reservation in the spring of 1855 in accordance with the treaty made with the Government May 20, 1854. The first claim stakes in the county were driven at Tekamah, October 7, 1854, by B. R. Falson and a party of pioneers less than five months after the Territory of Nebraska was obtained from the Indians. No Government survey existed at the time, and as the homestead law was not enacted until 1863, the land was acquired only by claim title, possession, or occupancy. The county was named for Francis Burt, the first governor. Originally it included a large part of northeastern Nebraska, but subsequent legislation reduced it to its present size. The first permanent settlement was made in 1855, and the first settlement west of the Missouri River bottoms was made in 1857. The source of the early settlers extended from New York to neighboring Iowa.

Burt County had a population of 12,559 in 1920, a decrease of about 1.3 per cent since 1910, according to the census report. The average density was 26.4 per square mile. There were 10,988 native whites, 1,518 foreign-born whites, 22 negroes, and 31 people of other nationalities in the county, but over two-thirds of the foreign-born whites were naturalized. The entire population is classed as rural, as there are no cities of over 2,500 inhabitants.

Tekamah, the county seat, had a population of 1,811 in 1920; Oakland, 1,356; Lyons, 1,025; Decatur, 657; and Craig, 418. Outside of the towns, the population as a whole is fairly evenly distributed in the rural sections. Oakland is in a community of Swedish extraction, and the western part of the county is occupied by people of German descent. Arizona, Bertha, and Basford are inland trading centers of local importance.

The county as a whole has good transportation facilities. The western part is served by two lines, the Lincoln and Sioux City branch of the Chicago, Burlington & Quincy Railroad and the Omaha and Sioux City branch of the Chicago, St. Paul, Minneapolis & Omaha Railway. The latter road also traverses the southern and southeastern parts of the county. The northeast section has no railroad, but a ferry at Decatur gives connection with Sioux City through the Chicago & North Western Railway across the river at Onawa, Iowa. Lyons and Oakland are both served by two lines and Craig and Tekamah by one line. All points in the county are within 12 or 15 miles of a shipping point.

The roads follow section or land lines as a rule, except a few in the bluff zone and at the foot of the bluffs, and several which follow valleys and railroads or detour to avoid unfavorable locations. The bluff belt is the least accessible because of the topography. None of the roads are gravel surfaced, but the most important highways are dragged after rains. The Washington Highway passes through

Tekamah, Craig, Oakland, and Lyons, and the Cornhusker Highway extends through Oakland and Lyons. Telephones are in general use and rural mail delivery routes reach all parts of the county.

The public-school system of the county is good. In general the schools are well distributed, there being 73 districts reported. The towns have graded and high schools. Churches are conveniently apportioned in the rural sections. The principal outside markets are Omaha and Sioux City, but some livestock, especially from Oakland, is marketed in Chicago.

CLIMATE

The climate of Burt County in general is temperate, healthful, and well adapted to agriculture. There are hot, sultry periods during the summer and rather severe winter storms, but these spells are usually infrequent and of short duration. Droughts lasting a month may occur in the growing season, but some of the soils of the county are so retentive of moisture that with proper cultivation serious injury from drought is prevented. On some of the bottom lands there is greater likelihood of damage to crops from excess of moisture than from any deficiency, though in occasional years in certain localities dry weather of several weeks' duration may result in loss of crops. Hailstorms are unusual and heavy downpours of a damaging nature are not frequent.

The average annual precipitation, according to the records of the Weather Bureau station at Tekamah, is 30.64 inches. This is adequate for all crops grown. During the critical months, May to August, when rainfall is most vital, the average precipitation is 17.37 inches. The distribution is general, and the rainfall occurs as local showers, or slow, moderate rains. The low average precipitation in fall is favorable for harvesting.

There is considerable snowfall in the winter which adds a helpful amount of moisture and affords protection to growing crops. Deep drifting may cause delay in traffic, and sudden thaws in the early spring sometimes make dirt roads impassable. Planted groves of cottonwood, box elder, and other trees are common for windbreak protection from the strong winds sweeping the open prairies. The topography does not play an important part in influencing the climate, but the valleys afford some protection from winds and cold-air drainage, while the hill crests are subject to wind erosion of snow with consequent winterkilling of crops. Narrow tree belts along the larger streams offer some natural protection and were chosen by the early settlers for homes.

The lowest annual precipitation recorded at Tekamah was 21.07 inches in 1910. In that year the rainfall for the critical crop months, May to August, inclusive, was 13.87 inches, of which 8.30 inches fell during August. The highest annual precipitation recorded at this station was 46.61 inches in 1903, when over 72 per cent of the rainfall occurred during the most critical crop months.

The mean annual temperature, as recorded at the Weather Bureau station at Tekamah, is 49.6° F. The winter months are cold. An absolute minimum temperature of -37° F. was reached in January and a maximum winter temperature of 78° F. in February. The average coldest month is January. The mean summer temperature

is 73.2° F. Short periods of excessive heat occur and a maximum temperature of 109° F. has been recorded in both July and August. The lowest summer temperature on record is 35° F. in June. There is a range of 50° F. between the summer and winter means, but the fluctuation in temperature is not great during the growing season and abrupt changes are infrequent.

The latest recorded date of killing frost in the spring is May 21 and the earliest recorded killing frost in the fall, September 12. The average date of the first killing frost in the fall is October 6, and that of the last in spring is April 29, giving a normal growing season of 160 days, which is sufficient to mature all crops grown. The warm summers are especially favorable to corn.

The relative humidity is fairly high and uniform, with an annual average of about 70 per cent. The prevailing winds in winter are from the northwest and in summer from the south and southeast. The average annual wind velocity is 9 miles per hour. About 50 per cent of the days are recorded clear, 25 per cent cloudy, and 25 per cent partly cloudy.

The following table, giving the normal monthly, seasonal, and annual temperature and precipitation, is compiled from records of the Weather Bureau station at Tekamah:

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

[Elevation, 1,060 feet]

Month	Temperature			Precipitation			
	Mean	Absolute maximum	Absolute minimum	Mean	Total amount for the driest year (1910)	Total amount for the wettest year (1903)	Snow average depth
	° F.	° F.	° F.	Inches	Inches	Inches	Inches
December.....	25.3	69	-25	1.00	0.60	0.27	6.3
January.....	21.3	63	-37	.77	.75	.03	6.8
February.....	22.9	78	-33	1.04	.45	.93	7.8
Winter.....	23.2	78	-37	2.81	1.80	1.23	20.9
March.....	37.2	89	-8	1.46	.00	1.08	6.7
April.....	50.6	100	13	2.91	.63	3.57	2.2
May.....	61.1	102	23	4.36	2.35	10.97	T.
Spring.....	49.6	102	-8	8.73	2.98	15.62	8.9
June.....	70.8	103	35	5.20	1.09	3.24	.0
July.....	75.5	109	41	4.22	2.13	7.31	.0
August.....	73.3	109	39	3.59	8.30	12.12	.0
Summer.....	73.2	109	35	13.01	11.52	22.67	.0
September.....	65.4	101	23	2.78	3.55	3.83	.0
October.....	53.5	93	10	1.88	1.09	1.43	1.1
November.....	38.0	86	-8	1.43	.13	1.83	2.8
Fall.....	52.3	101	-8	6.09	4.77	7.09	3.9
Year.....	49.6	109	-37	30.64	21.07	46.61	33.7

AGRICULTURE

The first actual settlement in Burt County was made in 1855, near the present site of Tekamah. The pioneers were attracted by the

abundant supply of wood and water, sandstone for building purposes, quantities of wild forage, a large belt of forest land, and abundance of game. Agriculture at this period consisted of raising subsistence crops and constituted one of the earliest occupations. The extension of railroad facilities into the county in 1876 marked the beginning of more substantial progress.

As late as 1880 part of the county was still covered with the original prairie grass, bluejoint, and other varieties, which furnished an abundance of pasturage and hay, though some Kentucky blue grass and timothy were sown. It was recognized that the soil was exceedingly fertile both in the valleys and on the uplands. The bottom lands were especially adapted to corn, grass, and vegetables, and the uplands were considered unlimited in fertility.

Corn and spring wheat were the first crops grown by the early settlers. Corn is said to have been the first crop, and was planted on the freshly broken sod, and it has never lost its leading position in the county. In crossing the Missouri River bottom lands of Iowa, the early settlers found the farmers there planting a variety of white corn which produced a very large ear. This variety was cultivated widely in Burt County for a number of years, but as the yields on the uplands were not so great as those of the deeper soils on the Missouri bottoms, other varieties were introduced. These were mostly hybrids, with few well-defined varietal characteristics. Since 1900 some attention has been given to scientific seed selection.

Wheat was brought to Burt County by the first settlers and assumed a place of importance along with corn as an article of food. The grain was ground into flour at local mills, much of it being hauled to a mill at the mouth of Logan Creek, near Winslow, in Dodge County. Since very little wheat was sold until the railroad reached Herman, in Washington County, the acreage was necessarily small, only enough being grown to supply local needs. The hard spring varieties were grown for many years. Winter wheat was introduced in the early part of the twentieth century, Turkey being especially favored. Since that time winter wheat has generally occupied the larger acreage, but occasionally it has been equaled or surpassed by spring wheat.

Oats were a crop of small importance compared to corn and wheat, as the early settlers were concerned primarily with the problem of raising enough food for their families, and the abundance of prairie grasses for forage obviated the necessity of growing much grain for animal feed. Until about 1890 the acreage of oats did not exceed 10,000 acres, but now it is second only to corn and occupies on the average an acreage approximately one-half that of corn.

Flax was occasionally grown as a sod crop by the earliest settlers. Rye was introduced early but never became a crop of importance. Buckwheat was raised by a few farmers in quantities sufficient to supply local needs for flour, but the quality was not so good as could be produced farther east, and the crop has never been widely grown in the county.

The wild grasses furnished the basis for an early livestock industry. In most cases the farmers cut only enough hay to feed a few work animals and the sheep and cattle during storms. Very

little feeding was practiced. Forage crops were introduced after 1890, varieties of red and white clover being grown in rotation with corn, wheat, and oats. Alfalfa was introduced some years later, but in 1897 both clover and alfalfa were generally grown in the west side of the county. About 10 years ago alfalfa surpassed clover in acreage and now occupies an area several times as large.

In the early seventies and on through the eighties the cattle were largely driven south and shipped from Herman, a short distance south of the present county line in Washington County. Most of the hogs, during this period, were butchered and dressed on the farms and hauled to Omaha, where they were sold to commission men. In the northwest corner of the county, especially in the uplands north of Oakland, the early settlers practiced sheep raising extensively. In the sixties, seventies, and eighties the sheep were raised almost exclusively for the wool, as there was no market for mutton, and wool continued to be an important product until the early part of the twentieth century.

The early settlements were established along the bluff lines across the county, and from here they spread to the bottom lands and to the uplands. The low flat bottom lands were regarded as worthless by some on account of their moist and rather marshy conditions.

The agriculture of the county experienced a severe setback in the early seventies, when grasshoppers were especially destructive, and it suffered somewhat from drought during 1894 and 1895, but the growth of the county on the whole has been steady.

The following table, giving the acreage and production of the principal crops of the county, as reported by the Federal censuses of 1880, 1890, 1900, 1910, and 1920, shows the general progress of agriculture during the last 40 years:

Acreage and production of principal crops in 1879, 1889, 1899, 1909, and 1919 as reported by the Federal censuses

Crop	1879		1889		1899		1909		1919	
	Area	Production								
Corn	Acres	Bushels								
Oats	Acres	Bushels								
Wheat	Acres	Bushels								
Rye	Acres	Bushels								
Barley	Acres	Bushels								
Potatoes	Acres	Bushels								
Flaxseed	Acres	Bushels								
Hay, all kinds	Acres	Tons								
Wild hay	Acres	Tons								
Tame hay	Acres	Tons								
Alfalfa	Acres	Tons								
Timothy and clover	Acres	Tons								
Clover alone	Acres	Tons								
Apples	Trees	Bushels								
Plums	Trees	Bushels								
Cherries	Trees	Bushels								
Peaches	Trees	Bushels								
Grapes	Vines	Pounds								

The following table gives the average yield per acre of the principal crops for the years 1913 to 1921, inclusive, as reported by the State board of agriculture, 1913-1918, and the State department of agriculture, 1919-1921:

Average yields per acre of the principal crops for the years 1913 to 1921 as reported by the State board of agriculture and by the State department of agriculture

Crop	1913	1914	1915	1916	1917	1918	1919	1920	1921
	<i>Bushels</i>								
Corn.....	29.1	41.1	41.0	36.6	44.0	25.0	34.0	42.0	45.0
Winter wheat.....	25.66	18.9	28.7	21.3	18.0	18.0	10.0	16.0	15.0
Spring wheat.....	14.0	13.3	15.5	13.0	19.0	16.0	7.0	7.0	9.0
Oats.....	34.0	34.4	37.1	42.0	53.0	34.0	33.0	37.0	28.0
Rye.....	25.0	25.0	18.0	26.0	30.0	19.0	19.0	22.0	17.0
Barley.....	25.0	25.4	32.0	34.7	38.0	33.0	27.0	28.0	30.0
Potatoes.....	28.0	110.8	127.7	77.6	133.0	56.0	48.0	92.0	60.0
	<i>Tons</i>								
Alfalfa.....	3.8	4.25	4.1	4.1	2.9	3.0	3.6	3.2	3.2
Wild hay.....	1.7	1.8	1.9	1.6	1.7	1.2	1.7	1.4	1.4

The present agriculture of Burt County consists of the production of general farm crops, hog raising, beef-cattle production and feeding, and dairy farming. The major crops are corn, oats, and alfalfa, and the less important crops include wild hay, wheat, and red clover.

Corn is the principal feed and money crop. It is grown on every soil type in the county and occupies an acreage practically equal to the combined acreage of all other crops. According to the annual State reports the area in corn increased from 89,296 acres in 1913, with a production of 2,598,514 bushels, to 102,802 acres in 1921, with a production of 5,120,841 bushels. About one-third of the entire area of Burt County is devoted to corn, the largest acreage being on the Marshall silt loam. Yields of 75 bushels per acre are realized on the Marshall soils and Missouri River bottom land in good years, but yields in unfavorable seasons have fallen to 10 bushels per acre on the poorer soils. The crop is fed to beef cattle, dairy cattle, hogs, and work stock, and large quantities are sold to the local elevators. Reid Yellow Dent, Hogue Yellow Dent, and Iowa Silver Mine are the leading varieties grown. The larger part of the crop is checked and surface planted, but some corn is listed.

Oats, the second important crop, occupied nearly one-third of the cultivated acreage in the county in 1921. Since 1913 the average yield per acre has varied from 53 bushels in 1917 to 28 bushels in 1921. The crop is an important stock feed and fits well with corn in the crop rotation. It is subjected to injury by drought in seasons of unfavorably distributed rainfall, and wind and grasshoppers do some damage. The grain does well on the Marshall soils of the upland and on the Waukesha soils of the terraces, but on the bottom land it grows rank and lodges. The short stiff-strawed Kherson is the most popular variety. The crop is largely fed to work stock and other animals, very little being sold except from the rough hill land in the northeastern part of the county.

The production of wheat is confined almost entirely to the heavy soils of the Missouri River bottoms. Winter wheat has been grown

on the larger acreages, but the total area sown to wheat has decreased in recent years. In 1913 there were 16,608 acres in winter wheat and 10,646 acres in spring wheat, but only about half as much winter wheat is now planted, while spring wheat in 1921 dropped to 1,443 acres. Winter wheat is the chief money crop of the valley. Practically the entire crop is sold as soon as it is threshed, the grain being hauled directly from the threshing machine to the local elevators. The average yield of winter wheat is 20 or 25 bushels per acre, but yields of 50 bushels are realized in favorable years. Almost no wheat is grown on the upland farms because the protective snows are subject to removal by winter winds, but on the flat valley bottoms there is little danger of loss from this cause.

Barley has occupied only a moderate acreage in recent years, approximating 1,500 to 2,000 acres. The crop is fed to hogs, cattle, and horses or is sold locally. The average yields range from 20 to 25 bushels per acre, but an average of 38 bushels was obtained in 1917, according to the State reports.

Alfalfa now (1922) ranks third in acreage among the farm crops and is the most important source of hay in the county. In recent years it has had a steady acreage with a tendency toward an increase. In 1921 alfalfa occupied 15,881 acres and produced an average yield of 3.2 tons per acre. The average yield for a series of years is estimated at 3 to 4 tons per acre. As a rule four cuttings per year are possible—about May 30, June 30, August 1, and in the fall. The crop is well adapted to the Marshall, Waukesha, and Knox silt loams and to the better drained flood-plain lands. The stand maintains itself for five to seven years on the uplands. Some of the crop is pastured by hogs. Its high feeding value and its beneficial effects on the soil make it a very desirable crop. Owing to the high lime content of the soils of the county, it is not necessary to lime the soil before sowing alfalfa.

Although wild hay is slowly declining in total acreage, it ranked fourth in area among all crops reported in 1921, when 8,654 acres were devoted to this crop, which averaged 1.4 tons per acre. The individual yields vary widely with the soil conditions, seasonal rainfall distribution, and topographic position. There are relatively large acreages along the Missouri River bottoms which are poorly drained and utilized for wild-hay production, and narrow belts fringe practically every drainage way in the upland, but increased drainage facilities will largely reduce the acreage on the bottom lands. Many fields in native grass are used for pasture, none of this crop being cut for hay. The hay is generally stacked in the field and fed from the stack. Some hay is cut on shares, and small pasture lots are commonly rented.

In addition to the crop of native hay and alfalfa, there are considerable acreages of other tame grasses, principally red clover, timothy and clover mixed, sweet clover, blue grass and clover mixed, timothy, and yellow sweet clover. According to the 1921 State report, red clover occupied 4,553 acres and yielded an average of 2 tons per acre; timothy and clover mixed, 1,293 acres with an average yield of 2 tons; sweet clover, 613 acres; and timothy, 338 acres with an average yield of 1.6 tons per acre. Red clover is valuable not only for hay but yields 2 to 3 bushels of seed per acre and fits

well in the crop rotation. Its beneficial effects on the soil are fully appreciated. Very little red clover is sown in the northeastern hill section of the county or on the Missouri River bottoms. In the hilly region yellow and some white sweet clover occupy the legume acreages.

Potatoes are grown on nearly every farm for home consumption. An average yield of 60 bushels per acre from 614 acres was reported in 1921. The yields vary widely, according to the soil conditions, the highest yields being obtained on the lowlands. Yields of 50 to 75 bushels are common, but yields of 225 bushels per acre have been reported. On the sandier soils in the vicinity of Arizona, which are very favorable for potato production, some farmers raise potatoes to sell for seed.

The less important crops of Burt County are rye, millet, Sudan grass, flax, and sorghum. These occupy small acreages and are insignificant in the general agricultural scheme. Although nearly every farm has fruit trees, little fruit is sold except locally when a surplus is produced. According to the Federal census there were 20,964 apple trees in 1890, which increased to 86,695 in 1900, and decreased to 13,995 trees in 1920. The number of plum and cherry trees was also reduced from 4,855 and 4,395 trees in 1910 to 1,217 and 2,301 trees, respectively, in 1920. There were 12,029 grapevines in 1900, 14,811 in 1910, and only 4,927 vines remaining in 1920, with a production of 18,991 pounds.

The following table of livestock statistics for 1920 and 1921 is compiled from Bulletins 107 and 114 of the Nebraska Department of Agriculture:

Livestock in Burt County in 1920 and 1921

Animals	1920		1921	
	Number	Value	Number	Value
Horses:				
Yearling colts.....	510	\$14,315	372	\$8,395
Two-year-olds.....	526	27,800	458	18,580
Three-year-olds.....	431	40,585	453	30,775
Work.....	5,397	645,990	4,823	488,040
Range.....	331	26,580	323	21,250
Ponies and plugs.....	2,096	101,855	2,614	118,345
Stallions.....	23	6,075	16	2,850
Total.....	9,314	863,200	9,059	688,035
Mules:				
Yearlings.....	190	12,055	177	7,325
Two-year-olds.....	192	20,255	171	11,805
Three-year-olds.....	194	27,715	157	15,135
Work.....	1,110	177,535	1,184	135,410
Jack.....	10	2,165	11	2,110
Total.....	1,696	239,725	1,700	171,785
Cattle:				
Yearling steers.....	4,069	123,075	3,411	74,241
Yearling heifers.....	3,329	87,190	2,705	42,148
Two-year-old steers.....	2,159	118,415	1,035	30,689
Two-year-old heifers.....	1,912	89,450	1,622	41,198
Three-year-old steers.....	40	2,360	89	4,305
Cows and calves.....	1,399	108,600	1,505	71,790
Dry cows.....	3,045	216,625	2,591	96,055
Milk cows.....	4,028	383,070	4,179	238,511
Registered bulls.....	141	21,175	131	12,012
Bulls (not registered).....	484	40,010	446	21,743
Pat cattle.....	3,218	265,330	3,872	226,228
Total.....	23,824	1,455,300	21,586	858,920
Hogs.....	38,105	667,560	43,314	522,610
Sheep and goats.....	1,479	14,655	1,530	7,690
Total all livestock.....	74,418	3,240,440	77,189	2,249,040

Livestock holds high rank in the agricultural wealth of the county. In 1920, according to the State report, the total value of all agricultural products, including livestock, was \$7,176,673.40, exclusive of a few minor products. Livestock alone had a value of \$3,240,440, or 45 per cent of the total.

Among the animals, cattle hold first position in value and numbers. In 1921 Burt County had 21,586 cattle of all kinds, valued at \$858,920. The larger number, 4,179, are milk cows; but there were 3,872 fat cattle, 3,411 yearling steers, and 2,705 yearling heifers. Cattle feeding is common on the majority of the farms, and many farmers feed a carload or more each year. The practice is least common in the rough hill country in the northeastern part of the county, as a comparatively large proportion of the grain is marketed at local elevators. The Shorthorn and Hereford are the dominant breeds, with a few Angus. There were 131 registered bulls in the county in 1921. The stock as a rule is composed of grades of good breeding, but there are some purebred Shorthorn and Hereford cattle in the county. Oakland is a prominent feeding center and ships in large quantities of corn. The finished animals are marketed mainly in Chicago and Omaha, and a few in Sioux City.

The dairy cattle consist of both purebreds and grades, the purebred herds being chiefly Polled Shorthorn in the vicinity of Lyons, and Polled Shorthorn and Holstein around Tekamah. Dairying is practiced on practically every farm in the county. In 1921 there were 4,179 milk cows, valued at \$238,511. A few are kept on every farm, but larger numbers are milked on some farms. Each town has a cream station from which the product is shipped to Omaha or Sioux City.

Horses are kept on every farm. Percheron is the favorite breed. Belgians were formerly common, but at present they are not numerous. The work stock of a mixed Percheron breed varies in weight from 1,200 to 1,600 pounds, the average size being about 1,400 pounds. The light horses are preferred in the hilly northeast section and the heavier types are most common on the heavy Missouri River bottoms. Horse raising is at present only a side line. Most farmers raise their own colts, and the surplus produced is generally enough to supply the local demands. The mares are generally bred to registered stallions and the quality of the stock is improved. In 1921 there were 9,059 horses in the county, valued at \$688,035. There are about one-fifth as many mules, which are used largely in the lower Missouri River bottoms.

Hog raising is an important industry. Nearly every farm has a fairly large number of hogs and good brood sows. On some farms all the corn produced is fed to hogs. The leading breeds are Duroc-Jersey, Poland-China, Hampshire, and Chester White, but the strains are not kept pure. In 1921 there were 43,314 hogs in the county, valued at \$522,610. The animals are either sold to local buyers or marketed in Omaha and Sioux City.

Sheep are not important in the livestock industry. Some sheep are shipped in every year for fattening and sold on the Omaha market. As a whole, sheep feeding is a satisfactory additional source of revenue.

Practically every farmer keeps a flock of chickens, and small flocks of turkeys, geese, and ducks are not uncommon. From 50 to several hundred birds are raised, but there is no reason why the poultry industry could not be considerably extended. On April 1, 1921, there were 8,610 dozen poultry, valued at \$86,100, in the county.

Beekeeping has received some consideration. The production of honey is especially favored by the large acreage of nectar-producing plants, as alfalfa and the clovers. In 1921 Burt County had 263 stands of bees, valued at \$1,315.

The adaptation of crops to the different soils is receiving more attention than formerly. The farmers recognize that corn does better on the dark-colored Marshall silt loam than on the light-colored Knox silt loam, and the yields are highest on the heavy, well-drained first-bottom soils. Wheat is not adapted to the upland soils, as the snow is blown off the fields, with consequent killing of the grain, but winter conditions for the crop are favorable on the flat Missouri River Valley bottoms. Oats, on the other hand, tend to lodge on the heavy flood-plain soils, and most varieties do better on the lighter-textured upland soils. The sandy soils of the Missouri River bottoms are not well adapted to the small grains but are excellent for truck crops, potatoes, and melons. The poorly drained bottoms are left for hay and pasturage. Fruit trees do best on the upland slopes where temperature conditions are more favorable and air drainage prevents serious frost damage. As a whole the variation in yields over the county is not marked enough to encourage extended specialized farming. It is noteworthy, however, that relatively few cattle are fed in the rough northeast hills of the county, although the topography is unfavorable to marketing the grain directly, while cattle feeding ranks high in the smoother areas, where the roads to market have small gradients.

Increased attention is being given to the proper cultivation and rotation of crops. There is division of opinion relative to fall and spring plowing. The former is preferred by many, as the land is thought to be in better condition especially for the corn crop, whereas the advocates of spring plowing maintain that fall plowing subjects the land to wind erosion with consequent undesirable results.

Land plowed in the fall for corn is commonly plowed in July or early August to an average depth of 5 to 6 inches. The following spring the land is disked about April 1 to destroy the weeds and again disked and harrowed just before planting, which is about May 10 to May 25, and for early-maturing varieties up to June 1. The larger part of the crop is surface planted, but listing is preferred by many, as it places the seed in moister ground at germination time and provides additional support after the soil is thrown back in the furrow. As there is some danger of "crusting in," it is necessary to work the surface of the ground before the corn comes up; otherwise the young seedlings encounter the hard crust and bend down, so that only a partial stand may ensue. When corn succeeds itself, the stalks are broken with a stalk cutter and the field is disked before plowing. The crop is cultivated three or four times and is laid by about July 4 to 10. Harvesting begins early in October, the corn generally being shucked and hauled to bins for winter feeding. Silos are not common, only 10 being reported in 1921. Small acreages are either hogged down or snapped and pastured.

The ground for clover is usually fall plowed. The crop is nearly always sown with a nurse crop, principally oats, in the spring. The additional trouble is small, and the oats yield 30 to 35 bushels of grain per acre.

The land for winter wheat is usually plowed in the fall and the seed bed prepared with a harrow and disk. The grain is usually drilled, though some is broadcast and covered with a harrow. Occasionally wheat is sown between the corn rows with a one-horse drill in the fall if the ground is in proper condition.

Alfalfa is generally sown broadcast and harrowed in, but many farmers prefer drilling, which gives a more uniform stand. A smooth, mellow seed bed is essential. As a rule little trouble is experienced in securing a fair stand. Occasionally it is sown with oats as a nurse crop. The average stand endures for five years and frequently more, but it is commonly plowed under after three or four years.

The ground for oats is usually disked in the spring, and the grain is drilled in or broadcasted.

The small grains are cut with a binder, either horse or tractor drawn, shocked and threshed by local threshing outfits, or stacked and threshed later.

Commercial fertilizers are little used. Many of the farmers apply manure to the land. Some farmers contend that the application is advantageous, but other farmers report that the increased fertility produces much straw and little grain. Much of the land has been farmed with little thought given to maintaining soil fertility. On the rough Knox silt loam areas the application of manure is advisable, and the building up of the soil by growing and plowing under legumes and other cover crops is essential, but tenants have paid little attention to soil improvement. The manure is piled out of doors, where its value is decreased by leaching, and most of it is used on fields in the immediate vicinity of the barnyard. It is believed by many of the better farmers that fertility can be maintained by proper rotation alone. The usual crop rotation consists of clover or alfalfa two years, corn two years, followed by small grain; or clover one year, corn one year, and oats one year. Little rotation is practiced on the Missouri River bottoms.

During normal times there is an adequate supply of labor, which is usually fairly efficient. The usual wage is \$40 to \$50 a month, with board. A man with family receives \$50 to \$60 a month and boards himself, but has the use of a house, garden, and chickens, and may also be furnished a cow and fuel. Harvest hands are paid \$3 a day. Corn pickers receive $4\frac{1}{2}$ to 5 cents a bushel. Wheat is threshed for 7 to 8 cents and oats $3\frac{1}{2}$ to 4 cents a bushel. Outside of the busy season most of the farm work is done by the farmer and his family.

The farm buildings throughout the larger part of the area are substantial and reasonably up to date. Those in the poorer section along the Missouri River channel, a few in the bluff lands, and those in the northeastern hill section are below the average. The houses are commonly well painted and in good repair. In 1921, 139 had modern water systems, 121 had modern heating systems, and 143 had modern lighting systems. Nearly every farm is fenced and

cross fenced with barbed wire, and some farms are entirely inclosed by hog-tight woven-wire fencing, but the larger number have only small pastures. There were 168 gas tractors and 88 trucks in use in 1921, mainly on the bottoms of the Missouri River. Passenger automobiles are in common use, there being 1,261 machines on the farms in 1921. Power for operations about the farm buildings was furnished by 572 gas engines in 1921. All farms are supplied with some labor-saving machinery. Plows, cultivators, binders, manure spreaders, drills, rakes, and mowers are in common use, and the larger farmers own more extensive equipment, but too little attention is given to proper sheltering of the machinery and implements.

The average value of all property per farm, according to the Federal census of 1920, was \$50,556, of which the land value is 82.1 per cent, buildings 8.2 per cent, implements 2.8 per cent, and domestic animals 6.9 per cent. Of the farms in the county 71.3 per cent reported an average expenditure for labor of \$874.62, 66.8 per cent reported an average expenditure of \$964.96 for feed, and 10 farms spent an average of \$181.40 for fertilizer.

According to the State report, in 1921, 56.7 per cent of the land in the county was in cultivation, 26.7 per cent uncultivated, and 16.6 per cent in pasture and range. The Federal census of 1920 reports a total of 1,417 farms, having an average of 190.4 acres per farm, of which 172.7 acres were classed as improved land.

Of the 1,433 farms in 1921, according to the State report, 37.5 per cent were occupied by owners, 11 per cent by part owners, and 51.5 per cent by renters. Of the 738 tenant farms, 27.1 per cent were leased for cash, 55.7 per cent for share, and 17.2 per cent on a share-cash basis. The cash rent was \$5 to \$7 an acre. The usual share rent varied from one-third to one-half the crop delivered at the elevator, but in the latter case the landlord frequently furnishes the seed. Breeding stock may also be furnished, the owner receiving one-half of the increase.

In 1922 the price of farm land ranged from \$35 an acre for sandy meander land in the Missouri River bottoms to \$300 an acre for choice upland, terrace, and heavy first-bottom soils having favorable locations near towns.

SOILS

The soils of Burt County have been differentiated in this report into a number of series and types on the basis of their most obvious physical characteristics and their chemical constituents so far as these could be readily ascertained in the field. The characteristics of the soils of any region are determined, first, by the composition of the parent material from which the soils have developed, and, second, by the processes of soil formation, including weathering, leaching, aeration, and oxidation, to which the soils have been subjected during their development. The soil-forming processes, which are controlled to a large extent by climatic conditions, are believed to have been of greater influence in fixing the present character of most of the soils of this area than the composition of the parent rock. Climatic conditions have been uniform for the entire area, so wherever the well-drained soil has remained undisturbed it has

acquired common characteristics, among which are the dark color of the surface soil and a certain stage of leaching, aeration, and oxidation of the different layers making up the soil profile.

The soil profile on the smooth or gently rolling upland may be regarded as the normal development under the conditions that prevail in this area. The dark grayish-brown color of the surface soil is its most striking characteristic. A large amount of organic matter, which has been derived mainly from the decay of grass roots and intimately mixed or combined with the mineral part of the soil, imparts this dark color. The soil usually has a silty texture and a loose, finely divided or floury structure. The underlying layer, which may be regarded as the upper subsoil, has a brown color, a finely granular structure, and a texture heavier than the surface soil, usually a silty clay loam. This material may extend to depths varying from 24 to 30 inches. Below this horizon is a brown or yellowish-brown lower subsoil, more friable in structure than the upper subsoil and approaching the parent rock in its characteristics. No large quantities of lime or other carbonates remain in the two upper horizons, but in the case of the Knox and Marshall soils there may be sufficient in the third layer to effervesce when treated with acid. This group of well-drained soils includes the soils of the Marshall, Carrington, and Lancaster series on the rolling uplands, and the Waukesha and Judson soils on the terraces.

Other soils of the area were developed under conditions of poor drainage. They have a surface layer of dark grayish-brown or black color and usually finely granular structure. This is generally underlain by a gray or mottled gray, yellow, and brown subsoil, heavier in texture than the surface soil. The details of the profiles of these soils vary considerably, depending upon the depth to which good drainage and oxidation have extended. Two soils in the lower bottoms may be placed with this group, the Wabash soils, which have been largely leached of their lime, and the Lamoure soils, which are highly calcareous in the subsoil.

The light-colored upland soils of the area occur on the valley slopes and bluffs where the topography has favored a growth of trees, and these soils owe their color and other characteristics to their development under a forest cover. Many eroded areas occur, however, where soil development has not been permitted to go on undisturbed and the weathered surface soil is very shallow or entirely lacking. The surface soils are grayish brown and the upper subsoils light brown or yellowish brown and somewhat heavier in texture. At depths of 24 to 30 inches in the undisturbed areas the yellow or gray calcareous parent material is encountered. In places where rapid erosion has taken place this slightly weathered parent material may be exposed over considerable areas. The Knox series occurs over the wooded loess areas. Drift is exposed in small areas, but the soils formed are not of sufficient size to map.

On the first bottoms two light-colored soils have been recognized, both of which are immature, being composed of sediments recently brought down from the light-colored materials of the upland. The Laurel series includes deep soils consisting of bands of light-colored sediments of various textures. The surface soils of the Ray series are light colored, usually sandy or silty in texture, overlying a dark-

colored heavier subsoil. These soils occur where light-colored sediments have been washed out over older bottom soils.

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

Burt County comprises a part of an area which in relatively recent geological times has been covered by two kinds of soil-forming materials. The older deposit was laid down during the Pleistocene period by a continental ice sheet, which blanketed its bed with a thick mantle of transported ground-up rock materials of many kinds in various degrees of firmness. The younger overlying deposit is a silty material, known as loess, which was deeply deposited over the glacial deposits and had a smooth, more or less level, plainlike surface.

The original smooth surface was destroyed by erosion, the destruction being most pronounced in the bluff zone and Missouri River Valley. The present loess material varies in thickness from a thin mantle on steeper slopes to a deposit more than 100 feet thick on the small upland. It is thickest on the flat areas where erosion has hardly started, and shrinks to a thin veneer on the bluff hills. The loess is composed largely of silt, with a very small admixture of very fine sand and clay. The color varies from gray to yellowish brown; the general effect is characteristically buff, owing to the presence of finely disseminated oxides of iron, but gray prevails where the oxide has been leached. Small quantities of calcium carbonate and iron oxide act as a cement, which, as revealed in bluffs and cuts, gives the loess a vertical structure and a massive appearance.

The loess, under a grass cover and the influence of normal soil-forming agencies already mentioned, produced a soil type having a characteristic dark-brown surface soil, and a light-brown to yellow slightly heavier subsoil, which has been called the Marshall silt loam.

Under a vegetation consisting of trees, there has been developed from the loess the light-colored, usually shallow surface soils and the yellowish-gray calcareous subsoil of the Knox series, represented in this area by the Knox silt loam.

Along the lower slopes of the bluff zone, and in the valley sides of many drainage ways, the loess cap has been removed and the glacial drift exposed. There is some slippage of loess and some surface wash from the higher capped areas, but, in general, the till deposited by the Kansan glacier has weathered into the types of the Carrington series, which have dark-brown surface soils over a yellow to light-brown subsoil.

The Dakota sandstone outcrops along some of the larger streams in the eastern part of the county and has weathered into small bodies of soil where the topography was not too unfavorable. As a rule there has been modification by higher lying loessial and drift materials, but the profile developed is that of the Lancaster series. The colors

are similar to those of the other upland series—dark-brown to brown surface soils with a light-brown to light grayish-brown subsoil.

The terraces or bench lands have been in place long enough to permit the development of a profile which in general characteristics is similar to that of the upland Marshall silt loam. The lime is leached from the surface layers, and the lower subsoil usually will not effervesce with acid. This constitutes the Waukesha series, which is characterized by dark-brown soils underlain by a light-brown to yellow subsoil, which is heavier in texture than the surface layers but not compact and impervious. The position is above the present limit of overflow, and the drainage is generally good.

The foot of the bluff zone, certain slopes along the larger drainage ways, and the floors in the upper courses of many small streams are composed of colluvial silt carried down from adjacent and near-by upland soils. This material has not developed a very definite profile. As a rule there is little change in color or texture between the surface layers and the lower horizons of the Judson silt loam, but the subsoil may be a lighter brown than the surface soil, owing to a slightly lower organic content. Except along the small drainage ways, the Judson silt loam is above overflow, and as a rule it is associated with the Knox and Marshall soils of the upland.

The flood plains have soils representing a wide range of soil-forming materials. Along the small streams the material is derived from local upland soils, and the profile is uniform in texture and color. The soils along Logan Creek and the Missouri River are more complex. The alluvium consists of successive layers and belts of sand, very fine sand, silt, and clay, ranging in color from gray to dark brown. The belts adjacent to the present channel have the coarser texture and a loose friable structure, whereas the deposits farther from the stream are made up of fine materials, compact to heavy in structure, and more or less firm and tenacious. The source of some of the material is the sediment washed from adjoining upland and slope-land soils, but the larger part is derived from upstream areas. In the normal process of assortment the soils of heavy texture have been deposited some distance from the main channel, from slowly moving waters.

The Wabash series includes soils of dark-brown color and high organic content, over a dark-drab to gray heavy subsoil. They consist of sediments washed from loessial and silty glacial soils of the region. Although these soils are subject to overflow, natural drainage is well established in some areas.

In the Lamoure series the surface soils are dark brown to black and the subsoil varies from yellowish brown to gray or dark drab and is usually much heavier in texture than the soil, but in places both may be of about the same texture. The materials are derived from the alluvium of streams that drain calcareous soils. They are only partially leached, and the lower subsoil effervesces when treated with acid. The types are moderately to poorly drained and are subject to flooding at varying intervals.

The lighter-colored, lighter-textured sediments lie near the Missouri River. The Laurel series includes soils that range in color from gray to yellowish brown. The subsoil usually differs little from the surface soils in texture to a depth of 3 feet, and though it

may be either lighter or heavier texturally, it does not pass into sand or gravel. The subsoil is usually calcareous. The soils occupy the first bottoms and are subject to overflow.

Adjacent to the Missouri River channel are narrow strips of alluvial soils which have weathered from relatively recent deposits of light-colored sediments over dark-colored older sediments. These soils have light yellowish-gray, friable surface soils and dark-gray, heavy subsoils, and have been correlated with the Ray series. The surface layer of the Ray soils shows a high lime reaction, but the lower layers contain little lime. These soils occupy first bottoms and are subject to overflow.

On the lowest part of the flood plain adjacent to the channel, sand bars and silty flats occur which have not been in place long enough to develop soil characteristics. These deposits are termed river-wash.

In subsequent pages of this report the soils of Burt County are described in detail and their relation to agriculture is discussed. The accompanying map shows their distribution in the area. The table below gives the name and the actual and relative extent of each soil type mapped:

Areas of different soils

Soil	Acres	Per cent	Soil	Acres	Per cent
Marshall silt loam.....	137,280	} 46.3	Riverwash.....	7,488	2.5
Flat phase.....	3,648		Knox silt loam.....	6,656	2.2
Wabash silt loam.....	33,984	11.2	Laurel silt loam.....	6,400	2.1
Lamoure silty clay loam.....	21,888	} 8.7	Laurel very fine sandy loam.....	4,224	1.4
Poorly drained phase.....	4,480		Laurel clay.....	2,368	.8
Waukesha silt loam.....	18,688	6.1	Ray silt loam.....	1,472	.5
Carrington silt loam.....	18,048	5.9	Lancaster loam.....	256	.1
Wabash clay.....	14,080	4.6			
Wabash silty clay loam.....	13,952	4.6			
Judson silt loam.....	9,088	3.0	Total.....	304,000	-----

MARSHALL SILT LOAM

The surface soil of the Marshall silt loam is a dark grayish-brown moderately heavy silt loam, 8 to 12 inches deep. The transition from soil to subsoil is gradual in a zone varying from 2 to 6 inches in thickness and consisting of a brown, slightly heavier silt loam which gradually becomes lighter in color. The subsoil is a yellowish-brown to brownish-yellow, rather compact, friable, heavy silt loam or silty clay loam. The upper part of the subsoil is granular; the lower part and the unweathered loess of the substratum have a columnar structure. Lime concretions are common and the subsoil is highly calcareous. In places on the more eroded slopes the surface soil has been almost entirely removed and the brown to yellowish-brown, heavy silt loam carrying lime concretions is exposed. In some areas iron stains and faint gray mottlings occur in the profile, but these are not typical, and in places they are entirely absent or are confined to the lower part of the 3-foot depth or below, where they may be abundant.

On many of the flatter divides and long slopes the soil is 15 or 20 inches deep, the thickness increasing toward the base of the hills, where the material is in part colluvial. Locally the dark-colored

horizon extends throughout the 3-foot section, but this condition is common only to the upper troughs of small intermittent drainage ways. The shoulders of many hills in the rougher upland sections of the county have suffered severe erosion, and patches of Knox silt loam occur which were too small to indicate on the soil map. There is a constantly shifting transition zone in these situations between the Knox and Marshall silt loams, as erosion tends to increase the extent of the former, whereas certain cropping methods check the progress. Small outcrops of glacial till are scattered throughout the type where the loess cap has been stripped. These bodies either occur on exposed ridges or occupy outlier positions and are included on the soil map with the Marshall silt loam.

The Marshall silt loam is the most extensive soil in Burt County, covering 45.2 per cent of the entire area. It occupies nearly all the upland west of the bluff zone. In general, the topography is undulating to rolling, becoming more irregular in the areas adjacent to the larger streams. The smoother developments parallel the watershed between Logan Creek and the Missouri River, but there is always enough relief to insure good drainage. Most of the drainage valleys are distinctly V-shaped, with smooth slopes and gentle to moderate gradients. The greatest relief in the type occurs in the northeastern part of the county and in the bluff zone, where the slopes may be precipitous and the divides narrow crests.

Drainage is good. In some places, if the soil is not handled carefully, there is a tendency toward erosion, which is a serious problem on a number of farms. The soil has a high water-holding capacity, which, combined with a high content of organic matter, a friable structure, and a favorable silty texture, prevents injury to crops in periods of prolonged drought where the crops are given proper attention.

The Marshall silt loam was originally covered with a luxuriant growth of prairie grasses common to the region. Along the drainage ways and in the bluff zone a tree growth had established itself within comparatively recent times. Much of the forest growth has been cut, but desirable stands still remain in narrow strips along the stream courses and the bluffs. The commoner trees include bur oak (scrub oak), red oak, linden, white elm, black walnut, and hackberry, with a more or less dense undergrowth of shrubs, largely sumac, dogwood, and hazel brush. Windbreaks of cottonwood, mulberry, box elder, and other trees have been planted around the farmhouses and orchards to give protection from the winter winds.

The major crop is corn, but oats and hay are also important. Corn is the money crop and receives the greatest attention, oats rank next to corn in acreage and in importance as a source of income, and hay occupies third position. The hay crop consists principally of alfalfa, clover, and wild hay with some timothy alone or mixed with clover. Timothy and clover mixed formerly occupied the larger acreage, but alfalfa is rapidly gaining favor and is now the most important hay crop. Considerable corn, oats, and hay is fed to the work stock, milk cows, beef cattle, and hogs that are kept on nearly every farm, but a large quantity of corn and oats is sold to the local elevators, and a little is ground for home use. Vegetables and potatoes are produced on nearly every farm; fruit trees, con-

sisting of apples, cherries, plums, and a few peaches, are common; and grapes are very plentiful. These crops are not produced on a commercial scale, but are used largely in the home or sold locally.

The main livestock industries are the raising of hogs, the raising and fattening of beef cattle, and dairying. Most farmers feed, on the average, one car of steers annually. Breeding herds are kept on a few farms, but as a rule the feeders are bought in Sioux City and Omaha. Dairying, although conducted only on a small scale, is carried on the year round, nearly every farm having a few milk cows and some farmers owning good dairy herds.

Corn yields 20 to 75 bushels per acre. The higher yields are obtained where crops have been carefully rotated and cared for and proper moisture and temperature conditions have prevailed. The average yield on good land is 50 bushels, but on land where fertility has not been maintained the yield may fall to 15 or 25 bushels. Oats produce 20 to 60 bushels per acre, the return varying with the soil, season, and cropping system. Alfalfa produces from three to four cuttings per season, with a total yield of three to four tons of hay per acre. The stand is maintained from five to seven years, occasionally longer, but where included in a rotation scheme the field is often plowed after three to five years. Red clover is the principal variety grown, but there is a considerable acreage of white and some yellow sweet clover. Clover yields less than alfalfa, about two tons per acre being the average; and when one crop is cut for seed, two to three bushels per acre are obtained. The production of white and yellow sweet clover is practically confined to the northeastern rough section and the bluff zone.

Fairly definite crop rotations are practiced, the most common rotation consisting of two years corn, third year small grain, followed by one or two years clover (or alfalfa). When clover is grown primarily for soil improvement it is usually seeded alone, but the prevailing practice is to seed with a nurse crop. If alfalfa is introduced into the rotation, it is allowed to remain for several years before the land is returned to corn.

Little barnyard manure is applied, and it is the opinion of the better farmers that proper rotation will better maintain fertility. Much manure is piled out of doors, where it is exposed to leaching; and many tenant farmers apply the manure only to those fields in the immediate vicinity of the barnyard.

As a whole, the Marshall silt loam is friable and silty and can be cultivated under a wide range of moisture conditions. If plowed when very wet it forms clods, but under proper methods of handling it works up into a mellow condition. Crop rotations including legumes should be used on every farm, as legumes add organic matter and nitrogen to the soil. Thorough preparation of the seed bed is necessary, and where the land is not subject to blowing or erosion, plowing in fall is an important initial step. The steeper slopes should be terraced to prevent erosion. Where gullies have formed proper dams should be constructed to impede the flow of water and collect its load of sediment, and such areas should be planted to permanent crops. The raising and feeding of purebred stock and the extension of both the dairy and poultry industries are important.

Marshall silt loam, flat phase.—The flat phase of the Marshall silt loam occurs on flat divides, principally on the crest of the watershed between the Missouri River and Logan Creek. In soil and subsoil texture, structure, color, and drainage it is practically identical with the typical Marshall silt loam, but it differs in the thickness of the surface soil. The dark grayish-brown surface soil extends on an average to greater depths than typical, as the topography has favored the accumulation of a deeply weathered surface zone. The phase is preferred to the typical Marshall silt loam on account of its flat topography and slightly higher productiveness. It also has a somewhat higher market value.

KNOX SILT LOAM

The surface soil of the Knox silt loam is a light-brown or grayish-brown, loose, friable silt loam, 6 to 12 inches deep, grading into a yellowish-brown to yellow or buff-colored heavy silt loam subsoil. There is no distinct line of demarcation between soil and subsoil, the brown color of the soil grading into the yellowish color of the subsoil. Where the organic matter has been allowed to accumulate the surface soil resembles the darker Marshall soil, but the pale-yellow color is characteristic and is especially noticeable where erosion has been active. The substratum is a light-gray loose silt loam, which becomes lighter colored or more yellowish with depth, is faintly mottled in places with gray, has reddish-yellow iron stains, and local concentrations of lime in the form of concretions. The concretions are frequently encountered in the surface soil in areas of harsh relief or where severe washing of the surface material has occurred. The soil and subsoil have the smooth, floury feel characteristic of the loess, and the subsoil has a pronounced columnar structure.

The soil is coarser than typical in the bluff zone where the texture has been modified by sand blown from the Missouri River channel. The color in this zone, where the native forest cover still prevails, is also darker than typical because the tree growth serves to check washing. A similar condition exists on the virgin grasslands and on some of the lower slopes of the hills. The typical Knox soil consists of a weathered loess from which organic matter has been removed almost as rapidly as it was formed.

The type occurs only in the dissected parts of the county, and most of it occupies the scoured hill crests. The most extensive and numerous areas are in the bluff zone bordering the lowlands of the Missouri River and in the northeastern hilly section of the county. The relief is characterized by steep bluffs, and many of the hill crests rise over a hundred feet above the valley floor, giving the type the highest positions in the uplands.

Areas of the Knox silt loam are irregular in outline and generally occupy hilltops, steep slopes, and winding ridges, the majority being surrounded by areas of the Marshall silt loam, which occupy the lower situations.

The topography is rolling to broken, with angular divides and crested watersheds. The bluffs in many places present a terraced steplike appearance due to the faulting or slippage of the columnar-structured silt.

The drainage is everywhere good, and on the steep, unprotected slopes it is excessive, but the soil is very retentive of moisture. Numerous drainage ways of steep gradient have cut the bluff section, and many slopes are so steep that they interfere seriously with cultivation or prevent it entirely. The tops of the bluffs are mostly barren of vegetation, but the lower slopes support grasses, shrubs, and trees and are cultivable. Where there is serious washing the land should not be farmed. Under careful management the Knox silt loam can be largely protected from erosion, and the injured areas in many places can be reclaimed by proper aeration of the subsoil and the incorporation of organic matter.

About 60 per cent of the type is in cultivation, and the rest is used for forestry and pasture. The tree growth is similar to that on the Marshall silt loam, and the pastures have dense growths of native grasses.

The important crops are corn, oats, and hay. Corn is the principal crop and occupies the largest acreage. Clover and alfalfa are the chief hay crops; the latter in recent years has rapidly grown in favor, as the thorough drainage and high lime content of this type have favored its production. In years of sufficient rainfall, and especially on land whose fertility is maintained by manure, the yields are similar to those of the contiguous Marshall soils.

The principal livestock industries are hog raising and cattle feeding. A few sheep are pastured by some farmers, and dairying is an important minor source of income. Large areas, especially in the rougher sections of the county, constitute much of the natural grazing land.

Corn yields 25 to 30 bushels per acre under favorable conditions. Higher yields are obtained on some farms, but on the eroded hill crests the yields are poor. Oats yield 20 to 30 bushels per acre. Alfalfa yields 3 to 4 tons from three cuttings. The soil is also well adapted to potatoes.

The Knox silt loam holds high rank among the fruit soils. It is well adapted to grapes and apples, and cherries do especially well. The topographic position is an advantage in promoting the necessary air drainage. The orchards at present are small and the products are used in the home or sold on the local market.

The same general farming practices prevail as on the Marshall silt loam. Owing to the rougher topography, cultivation is more difficult. Because of the low content of organic matter the soil is sticky in wet weather, so that it can not be worked under as wide a range of moisture conditions as the Marshall soils. The farmhouses on this type are usually smaller, and as a whole the farms are less improved than those on the Marshall silt loam.

The Knox silt loam ranges in value from \$50 to \$75 an acre, depending on topography, location, improvements, and the condition of the land. It is usually sold in connection with the adjoining Marshall silt loam.

The Knox silt loam should be handled with care to prevent erosion and gulying. Where topography is especially unfavorable, the fields should be kept in pasture and hay crops. In cultivated areas special attention should be given to building up and maintaining productiveness by the addition of barnyard manure and green-manuring

crops to increase the content of organic matter. In the forested areas, where overgrazing has not injured the tree growth, the production of fence posts is profitable. Pasture crops not only do well but prevent the soil from washing, so that dairying and stock raising should prove beneficial. The production of certain orchard fruits can be extended where transportation and market conditions are favorable.

CARRINGTON SILT LOAM

The surface soil of the Carrington silt loam consists of 8 to 12 inches of dark-brown to dark grayish-brown silt loam, which is generally mellow and friable, and high in organic matter. The upper part of the subsoil is a dark-brown heavy silt loam, grading quickly into a slightly compact silty clay loam of yellowish-brown or gray color. Below 30 inches the lower subsoil becomes more friable and approaches in its characteristics the parent material. Boulders may occur throughout the soil profile but are usually more abundant in the subsoil and rare in the surface soil.

As mapped in Burt County, the Carrington silt loam represents a rather wide range in structure and soil profile and also includes small areas of Carrington loam and Shelby silt loam which can not be satisfactorily separated on a map of small scale. One variation consists of an extension of the dark-brown upper subsoil to an average depth of 20 inches before it grades into the yellowish-brown lower horizon. The subsoil may also be mottled with gray and brown oxide of iron concretions. Where the drift materials are less thoroughly weathered, the surface is in places light textured, approaching the loam.

The areas showing the Shelby silt loam characteristics have a yellowish-brown to gray silty clay loam or clay loam subsoil, which is commonly plastic in thin horizons but is generally modified by masses of sand and lime concretions. Boulders on the exposed shoulders and hillsides subject to heavy washing, and pebbles of sandstone, limestone, and quartz, and rocks varying from the dark-colored basics to the light-colored granitics, are common. These fragments may cover only the surface or may occur in both soil and subsoil.

There are also included with this type small areas of a soil which was mapped as Thurston loam in Thurston County to the north, but these are not of sufficient size to show on the soil map of this county. This soil has a uniform surface layer of brown to grayish-brown friable silt loam, which in places contains many pebbles and boulders, so that it is too stony to cultivate. The subsoil, however, is highly variable within very short distances, ranging from a brown, coarse, calcareous, gritty sand to a light-gray silty clay containing many large concretions of calcium carbonate. The sandy subsoil in places is a very fine sand, iron stained, and calcareous or neutral. This range in variation may occur on the same hill where the drift is exposed. Although the derivation of this soil material is assigned to the Aftonian sand sheet, it appears to be related to the Kansan drift, as are the Carrington and Shelby soils.

The Carrington silt loam has been developed over the Kansan drift, which is exposed on the eroded slopes of the bluff zone and along the larger tributaries leading into the Missouri River bottoms, and in a few places in the central part of the county. As a general rule the higher-lying loessial soils have contributed varying amounts of silt to the surface soil by wash and colluvial action, but the low points between drainage ways are commonly scoured off and unmixed with loessial silt.

The type is well drained and is generally cut by a large number of draws. Owing to the topography the drainage is frequently thorough to excessive, and erosion may become harmful. Internal drainage is rapid in the areas of coarser-textured subsoil, but where the subsoil is heavier the type usually maintains a good supply of moisture.

The Carrington silt loam was originally covered with prairie grasses, except that the lower slopes along the bluff zone and large streams had a shrub or forest cover, which still remains in places where the land is not in cultivation and overgrazing has not reduced the trees to scrubs. Corn, oats, alfalfa, and clover constitute the important crops. Corn does fairly well and yields from 35 to 40 bushels per acre; oats yield 20 to 45 bushels; and alfalfa 3 tons. Alfalfa is especially well suited to this soil, as it prevents erosion after a stand is secured, and consequently is favored by the owners of land subject to washing.

The Carrington silt loam is handled in practically the same way as the loessial soils with which it is associated, and it can be worked under a wide range of moisture conditions. No commercial fertilizers are used, but applications of manure might be profitable.

The price of land varies from \$50 to \$75 an acre, depending on the location and the character of the improvements.

LANCASTER LOAM

The surface soil of the Lancaster loam is a brown to dark-brown friable loam 12 to 15 inches deep. The subsoil is a light-brown to grayish-brown sticky loam, passing at an average depth of 24 or 30 inches into brown sand consisting of slightly weathered material of the Dakota sandstone. When thoroughly dry this sand is loose and incoherent but when moist it is peculiarly sticky. The soil is low to deficient in organic matter.

There is some variation from the typical. Owing to the topographic position of many areas, considerable colluvial material has been brought from higher-lying soils and mantle rocks, consisting of glacial boulders, debris, weathered material, or loessial silt scattered over the surface. This material may or may not affect the texture and profile of the soil, but where its influence is manifest the texture is commonly lighter, except where the silt predominates. The Dakota sandstone itself in places does not break down into loam, in which case the soil may vary from a sandy loam to a very fine sandy loam. In other places the weathered soil products are shallow, only a few inches of soil may cover the bedrock, and fragments of Dakota sandstone are commonly strewn over the surface. Owing to the small total area of this bedrock

exposed in the county, these variations are not separated but are mapped with the Lancaster loam.

The Lancaster loam occurs chiefly in the bluff zone and rough hill section of the county where dissection is so deep that the overlying mantles of drift and loess have been carried away and the Dakota sandstone outcrops. The topography is steeply sloping, the exposures occurring only on hillsides or the lower parts of hill brows. Drainage is thorough, the open, porous bedrock, which is always near the surface, rapidly removing all surplus water.

Owing to its topography and low moisture content, very little of this soil is cropped. A few areas are planted where they intercept fields of other upland soils, but the yields are low and most of the type is devoted to grazing. Some areas are in forest, principally scrub oak. This land is used to some extent for orchard fruits, and such utilization seems to be profitable. The land also has value in the production of early vegetables and such crops as melons, which do best on light-textured or sandy soils.

The following table shows the results of mechanical analyses of samples of the soil and subsoil of the Lancaster loam:

Mechanical analyses of Lancaster loam

Number	Description	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
		<i>Per cent</i>						
374921	Soil, 0 to 15 inches.....	0.4	0.6	0.4	17.9	23.4	44.8	12.8
374922	Subsoil, 15 to 36 inches.....	.2	.6	.7	35.3	19.2	31.3	12.8

WAUKESHA SILT LOAM

The surface soil of the Waukesha silt loam is a brown to dark-brown, mellow, uniform silt loam 15 to 18 inches deep. The subsoil is a heavy yellowish-brown silt loam which typically extends to a depth of more than 36 inches. In places a few iron stains or faint gray mottlings occur below 30 inches, but they are not characteristic of this type. The change from soil to subsoil is through a transition zone consisting of compact brown silt loam which gradually becomes light in color with increasing depth. There is little change in the subsoil after the typical yellowish-brown color is reached, except for the presence of a few lime concretions, which as a rule do not occur in the 3-foot profile in sufficient quantity to show effervescence with acid. When thoroughly wet the surface soil is dark brown to nearly black. It is leached of the greater part of its lime.

In the flatter areas the intermediate brown layer is lacking in places, the surface soil passing directly into the yellowish-brown silt loam subsoil. On the crests of small hills the surface soil is usually lighter in color than typical, as the organic content is lower and the soil more shallow. The soil profile in general is similar to that of the Marshall soils, but as a rule the yellowish-brown subsoil of the Waukesha is more compacted and slightly heavier in texture. Included with the Waukesha silt loam, especially in Logan Valley, are small areas of dark-colored, poorly drained silt loams occurring

in sink-like depressions. One of these has a whitish-gray upper subsoil underlain by a dark-colored, heavy compact lower subsoil. These areas were too small to indicate on the soil map.

The Waukesha silt loam occupies the benches of terraces in the valleys of Logan Creek and the Missouri River south of Tekamah. The alluvial terraces lie at several levels representing a series of valley fillings and entrenchments, and all are above overflow. The greater number and most extensive developments occur in the valley of Logan Creek. These terraces resemble the upland Marshall silt loam, into which they merge, in some places so gradually that it is difficult to distinguish the line between upland and terrace. The boundary between flood plain and terrace, however, is clear-cut. As a whole the areas are continuous, with only narrow breaks where the most recent intrenchment has cut to the scarp.

The topography is flat to gently rolling. There is slight dissection where streams from the upland cross the valley floor. Drainage is generally good, there being a slight slope downstream and toward the main axis of the stream channel. Some of the surface waters are temporarily collected in the small included basins.

The Waukesha silt loam is one of the best agricultural soils in the county. It occupies a moderately large acreage and the greater part is in cultivation.

All the general farm crops are grown. The strips lying along the creeks are used for pasture and support good growths of the native grasses. Corn occupies the largest acreage and is the leading cash crop. Oats, alfalfa, clover, and timothy are extensively grown and have the same relative importance as on the Marshall silt loam, but probably a little larger proportion of this type is devoted to corn. The corn, oats, and hay crops are used on the farms to feed the work stock, dairy cows, beef cattle, and hogs, the surplus being sold on the local markets. An average of a carload of cattle is fed each year on nearly every farm and many hogs are raised and shipped. Gardens and small orchards are maintained on nearly every farm, and dairying and poultry raising are engaged in on a small scale.

Corn yields an average of 50 bushels per acre where proper rotation methods are practiced, with occasional high yields of 70 to 75 bushels, but on old ground not well farmed the production drops to 15 to 35 bushels. Oats yield from 35 to 60 bushels per acre, with an average of 35 bushels. Winter wheat yields from 15 to 20 bushels per acre. Alfalfa yields 3 to 3½ tons per acre, and clover 2 to 2½ tons of hay from two cuttings.

This soil is valued highly and as a rule is well farmed, the most modern methods being used. The most common crop rotation consists of clover (or alfalfa) two years, corn two years, small grain. The clover is usually sown with a nurse crop early in the spring, cut for hay about June 15 and August 31, and then used for fall pasture. When used only for pasture 1 acre will support one cow or steer. Land for oats is disked in the spring and the grain drilled in. Manure was formerly applied, but the best farmers report that this practice yielded much straw and little grain and that fertility is best maintained by rotation. It is probably best to use the manure for the improvement of pasture and hay lands.

As a whole, early planting is preferred to late planting, and early fall plowing is advocated so that the soil may settle properly and not blow.

The average-sized farm includes about 200 acres. Unimproved land is valued at \$150 to \$175 an acre, and improved land sells for \$200 to \$300, depending upon its location.

For the improvement of this soil the content of organic matter should be maintained. It is naturally a productive soil, but care should be exercised to keep it in good condition by systematic crop rotations. In areas subject to erosion, as near drainage ways and along the terrace fronts, care should be taken to prevent washing, and such areas are probably best kept in cover crops.

JUDSON SILT LOAM

The Judson silt loam, where typically matured, consists of dark-brown to nearly black, loose, friable silt loam, 15 inches deep, underlain by a friable material of about the same texture, ordinarily light brown in color but very commonly variable. The color of the subsoil is usually lighter than that of the surface soil, probably owing to a lower content of organic matter. In general there is little change in structure or texture throughout the 3-foot section, though there is an occasional development of compaction or a thin heavier layer. Both soil and subsoil are devoid of grit or coarse particles.

The Judson silt loam is largely the result of colluvial action or the downward movement of silt from the silt-textured upland soils. The type occupies the foot of the slopes between the upland and terraces and between the uplands and first bottoms, and constitutes the floor of the upper course of many small drainage ways. It is moderately extensive in the area. Although not generally subject to overflow, it has been modified by alluvial deposits, especially where it occurs at the point of emergence of small tributaries carrying heavy sediment. The Judson silt loam also occupies small terrace positions in the Logan Creek and Missouri River Valleys.

The topography is almost flat, with a slight slope in the direction of the streams. Drainage is good. Ordinarily the open structured though not porous subsoil permits the holding of soil moisture, and the location of many areas of this soil near the mouths of minor drainage ways, which discharge upon its surface, is favorable in seasons of prolonged drought.

Owing to its high organic-matter content, favorable structure, texture, and moisture conditions, the soil is agriculturally important and with good farming methods is easily kept in a productive state. A large part is under cultivation, the principal crops being corn, oats, alfalfa, and red clover. The native vegetation consists of a dense growth of grasses. Corn, which occupies the largest acreage, yields from 30 to 60 bushels per acre, oats 30 to 45 bushels, and alfalfa 3 or 4 tons of hay. The yields on this type are up to the average of the county. The livestock industry includes the feeding of beef cattle, dairy cows, work stock, hogs, and a few sheep. The surplus corn and oats are sold. Cultivation methods are similar to those on the Marshall and Waukesha silt loams. The soil is easier to handle than the upland soils and is relatively free from erosion. No commercial fertilizer is applied.

Although the areas in which this soil is developed are small and do not include entire farms, the Judson silt loam raises the value of farms with which it is included.

WABASH SILT LOAM

The surface soil of the Wabash silt loam to a depth of 12 to 15 inches is a dark-brown to almost black, heavy, smooth silt loam, high in organic matter. The subsoil is a dark-drab or dark-gray to dark-brown, waxy silty clay loam to silty clay. The change in color and texture between the surface soil and subsoil is gradual, the clay content increasing with depth. The surface soil contains a relatively large quantity of organic matter, but its depth varies, depending upon the frequency of overflow and the amount of deposition during flood periods. Pockets of sand occur in both soil and subsoil. Although the lower subsoil is compact, a granular structure characterizes the entire soil profile. Iron concretions and iron stains are common in the lower part of the soil section, although not characteristic of the Wabash soils in general.

There is some variation from the typical. Small areas of silty clay loam are included with the type as mapped. In places the lower subsoil is gray or light gray in color but shows no effervescence with acid, as might be expected, while gray and other mottlings are common elsewhere without giving a lime reaction. In other places small lime nodules are scattered through the subsoil, but these do not make it sufficiently calcareous to recognize the type as Lamoure silt loam. Lime concretions are locally abundant below 3 feet, especially in the Missouri River bottoms. Typically the subsoil is heavier, tougher, and more refractory than the surface soil, but in local areas, most commonly along the smaller streams, there is little change between soil and subsoil except a greater degree of compaction in the latter.

Small areas of a soil having a calcareous subsoil have been included with this type on the soil map. If these areas had been of sufficient size they would have been mapped as Lamoure silt loam. The largest of these areas lie just south of Tekamah. One occurs 4 miles south of the town and one on the northeast edge. Small patches also occur in Logan Creek Valley. The profile in color and texture does not differ essentially from that of the typical Wabash silt loam, and the principal difference is the high lime content beginning at depths ranging from 20 to 30 inches.

The Wabash silt loam is extensively developed throughout the county along every drainage way having a flood plain. It occurs in strips ranging in width from a few hundred feet to one-half mile. In the smaller valleys the bands are continuous below the Judson silt loam areas to the mouth of the channel, but in the larger valleys the areas are detached. The soil is derived from reworked silt and clay sediments deposited on the flood plains.

The topography is almost level, occasionally dissected by old stream channels and sloughs, which constitute the only surface relief. Where the type has not been cleared there is still a sparse forest growth along the stream channel. Originally much of the drainage was poor, particularly in the Missouri River bottoms, but by straightening the channels of the streams, digging drainage

ditches, and installing tile these conditions have been much improved. There is a slight slope toward the stream, and all the type is subject to overflow except local areas in the larger bottoms which are high lying and have better drainage. Along the smaller streams water may stand on the soil after each inundation or heavy rain.

About 60 per cent of the type is devoted to the production of the staple crops, and the acreage in cultivation is being extended. The balance is in forest or pasture land, the wetter areas supporting luxuriant growths of slough and marsh grasses. Corn is the principal crop on the higher lying and better drained areas and has been grown on the same land for years without showing a marked decrease in yield. The yields are high except on those areas where drainage is poor and the water table lies too near the surface. The small grains are grown less extensively owing to their tendency to grow too rank and lodge in wet years. Alfalfa is grown only where the soil is well drained, but the wild grasses and clover and timothy mixed do well. Corn yields 35 to 60 bushels per acre, oats 35 to 50 bushels, wheat 15 to 25 bushels, and hay 1 to 3 tons, alfalfa producing 3 to 5 tons per season.

This type is well adapted to livestock raising, as both wild and tame grasses grow rank and furnish excellent pasturage for cattle and hogs, and water supplies are convenient. The livestock industry consists of winter fattening of beef cattle, hog raising, and sheep feeding. Part of the corn and oat crops is used to feed the dairy cows and work stock, but the bulk is used in fattening hogs and beef cattle. Wheat is a cash crop. Good yields are obtained in favorable years, but on low, poorly drained ground, wheat is subject to injury by flooding or surplus moisture in the soil.

There is no common crop rotation practice. Corn commonly succeeds itself but is occasionally alternated with oats or wheat. Care must be exercised in plowing this land, as the soil when too wet or too dry turns up in large clods which are hard to reduce and make cultivation difficult, but the type can be handled under a much wider range of moisture conditions than the silty clay loam or clay. The soil is rich in organic matter, and productiveness is maintained by wash from upland soils. The flat topography, silty texture, and friable structure when in proper moisture condition make this a desirable soil.

The selling value of land of this type ranges from \$100 to \$300 an acre, depending upon its improvement, drainage, and location with respect to towns. Many tracts are included in the sale of other soil types.

Drainage improvement is the outstanding need on this soil. Where the cost is justified, main stream channels should be straightened and diked and open ditches and tile drains should be employed to remove the surplus water.

WABASH SILTY CLAY LOAM

The surface soil of the Wabash silty clay loam is a very dark grayish-brown to nearly black heavy silty clay loam, rich in organic matter, 12 to 15 inches deep. It is sticky and plastic when wet but becomes compact and hard upon drying. The subsoil is a dark-drab to dark-gray, heavy, tenacious, plastic silty clay that becomes slightly

lighter colored and more plastic at greater depths. The structure is close and impervious. Iron stains are common but not necessarily present, and lime concretions occur in the lower subsoil. In the typical soil section the tough subsoil continues throughout the 3-foot depth, but in some places it passes into or through brownish sandy layers, rarely more than 2 to 6 inches in thickness. Where the heavy material continues throughout the section the color may change to a mottled gray or drab.

The degree and color of the mottlings vary widely. Iron concretions, brown iron strains, and undecayed organic matter occur in both soil and subsoil. In some small areas the soil contains sand, and layers and pockets of sand are present in the 3-foot section. When wet the surface soil appears black in color and is so sticky and slippery that travel is difficult. Both soil and subsoil have a granular structure when dry, and fields have a finely checkered, crumbly appearance, as the soil tends to bake and crack. The type as mapped includes small areas of Wabash silt loam and Wabash clay, as the textures grade into each other.

The Wabash silty clay loam occurs as first bottoms along the Missouri River, Logan Creek, and Bell Creek, the most extensive areas being developed along the Missouri River. The bodies are disconnected and occupy the zone below the Wabash silt loam, which generally foots the bluff.

The surface is level to gently sloping, the gradient being so slight that natural drainage is inadequate except in dry years. Extensive open ditching and some tile drainage have been installed in the Missouri River Valley areas, in Logan Creek Valley, and to a small extent in Bell Creek Valley.

The type was originally forested along some of the streams. About 40 per cent is now under cultivation, the remainder being used for wild hay, consisting of water-loving grasses.

Corn, wheat, and hay are the principal crops. In favorable years excellent yields of corn are obtained, and the crop is grown on the same land year after year with little decrease in yields. Wheat and oats tend to grow rank and lodge. Alfalfa, which constitutes a part of the hay crop, is grown on the better-drained land. Prairie grasses occupy a large acreage. The average yield of corn is about 50 bushels; wheat, 10 to 25 bushels; oats, 30 to 40 bushels; alfalfa, 3 to 5 tons; and native grasses, 1 to 2 tons of hay per acre. The wild hay is coarser than that produced on better-drained land in the county, especially when the rainfall is above normal. The livestock industry includes the feeding of beef and dairy cattle, hogs, and work animals.

Owing to its poor drainage and heavy texture the Wabash silty clay loam is much harder to handle than the Wabash silt loam. The soil puddles if plowed when wet, but under favorable moisture conditions it granulates and makes a good seed bed. Drainage by open ditches and tiling, as in the case of the Wabash silt loam, is the imperative need in the utilization of this soil.

This type is valued at \$75 to \$175 an acre, depending mainly upon drainage conditions and to some extent upon improvements and location.

WABASH CLAY

The surface soil of the Wabash clay is a dark-brown to dark-drab or almost black, heavy, plastic clay having an average depth of 10 to 12 inches. This is underlain by a heavy, stiff, plastic, and waxy clay, bluish gray or drab to gray in color. The surface soil when wet is very slippery, but on drying it cracks into irregular blocks, forming numerous crevices, and in cultivated fields, when thoroughly dried, it has a "buckshot" appearance, as it breaks readily into small granules. In places the subsoil is mottled, especially in the lower part, chiefly with rusty brown, accompanied locally by ochreous yellow. As a rule the soil section is not calcareous, though lime nodules and certain cretaceous or tertiary shells are occasionally encountered. The low lime content distinguishes the type from the Lamoure clay.

As a whole the soil is very uniform, but there is some local variation. The dark color of the surface soil in places continues throughout the 3-foot section, but elsewhere the lower part may change into a gray, plastic, calcareous clay. Local pockets and seams of sandy materials occur, but these affect the structure and imperviousness of the soil very little. Both soil and subsoil are high in organic matter, as the color indicates. Small bodies of Wabash silty clay loam are included with the Wabash clay as mapped.

The Wabash clay is confined to the flood plains of the Missouri River Valley. It occupies the level or depressed areas in the large bottoms, lying somewhat back from the main stream channel, and was deposited in very quiet backwaters.

The type is not naturally well drained. A large part is ditched and some is tiled, as the surface slope is not sufficient to remove the surplus water, and internal drainage is also deficient. The soil is not subject to overflow by the Missouri River, but where thorough artificial drainage is not developed the land is in a marshy condition after heavy rains.

Owing to its heavy texture and poor natural drainage this soil does not rank high agriculturally. About 60 per cent is in cultivation, and the balance is used for hay and pasture for cattle, hogs, and horses. Corn and wheat are the principal crops. The hay consists of native grasses and alfalfa. The yields depend upon local drainage conditions and the seasonal rainfall. Where drainage is provided or in dry seasons corn yields from 40 to 50 bushels per acre, wheat 20 to 25 bushels, oats 30 to 50 bushels, and wild hay 1 to 2 tons. Alfalfa yields from 3 to 4 tons per acre per season.

Although the Wabash clay is very rich in plant food, its usefulness is limited by its drainage conditions. Crops rarely suffer from lack of moisture, but as a rule do not do well in wet years. As the small grains tend to grow rank, short-strawed varieties are usually grown. In favorable seasons alfalfa may supply four cuttings. On farms including poorly drained areas, which support dense growths of blue grass and slough grasses, stock feeding is an important industry, the better drained land producing the necessary field crops while the hay and pasturage is furnished by the meadow land.

The type is very difficult to handle in cultivation, as it is tough and intractable, and if plowed when too wet or too dry, it forms large clods which are difficult to reduce. When broken at the optimum moisture content it breaks up into a fine pulverulent seed bed. In dry seasons the soil may crack and injure the roots of plants. Little or no crop rotation is practiced, grain being grown year after year with little decrease in yield. Tractors or heavy draft animals are needed to break and cultivate this soil.

The Wabash clay ranges in value from \$75 to \$200 an acre, depending upon location and the drainage and other improvements.

LAMOURE SILTY CLAY LOAM

The surface soil of the Lamoure silty clay loam consists of a dark grayish-brown heavy silt loam of tough and refractory structure. Where the soil is thoroughly weathered and dried it is often streaked with light gray. The surface soil grades into a dark-gray or grayish-brown, intractable, extremely compact and impervious clay subsoil which varies in thickness from 10 to 20 inches. The soil and subsoil as a rule do not contain any coarse material and both have a smooth, velvety feel when dry and pulverulent. The lower subsoil consists of a heavy, tough, silty clay or clay loam, gray to light gray in color. Both subsoil horizons are very hard when dry, but plastic when wet. The soil and upper subsoil are low in lime, which has been leached to the lower subsoil and deeper horizons; this high lime content is the basis of distinction between the Wabash and Lamoure soils.

The subsoil in places is very dark in color and has its lime content mainly in the form of concretions. Locally it contains mottlings of rusty brown and yellowish brown. Streaks and seams of sandy material occur, but these do not affect the water-holding capacity of the soil.

The Lamoure silty clay loam is confined largely to the flood plains of the Missouri River, where its chief development is in irregular shaped bodies, some of which include several square miles of land. It also occupies several smaller areas along Logan Creek. The type has a flat topography with only slight elevations and depressions. It is closely associated with the Wabash clay, but has poorer surface drainage and subdrainage, so that oxidation of the organic matter is retarded. The impervious nature of the subsoil, combined with its depressed situation, makes this soil one of the most poorly drained in the county, and open ditches and tile have been installed in places to improve the water movement. Both soil and subsoil are retentive of moisture and maintain a good supply when drained. Small alkali spots occur in some depressions.

The soil is practically treeless, except for the planted groves and isolated trees along the drainage ditches, but supports a luxuriant growth of native grasses. It is not an important agricultural soil, owing to its poor drainage, and only about 30 per cent of it is in cultivation. Corn is the chief crop. Wheat, oats, and alfalfa occupy minor acreages. Under favorable conditions corn produces 30 to 50 bushels per acre, though higher yields are obtained. Wheat is the cash crop and produces 15 to 25 bushels, and oats yield 30 to 40 bushels per acre. The small grains tend to grow rank and lodge in

wet seasons where artificial drainage is not provided. Alfalfa yields 3 to 4 tons of hay per acre in favorable seasons, and native grasses yield 1 to 2 tons.

When in the proper moisture condition this soil is easy to cultivate and has a "buckshot" appearance, but if cultivated when wet it puddles and becomes compacted, and when dry it has a tendency to crack and form fissures of considerable depth and width. Rotation is not practiced, as the soil is high in fertility and yields do not materially decrease under continued cropping. Heavy horses or tractors are necessary to work this soil properly. The prime need of this type is the installation of drainage. The poor drainage sometimes delays seeding, and plant growth and maturity may be slower than on the better drained soils; development in these cases may be hastened by the application of potash and phosphate fertilizers.

The value of the Lamoure silty clay loam ranges from \$75 to \$200 an acre, depending upon local drainage conditions, improvements, distance to markets, and shipping facilities.

Lamoure silty clay loam, poorly drained phase.—The surface soil of the Lamoure silty clay loam, poorly drained phase, consists of a dark-brown to grayish-brown heavy silty clay loam 8 to 12 inches deep, which is sticky and plastic when wet and becomes compact and hard upon drying. This is underlain by gray to yellowish-gray silt loam or silty clay loam, the change from soil to upper subsoil being abrupt. The surface soil contains no lime, but the upper subsoil shows pronounced effervescence, being high in calcium carbonate. The lower subsoil is a dark-gray to dark-drab heavy silty clay to clay, which is similar in characteristics to the lower subsoil of the Wabash clay and is not highly calcareous. The transition from upper subsoil to lower subsoil is gradual through a zone varying from 2 to 8 inches in thickness, which changes in color downward and loses its lime content. The surface soil is high in organic matter. The soil profile is characterized by the light-colored, calcareous intermediate subsoil layer. There is little variation except in the thickness of the several layers and in the texture of the surface soil, which in places approaches a silt loam.

The phase does not have a large total area. It occupies several fairly large areas on the first bottoms of the Missouri River Valley, in association with the Wabash and other Lamoure soils. Its topography in general is flat, with minor local depressions. The natural drainage is poor, as the slope is not sufficient to insure adequate runoff and the heavy subsoil retards the internal movement of water. Drainage canals supply some relief.

This phase has an agricultural value about equal to the heavy Wabash and Lamoure soils, and the methods of cultivation, crops planted, and yields are similar. As with those heavy-textured soils, it has limited working conditions and requires extensive artificial drainage to maintain production. A small part is in native grasses and yields good hay.

LAUREL VERY FINE SANDY LOAM

The surface soil of the Laurel very fine sandy loam is a gray to light-gray, friable, mealy, very fine sandy loam, averaging 10 to 15

inches deep. The subsoil resembles the soil very much in color and texture, though as a rule it is more open in structure and a trifle coarser in texture, and the proportion of sand increases slightly with depth. Both soil and subsoil are calcareous, the latter effervescing freely with acid. The entire soil section is deficient in organic matter, the surface soil having a slightly higher content. The type as mapped includes small areas of Laurel loam.

Southeast of Arizona are small bodies of Laurel loamy fine sand, which on account of their small total area are not separated on the soil map. The surface soil of these areas is a gray to light-gray loamy fine sand, which is loose and friable in structure and 12 to 18 inches deep. This rests upon a subsoil of almost identical character except that the color is lighter because of a lower organic content. Owing to the open porous nature of the material the lime is leached from the soil and almost entirely from the subsoil. These areas occupy a series of well-drained low ridges. Corn is the main crop with small acreages of alfalfa and other field and truck crops.

The topography of the Laurel very fine sandy loam is level to slightly undulating, the occasional sand ridges making the surface irregular. The type occupies the first bottoms of the Missouri River Valley, usually lying close to the channel. It is generally not subject to overflow and its open structure insures good subsurface drainage.

Although the type is not extensive, it has high agricultural value, especially in seasons of abnormal rainfall, because of its excellent drainage. It is largely under cultivation and is farmed in conjunction with the surrounding heavier-textured soils. The crops are those common to the county, but the average yields are lower than on the Laurel silt loam. Corn, the most important crop, produces 25 to 60 bushels per acre. Wheat and oats are grown to a small extent. Potatoes, melons, and other truck crops do well. Alfalfa gives good yields and is adapted to this soil.

The soil is handled in the same manner as the adjoining types, but it can be worked under a very wide range of moisture conditions, as there is no tendency to clod. It is slightly subject to wind erosion, but the maintenance of a rough surface and a good content of organic matter largely overcomes this difficulty.

The type sells for \$150 to \$250 an acre, depending upon its location with respect to markets, condition, and improvements.

LAUREL SILT LOAM

The surface soil of the Laurel silt loam varies in depth from 12 to 15 inches and consists of a gray or grayish-brown friable silt loam which is darker colored when wet. The subsoil consists of a gray to light-gray, mealy, but compact silt loam to very light silty clay loam, which is slightly darker in the upper part but pales rapidly with depth. Both soil and subsoil are calcareous, but the former only slightly calcareous. The organic content of soil and subsoil is low.

The surface texture varies from a loam to a light-textured silty clay but the silt loam is predominant. The type as mapped also includes small patches of very fine sandy loam. Strata and pockets of sand are common throughout the soil in these areas, but they are not characteristic of the type. As far as could be determined,

the Laurel silt loam is not underlain by the sand or gravel substratum which characterizes the Sarpy series. In places, especially in the vicinity of Lake Quinnebaugh, the subsoil consists of layers of heavy mottled clay loam, which is only slightly calcareous, alternating with layers of very fine sand mottled with iron rust.

The Laurel silt loam occurs as first bottoms along the Missouri River. It is rarely subject to overflow. The topography is flat and is relieved only by old slough channels, minor depressions, and elevations, the latter giving the surface a slightly hummocky appearance. The soil is retentive of moisture, and the porous subsoil provides adequate internal drainage.

The type is not extensive in this area, but is important locally on account of its good drainage and consequent high agricultural value. It is naturally productive, and its porous nature makes it easier to handle than the heavy, poorly drained Wabash and Lamoure types, the first-bottom soils of largest acreage. The soil is friable, loose, easily plowed and kept in good condition, and is well adapted to all the general farm crops. Corn is the chief crop, with yields ranging from 35 to 75 bushels per acre; under good farm practice and proper rotation average yields of 50 to 60 bushels are realized. Potatoes yield from 75 to 150 bushels, with an average of 100 bushels per acre. They are raised largely for home use, but some farmers produce seed potatoes for sale locally. The farm practices are those common in the Missouri River Valley.

The land ranks with the more valuable first-bottom lands in the valley where it is not subject to river cutting. The selling price varies from \$150 to \$250 an acre.

LAUREL CLAY

The surface soil of the Laurel clay, to a depth of 15 to 18 inches, is a gray, dark-gray or drab, heavy silty clay loam or clay. The subsoil consists of a grayish-brown to gray or grayish-yellow silty clay loam which is friable and moderately open in structure. The surface soil is very rich in organic matter, but the subsoil is deficient. The soil section is calcareous throughout, the lime content increasing with depth.

There is some variation in the type as mapped. In places a light-brown to grayish-brown silt loam to silty clay constitutes the transition zone between the dark-colored soil and the gray subsoil. In some sections this horizon is only thin, in others it may extend to 30 inches below the surface, in which case the lime-content is not so pronounced. Locally the profile has streaks and seams of sandy material alternating with the clay and silt zones.

The Laurel clay occurs in the bottoms along the Missouri River, usually near the channel. It has a generally flat topography, with hardly any slope toward the stream. A few sand patches are scattered over the surface. Drainage is deficient, but it is superior to that of the heavy Wabash and Lamoure soils.

The type is of slight importance agriculturally because of its small area. It occupies only a small part of any individual farm. The common crops of the Missouri River bottoms are grown. Corn, the most important grain, yields from 30 to 60 bushels per acre. The small grains do better than on the Wabash and Lamoure soils on

account of better internal drainage. Alfalfa is grown in a small way and produces 3 to 4 tons of hay per acre each season. The soil is somewhat difficult to handle on account of its heavy texture, and it can only be worked and brought to proper tilth under favorable conditions. Improved surface drainage by ditching should be provided to remove the surface water.

The following tables gives the results of mechanical analyses of samples of the soil and subsoil of the Laurel clay:

Mechanical analyses of Laurel clay

Number	Description	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
		<i>Per cent</i>						
374931	Soil, 0 to 10 inches.....	0.0	1.2	0.2	1.1	3.7	4.2	53.6
374932	Subsoil, 10 to 24 inches.....	.2	.6	.2	.6	4.0	50.6	43.6
374933	Subsoil, 24 to 36 inches.....	.0	.0	.0	2.1	36.2	42.1	19.9

RAY SILT LOAM

The surface soil of the Ray silt loam is a gray to yellowish-gray friable silt loam, 6 to 18 inches deep, low in organic matter and distinctly light colored. The subsoil is a dark-gray, compact, granular silty clay or silty clay loam, similar to the lower subsoil of the Lamoure silty clay loam. The subsoil is not sufficiently calcareous to effervesce with acid, but the surface soil has a high lime content. Brown iron mottlings and some light-gray spots occur in the lower part of the soil section.

The surface soil is variable in thickness. It appears to be a rather heavy recent deposit of the river upon Wabash silty clay or silty clay loam. In places it extends to depths of 30 inches before the dark-colored material is encountered, but elsewhere it is very shallow. A few areas of very fine sandy loam texture are included, notably in T. 22 N., R. 11 E.

The Ray silt loam occurs on the first bottoms of the Missouri River where it is marginal to the channel. It is subject to and in the process of removal in some places. Structurally, it has poor drainage, but its proximity to the river bank provides sufficient outlet. Its topography is flat, with very minor depressions.

The type has a small total acreage, and all of it is farmed with the adjacent soils. The chief crops are corn, wheat, oats, and alfalfa. Corn yields from 35 to 60 bushels per acre, wheat 15 to 25 bushels, oats 35 to 50 bushels, and alfalfa 3 or 4 tons of hay.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of the Ray silt loam:

Mechanical analyses of Ray silt loam

Number	Description	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
		<i>Per cent</i>						
374901	Soil, 0 to 15 inches.....	0.0	0.0	0.2	0.8	3.8	64.1	31.1
374902	Subsoil, 15 to 36 inches.....	.0	.2	.8	8.4	10.4	45.9	34.4

RIVERWASH

Riverwash consists of alluvial material in the process of deposition in the river channel and along the banks of the Missouri River, in the form of sand-bar islands, sand banks, and sandy coves. The material consists of brown, grayish-brown, yellowish-gray, and gray sands, medium to coarse in texture, with some small gravel. In places the soil profile is made up of strata of sand of variable texture, similar in color to the surface material, alternating with thin seams of bluish, slate-colored, or dark-brown silty and clayey sediments. In times of high water thin beds of clay and silt are deposited on the surface of some of the lower-lying bars, but the materials are subsequently subject to partial or complete removal. Streaks of iron stains are common.

Riverwash is not permanent but changes with each overflow, a large part of it lying only slightly above normal stream level. The constant addition of new sediment may in places produce conditions favorable for the formation of stable soils, but in their present condition the materials are subject to constant reworking by flood waters and, even in normal flow, to the removal of some material and its deposition elsewhere. In dry weather it is subject to wind erosion, and characteristic hazy dust clouds are formed.

Some of the riverwash supports a growth of willow, cottonwood, and aquatic plants of several kinds. Many areas, especially the newer deposits, are devoid of vegetation. Riverwash is valueless for agriculture.

SUMMARY

Burt County is situated in the eastern part of Nebraska adjoining the Missouri River. It has an area of 475 square miles, or 304,000 acres.

The county lies in the hilly part of the State and embraces four topographic units—the upland, the bluff zone, the Missouri River Valley, and the Logan Creek Valley. The relief varies from flat surfaces in the Missouri River bottoms to hills and scarps in the bluff zone. The Missouri River Valley has minor terrace developments and broad bottoms, but Logan Creek has a series of terraces and a moderately wide flood plain.

The general slope of the county is to the south. The average elevation of the uplands is about 1,300 feet above sea level. The county lies entirely within the drainage basins of Logan Creek and the Missouri River. Artificial drainage of naturally poorly drained bottom lands of the larger streams is partially supplied by straightened channels, tiles, and open ditches.

The first permanent settlement was made in 1855. In 1920 the county had a population of 12,559.

Transportation is provided by the Chicago, Burlington & Quincy Railroad and the Chicago, St. Paul, Minneapolis & Omaha Railway. No point is more than 12 or 15 miles from a shipping point. The Washington and the Cornhusker Highways traverse the county.

The climate is temperate and well adapted to agriculture. The mean annual temperature is 49.6° F. as recorded at Tekamah. The

average precipitation is 30.64 inches. Planted groves are used for windbreak protection. The average frost-free season is 160 days. The relative humidity is high, and the long hours of sunshine are favorable to the corn crop.

Grain farming is the main type of agriculture. The chief crops are corn, oats, and alfalfa, the corn being dominant. The less important crops include wild hay, wheat, and red clover. Nearly one-third of the entire area of the county is devoted to corn. Small orchards and gardens are maintained on nearly every farm. Hog raising, beef-cattle production, feeding, and dairying constitute the livestock industries of major importance.

Increased attention is being given crop rotation and proper cultivation methods. The farm buildings throughout the larger part of the county are substantial and up to date, and nearly every farm is fenced and cross fenced. The work stock is of medium to good quality, and trucks, gasoline engines, and automobiles are in general use.

In 1920 the value of all property per farm was \$50,556. In 1921, 37.5 per cent of the total number of farms (1,433) were occupied by owners, 11 per cent by part owners, and 51.5 per cent by renters. About two-thirds of the rented land is leased on a share basis.

The Marshall silt loam is the most extensive and important soil in the county, covering about 45 per cent of the area. About 90 per cent of the type is in cultivation. The major crop is corn, but oats and the hay crops (alfalfa, clover, and wild hay) are also important.

The Knox silt loam is an eroded phase of the loessial Marshall silt loam. It has a lower organic content and a thinner surface soil, but is devoted to all the crops common to the region.

The Carrington silt loam is an important agricultural soil, but is not very extensive and is less productive than the Marshall silt loam. Corn, oats, alfalfa, and red clover constitute the major crops.

The Lancaster loam, derived from sandstone bedrock, is of minor extent, occurring chiefly in the bluff zone and hilly section of the county. It has an open, porous structure and is devoted largely to grazing, forestry, and orchards.

The Judson silt loam occupies colluvial slopes, terrace positions, and upper courses of small drainage ways. Its high organic content, favorable structure, texture, and moisture conditions make it an important soil, though not of large total acreage. All crops common to the region are grown.

The Waukesha silt loam is a dark-colored soil occupying the major terraces of the Missouri River and Logan Creek Valleys. It is a strong, productive soil and compares favorably with the best in the county.

The Wabash soils are dark-colored types with heavy subsoils and occur in the first bottoms of all streams in the county. They are productive soils and stand continued cropping for a long period, but are difficult to work in wet condition. They are considered good grain and hay soils where drainage is well established.

The Lamoure soils are as heavy as the Wabash soils, but have calcareous lower subsoils and are more poorly drained.

The Laurel soils are light colored, have good subsurface drainage, and are excellent first-bottom soils.

The Ray silt loam is a soil whose surface is light colored, calcareous, and low in organic matter.

Riverwash constitutes recent sand, clay, and silt deposits subject to continual alteration and of no agricultural importance.

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