SOIL SURVEY OF KALAMAZOO COUNTY, MICHIGAN

By S. O. PERKINS, of the United States Department of Agriculture, in Charge, and JAMES TYSON, of the Michigan Agricultural Experiment Station

DESCRIPTION OF THE AREA

Kalamazoo County, Mich., is situated in the southwestern part of the State, with only one county between it and the Indiana State line and one county between it and Lake Michigan. It lies about halfway between Chicago and Detroit. It includes 16 congressional townships and has a land area of 562 square miles, or 359,680 acres.

The principal topographic features of Kalamazoo County consist of a series, rather imperfectly developed, of broad low ridges and broad lowland belts, flat except for valleys that have been cut into them by the existing streams.

Both the ridges and the lowlands have a northeast-southwest trend across the county, the whole system maintaining a roughly parallel distribution. The northwestern corner of the county is occupied by a lowland belt, only part of which lies within Kalamazoo County. It has a maximum width in the county of about 6 miles. It has a smooth but not perfectly flat surface that lies a little below 800 feet in average elevation. It contains a few shallow depressions and one or two low elevations.

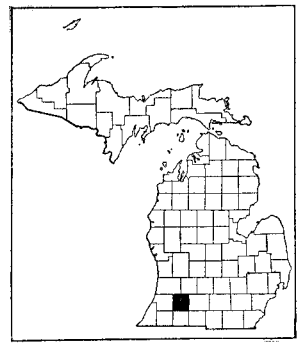

FIG. 18.—Sketch map showing location of the Kalamazoo County area, Michigan

Southeast of this lies a low ridge with an average width of about 7 miles, ranging slightly above and below this figure. Its elevation varies considerably, but it will average less than 100 feet above the lowland belt northwest of it. Its surface is quite uneven, the unevenness being produced by a great number of low hills and shallow depressions with no regularity of distribution, shape, elevation, or depth.

In physiographic terminology this ridge has a morainic topography. The hills are rarely more than 40 feet high and the depressions are shallower than that. The eastern boundary of this ridge crosses the northern boundary of the county about a mile west of Gull Lake and leaves the county crossing the western county line a few miles north of the southwestern corner.

The broadest and most clearly defined of the lowland belts in the county lies east of the ridge just described, which may be called the Cooper ridge, occupying a broad belt running entirely across the central part of the county. Its eastern boundary enters the northern part of the county in sec. 4, T. 1 S., R. 9 W., runs thence southward

to the Kalamazoo River and thence slightly southwestward to the St. Joseph-Kalamazoo line to sec. 34, T. 4 S., R. 10 W. It ranges in width from about 5 miles, just north of the city of Kalamazoo, to more than 15 miles on the southern boundary of the county. A low ridge, similar in character to the Cooper ridge, lies east of it and an irregular tongue of this ridge projects into the valley west of Augusta for several miles. This tongue is responsible for the narrowing of the belt north of the city of Kalamazoo.

Its surface is in general quite smooth, but slight elevations and depressions are present here and there. It contains a few lakes, the largest of which is Gull Lake, and a number of shallow depressions.

It is crossed by the Kalamazoo River, the river valley having been cut beneath the surface of the lowland to a depth of about 100 feet. The valley is about a mile and a half wide.

The eastern part of the county is occupied by another low ridge, similar in general character to the Cooper ridge but less well defined, especially in the southeastern part of the county. In this part of the ridge there is an intricate series of winding depressions traversing the area in all directions, with higher areas intervening. Its elevation is about 75 feet above that of the adjoining lowland belt to the west. That part of this ridge lying north of the Kalamazoo River, which crosses the belt east of Kalamazoo, is somewhat rougher in its topography than the Cooper ridge, but is some 50 feet lower than the latter.

The main drainage of the county flows slightly northwestward, nearly at right angles to the trend of the main relief features. All of the belts described above are crossed by the Kalamazoo River.

The highest elevation in Kalamazoo County is in Oshtemo Township, the altitude being 1,040 feet above sea level. The general elevation of the county is 80 to 275 feet above the bed of the Kalamazoo River. The elevation above sea level is 770 feet at the post office in Kalamazoo, 800 feet where the Kalamazoo River enters the county, and 735 where it leaves the county. Richland has an elevation of 931 feet, Schoolcraft 884 feet, Vicksburg 860 feet, Portage 867 feet, Fulton about 900 feet, and Climax 968 feet.[1]

The Kalamazoo River, the principal drainage way of the county, flows in a westerly direction as far as Kalamazoo, thence in a northerly direction, leaving the county 1 mile west of Argenta. Over half of the county, including Ross, Richland, Cooper, Alamo, Kalamazoo, Comstock, and parts of Charleston, Portage, Oshtemo, Texas, and Pavilion Townships, is in the Kalamazoo River drainage basin. The rest of the county lies in the basin of the St. Joseph River, only tributaries of which reach the county. All the drainage from the county finally reaches Lake Michigan.

Kalamazoo County was organized in July, 1829. The earliest settlers came chiefly from New York. The population in 1850 was 13,179, and by 1860 it had about doubled. The 1920 census reports a population of 71,225, 31.9 per cent of which is classed as rural. The density of the rural population is 40.5 persons per square mile; the eastern, southeastern, and southern parts of the county are a little

[1] Elevation data from United States Geological Survey quadrangle.

more thickly populated. The inhabitants for the most part are native-born Americans, but in recent years quite a number of foreigners, mainly Hollanders and Greeks, have come in. The Hollanders are engaged mainly in growing truck crops and the Greeks settle in the towns.

Kalamazoo, the largest city and the county seat, with a population of 48,487 in 1920, is situated near the center of the county. It is an important manufacturing city and is known as the paper city of Michigan. Other towns in the county are Vicksburg, with a population of 1,712; Schoolcraft, 731; Augusta, 651; and Galesburg, 692. Other villages are Fulton, Climax, Scotts, and Comstock.

Kalamazoo County has excellent transportation facilities. It is traversed by railroad and electric lines in all directions, giving direct communication with all parts of the country.

Four State trunk-line highways traverse or enter the county. The county roads are good, and much improvement work is being done. There are some concrete and asphalt roads, and most of the others have a gravel surface. Rural mail routes reach every section. Churches and schoolhouses are distributed throughout the county.

All parts of the county are within easy distance of shipping points. Kalamazoo itself affords an excellent market for truck and vegetables. Chicago and Detroit are important markets. Hundreds of carloads of celery are shipped to eastern and southern markets each year.

CLIMATE

Kalamazoo County is characterized by short summers and long, cold winters, not always severe. In the winter the temperature may fall to 20° or more below zero. In the summer it may range from 100° F. to 34° F. The mean annual temperature as recorded at Kalamazoo is 47.9° F. The summer mean is 69.9° F. and the winter mean is 24.9° F. The highest temperature recorded is 104° F. in August and the lowest is —25° F. in February.

The annual precipitation averages about 34 inches and is well distributed through the year, being heaviest in spring and summer. The rainfall varies from year to year, but is seldom so deficient as to result in injury to the crops, except on the drier sandy soils. The precipitation for the driest year on record was 21.79 inches. In the wettest year (1877) the rainfall in the spring, summer, and fall seasons was from 4 to 6 inches more than the average. The snowfall averages about 51 inches annually.

The average date of the last killing frost in the spring is May 10, and of the earliest in the fall October 10, which gives a normal growing season of 153 days. Crops are sometimes damaged by frost. The latest date of killing frost recorded in the spring is May 27, and the earliest date in the fall is September 14.

The prevailing winds are from the southwest from June to January inclusive, and from the west during the rest of the year.

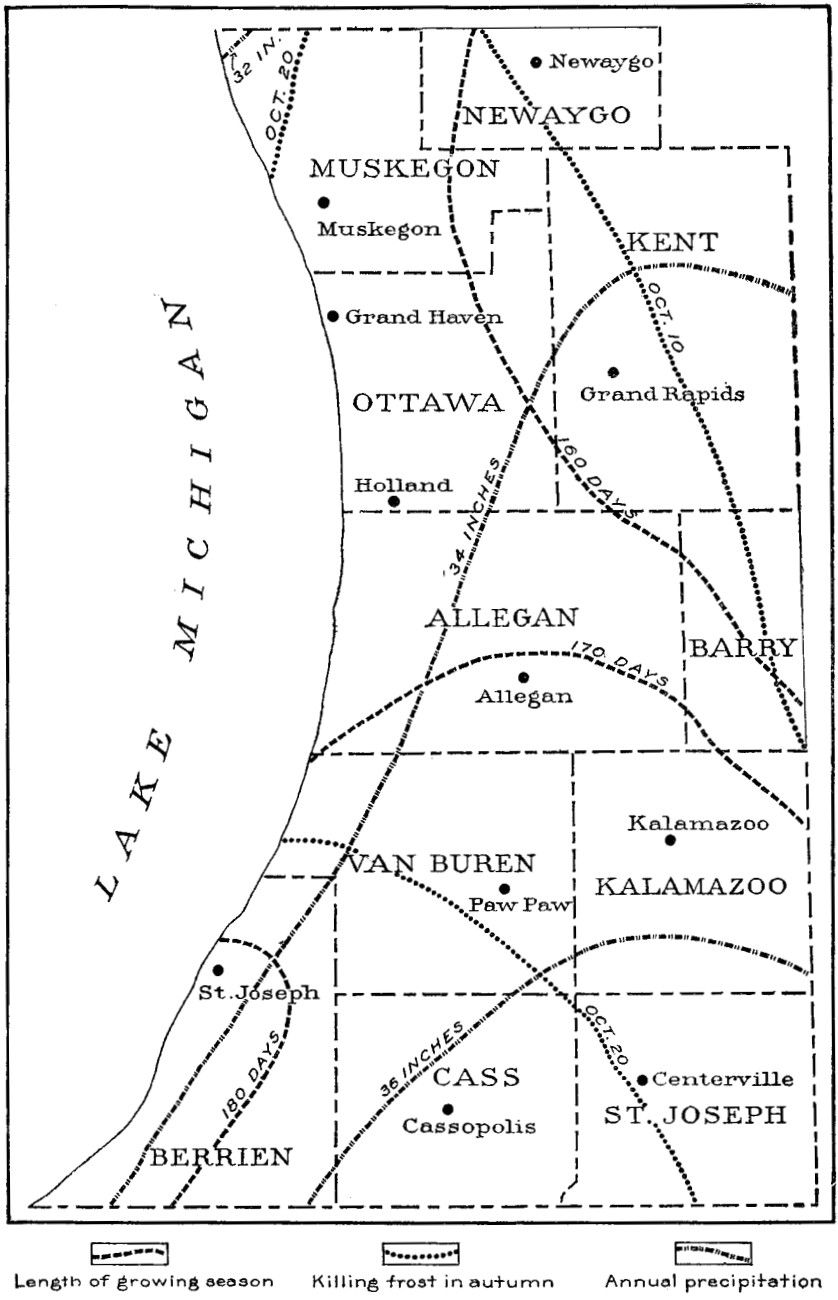

FIG. 19.—Sketch map showing climatic data for southwestern Michigan

The following table of climatic data is compiled from the records of the Weather Bureau station at Kalamazoo:

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

[Elevation, 955 feet]

Month	Temperature			Precipitation			
	Mean	Absolute maximum	Absolute minimum	Mean	Total amount for the driest year (1901)	Total amount for the wettest year (1877)	Snow, average depth
	° *F.*	° *F.*	° *F.*	*Inches*	*Inches*	*Inches*	*Inches*
December	27.6	63	−19	2.69	3.00	2.48	11.4
January	23.6	67	−20	2.17	1.32	1.91	14.4
February	23.5	62	−25	2.19	2.71	.12	13.4
Winter	24.9	67	−25	7.05	7.03	4.51	39.2
March	32.9	83	−14	2.16	1.91	7.33	4.9
April	46.9	89	6	2.52	.45	3.89	1.7
May	58.1	93	25	4.14	2.25	2.10	.3
Spring	46.0	93	−14	8.82	4.61	13.32	6.9
June	67.8	98	34	3.94	2.16	5.67	.0
July	72.2	103	43	3.31	3.31	6.50	.0
August	69.8	104	37	2.83	1.33	4.18	.0
Summer	69.9	104	34	10.08	6.80	16.35	.0
September	63.2	96	30	3.10	.06	2.55	.0
October	51.0	89	20	2.64	2.98	5.28	.2
November	38.0	72	−2	2.72	.31	5.77	4.8
Fall	50.7	96	−2	8.46	3.35	13.60	5.0
Year	47.9	104	−25	34.41	21.79	47.78	51.1

AGRICULTURE

The first white people in Kalamazoo County came from New York and settled in Prairie Ronde Township in 1828. Others came in the following year and settled along the Kalamazoo River. The open areas and lands along the streams were the first places to be populated. Kalamazoo County has several prairies scattered over the county, and one of these, the Schoolcraft Prairie, is probably the largest in the State of Michigan. These prairies had only a few scattering bur oaks growing on them and were comparatively easy to put into cultivation. At first development was slow. About three-fourths of the county had a heavy growth of hardwood, and lumbering was carried on quite extensively in the early days.

General farming has been practiced since the earliest settlement. Wheat, corn, and hay were the principal crops grown at first. Wheat continues to be the most important cash crop, but the acreage and production have fallen off in the last 20 years. It was and in some sections still is grown in the same fields year after year. In early times the heavy growth of wild grasses on the prairies and marshy places was the only source of hay, but clover and timothy soon became important. About 20 years ago the growing of alfalfa was

begun, but this crop has not received much attention until recent years.

The principal cereal crops of the county in 1879, according to the census, were wheat, corn, oats, buckwheat, rye, and barley. There were 32,126 acres in grasses, producing 35,068 tons of hay, and 2,366 acres in potatoes, yielding 223,655 bushels. In 1879 the orchard products were valued at $73,160, market-garden products at $23,296, and forest products at $134,186.

At present the main crops, named in order of their acreage, are hay, wheat, corn, rye, oats, potatoes, barley, vegetables, and buckwheat. Wheat is the leading cash crop, but corn, potatoes, hay, oats, and rye are marketed to some extent. Timothy and clover are the most important hay crops, but alfalfa is becoming an important source of hay. On the lighter soils a small acreage is devoted to grapes, strawberries, raspberries, and other small fruits. Vegetables, especially celery, onions, and cabbage, which are grown mostly on the Muck soils, have become important products. Apples and peaches are grown commercially by only a few farmers, but practically every farmer has a small orchard of apples and pears, usually large enough to produce a surplus. Livestock and dairying are important industries.

According to the 1920 census there were 30,938 acres in wheat in 1919, with a production of 597,282 bushels. The largest average yields of wheat are obtained on the Fox loam, Fox silt loam, Warsaw loam and silt loam, and the Bellefontaine loam. These soils give yields ranging from 15 to 30 bushels. Yields on the other soils range from 8 to 20 bushels.

Corn is next in importance. The 1920 census reports 30,234 acres of corn in 1919, producing 809,969 bushels. The crop is used mainly for feeding stock. The surplus is sold on the local market. Corn is produced on most all soils of the county, but the highest yields are obtained from the heavy soils. The largest acreage and production recorded by the census were for 1909, when 40,680 acres produced 1,529,061 bushels.

In 1919, according to the census, 40,174 acres in grasses produced 38,152 tons. Most of the hay is used on the farm. Timothy alone was cut from 9,903 acres, timothy and clover from 23,670 acres, clover alone from 4,531 acres. Silage crops and coarse forage combined occupied 22,938 acres, yielding 51,601 tons, and 1,473 acres of grain were cut green for hay. Timothy and red clover are often sown together, either in the spring with oats or in the fall with wheat.

Potatoes are grown for home use and for sale. In 1920 they occupied 4,009 acres, yielding 290,591 bushels. They are grown in small fields all over the county, but by far the largest areas are on the light and well-drained soils. The largest acreage reported by the census was grown in 1909, when 5,767 acres produced 719,797 bushels, or an average of about 127 bushels per acre. Occasionally much higher yields are obtained. With the incorporation of a good supply of organic matter by heavy applications of stable manure or green-manuring, and the use of a good grade of commercial fertilizer with high percentage of potash, the average yield could be greatly increased. The farmers at present either make heavy application of

well-rotted manure on the land intended for potatoes or plant the crop on land that has previously been green-manured or otherwise fertilized. Potatoes in large fields are usually harvested with diggers, but on some of the smaller areas a fork is used.

Hogs and cattle are found on the farms in all parts of the county, with the average numbers largest in the central, eastern, and southern parts. Most of the hogs and cattle, not including dairy cattle, are slaughtered to supply home needs, and only the surplus is placed on the market. Every farm on an average has two or more horses or mules. Cattle feeding is carried on to a small extent. About 10 carloads of feeders or young cattle are shipped in each year for fattening. Dairying is an important industry. Dairy herds ranging from 5 to 50 cows are found scattered over the entire county. Most of the dairies are located near good roads, railroads, and electric lines. Holstein, Jersey, and Guernsey are the chief dairy types, and Shorthorn, Hereford, and Angus are the beef types. The rest of the cattle are grades, chiefly Holstein. Fattening stock is grazed largely on marshy pasture land and finished with hay, silage, and corn. The 1920 census reports an expenditure of $469,708 for feed on 2,100 farms in 1919. Most of this feed was used for milk production rather than for fattening stock.

The number of sheep raised has decreased recently, but many farmers still keep small flocks.

Alfalfa has received considerable attention within recent years and has proved to be a profitable crop. It is grown mainly in small patches scattered throughout the county, but there are some fields of considerable size. The alfalfa acreage has increased greatly since 1909, when 82 acres were reported, producing 123 tons. In 1919 there were 946 acres, producing 1,361 tons of hay. Alfalfa is being tried out on nearly all the soils of the county with promising results. It produces higher average yields than any other hay crop. Three cuttings are usually made, and on some of the older stands in favorable seasons the yields are 2 to 5 tons per acre per season. Alfalfa should be sown on clean, well-prepared land, following some cultivated crop, such as corn or potatoes. It is a valuable crop on some of the light soils if a good stand is obtained, but before the best results can be expected on the lighter soils the fertility must be increased. Alfalfa does best on a deep, fertile, well-drained neutral or alkaline soil which is reasonably free from weeds. It is valuable as a hay crop, as pasturage for hogs, and as a perennial legume to be mixed with clover and grasses for cattle pasture.

The census reports 25,790 acres of rye in 1919, producing 345,690 bushels, or an average of about 12½ bushels per acre. Rye seems better suited to poor soils than any other crop. When a good seed bed is prepared and rye sown on a productive soil this crop should yield from 20 to 30 bushels per acre, and such yields have been obtained. Rye is an excellent cover crop. It is sown on most all the soils of this county, but usually more of it is grown on the sandier soils. Rye is used to some extent when seeding the soil to grass or clover. Most of the rye is sold and shipped out of the county.

Oats were grown in 1919 on 22,256 acres, producing 354,182 bushels, the yield averaging about 17 bushels per acre. This is

about one-half the yield reported for 1909, when 26,869 acres produced 894,118 bushels, a yield of about 35 bushels per acre. On the best soils and under favorable conditions oats yield from 40 to 60 bushels per acre. Most of the oat crop is used on the farm. Clover and timothy, either alone or mixed, are sometimes seeded with oats.

In 1919 barley was grown on 2,544 acres, producing 36,488 bushels. With favorable conditions barley yields 25 to 40 bushels per acre and in some instances higher yields have been obtained. Barley usually takes the place of oats in the rotation. Buckwheat is not an important crop and is sometimes plowed under for green manure. It was grown on 465 acres in 1919, with an average yield of about 11 bushels.

Vegetables are grown on nearly every farm for home use and for sale on the local markets.

Growing truck is quite an industry near Kalamazoo, Comstock, Vicksburg, and some other places in the county. A considerable acreage of Muck soil is devoted to trucking near Kalamazoo. The most important vegetables grown in the county are onions, cabbage, potatoes, beans, cucumbers, tomatoes, lettuce, cauliflower, peas, beets, radishes, and celery.

Fruit has never been as extensively grown in Kalamazoo County as in the counties bordering Lake Michigan, although a considerable part of the county is well suited to fruit production. Apples, peaches, pears, and cherries do well. The number of apple trees decreased from 154,839 in 1900 to 43,330 in 1920, and during the same period the number of peach trees decreased from 59,538 to 10,850. There were 10,921 pear and 10,563 cherry trees in 1920. Increased interest is being taken in the growing of fruit, especially peaches. Some new orchards are being set out and old ones renovated. There are several commercial orchards in the western, northern, and northeastern parts of the county, the most important being near Augusta. Climatic conditions and the topography of the sandy soils in the western part of the county favor peach and grape production. The southern and southeastern parts of the county are not so well adapted to fruit growing. Near the towns and summer resorts strawberries and raspberries are grown in considerable quantities, especially on the sandy soils.

The topography and the nature of the soils have influenced to some extent the type of farming and the character of farm practices. General farming is practiced on nearly every soil throughout the area. In a section in the western part of the county on the western edge of a large morainic system, where there is good air drainage and the soils are of sandy texture, peach and grape culture and early truck farming have developed.

Most farmers recognize to some extent the adaptation of soils to crops. The heavier soils are considered best suited to corn and hay. The Fox loam, Fox silt loam, Warsaw loam and silt loam, Bellefontaine loam, and Conover loam are recognized as the best for corn, wheat, and oats. The Brady, Newton, and Maumee soils are suited to corn and hay. Flat areas of the Brady loam, when properly drained, are sown to wheat with good results, but as a rule this soil is too wet through the winter and spring for the production of wheat.

The heavier soils give the largest yields of hay and clover, especially the Fox loam, Fox silt loam, Warsaw loam and silt loam, Maumee silty clay loam, and Newton silty clay loam. The Griffin loam and the flat, poorly drained areas of Newton silty clay loam and Newton loam support a good growth of grasses for pasturage. Clover does best on soils that have been limed, as most of the soils of this county are acid in the surface layer, although the substrata of many of the soils are calcareous. Clover is grown on most all the soils except the Coloma loamy sand. The well-drained medium-textured types having rather open and calcareous substrata are considered best suited to alfalfa. The Fox, Bellefontaine, Oshtemo, and Coloma sandy loams are considered best for beans, while Muck and low poorly drained soils are not suited to beans.

Well-drained Muck land is especially suited to the production of celery, onions, cabbage, peppermint, carrots, radishes, beets, and other vegetables. Reclaimed areas of swamp and Muck are considered well adapted to the production of hay. Celery is grown on a large commercial scale near Kalamazoo and in other places in the county. The Muck soil best suited to the production of celery is black to dark colored, alkaline in reaction, decomposed, and of loamy fine texture.

The lighter textured soils of the county are considered best for early market gardening. The sandy loam and loamy sand soils are best suited to peaches, but peaches and apples grow on all the well-drained soils. Most of the open sandy soils are adapted to small fruits, melons, and cucumbers. The light soils of the county are much better suited to truck growing than to general farm crops.

The method of growing wheat generally practiced is to plow under oat stubble in August and drill in the wheat before the 20th of September. The seed bed is usually well prepared. Special effort is made to destroy all the volunteer wheat and thus destroy the breeding places for fall broods of the Hessian fly. When wheat is sown on corn stubble, the land is usually disked and harrowed before the wheat is drilled in. Some farmers use commercial fertilizer on wheat at an average rate of about 200 to 250 pounds of acid phosphate per acre. The fertilizer is drilled in with the seed.

Corn is grown on practically all the soils but varies greatly in yield, quality, and time of maturity on different soils of the county. Barnyard manure is spread over the land, but commercial fertilizer is seldom used. Corn is usually planted between the middle of May and the middle of June.

Timothy is sown with some grain crop, usually wheat, in the fall. If a mixed hay is desired, clover is sown in the field the following spring. The land is generally limed when clover is to be sown. Some timothy is grown for seed. In this case the crop is cut with a grain harvester, shocked in the field, and threshed when thoroughly dry with a clover huller. Clover is sometimes grown for seed, the second cutting being used mostly for this purpose. When ripe it is mowed, raked up in windrows, and let dry out, then hauled and threshed. Alfalfa land is usually limed, using marl, ground limestone, or burnt lime. A good seed bed is prepared and either the land or seed inoculated. Seeding is done in late spring on the lighter types and in early summer on heavier soils.

The farms of Kalamazoo County as a rule are well equipped. The best improved and best equipped farms are on the heavier soils. Farm buildings are usually large and of modern construction. Machinery on all the farms of 40 acres or over is modern. Horses are used for most of the farm work. Many farms have tractors and engines for such work as filling silos, pumping water, and running separators. On many farms windmills are used for pumping water.

According to the 1920 census, the average value of all farm property per farm was $9,924, of which the land represents 54.8 per cent; buildings, 28.5 per cent; implements, 6.8 per cent; and domestic animals, 9.9 per cent.

The crop rotation commonly practiced throughout the county consists of corn, oats, wheat, and grass or clover. The land usually remains in hay two or three years, but in some cases as long as good crops of hay can be cut. Clover and timothy usually are seeded with the wheat. In some cases rye or some other crop takes the place of wheat, and sometimes barley is sown instead of oats in the rotation.

Comparatively little commercial fertilizer is used for general farming in Kalamazoo County, but heavy applications are used for special crops. There were 737 farms reporting the use of fertilizer in 1919, with an expenditure of $78,007. Since manure can not be bought except at high prices, the use of commercial fertilizer is necessary for the satisfactory production of celery and other special crops on the Muck land. Fertilizer has proved beneficial on many of the soil types. Burnt lime, marl, and ground limestone are used with excellent results, since most of the soils are acid in reaction. Lime is necessary for successfully growing alfalfa, clover, and many other crops on acid soils. Considerable increases in the yields of grain crops are often obtained by its use. When commercial fertilizer is used for special crops on Muck land, special mixtures of high grade, usually analyzing very high in potash, are used in large quantities, with or without manure, for growing celery and other vegetables. Lower grades of fertilizer are used for the general farm crops, and in many cases acid phosphate is used alone.

Farm laborers are mainly American born. Many of the farmers exchange labor for threshing, filling silos, and baling hay. The 1920 census reports that $572,092 were expended for farm labor in 1919, and 61.3 per cent of all the farms in the county used hired labor.

The average size of farms for the last 20 years has remained about the same, but the total number of farms has decreased from 3,308 in 1900 to 3,161 in 1920, when the average size of the farms was 98.7 acres. In 1920 about 87 per cent of the area of the county was reported in farms, and of the farm land 79.5 per cent is classed as improved land. The farms vary in size from a few acres to 1,000 acres. Over half of the farms range in size from 50 to 160 acres, and two farms have a thousand acres or over. In 1920, 74.8 per cent of the farms were operated by owners, 24.3 per cent by tenants, and 0.9 per cent by managers.

The average value of all farm land, not including buildings, in Kalamazoo County is reported by the 1920 census as $55.11 an acre. The value of all farm property has about doubled in the last 20 years. Land values vary greatly in this area. Some of the rougher areas range in price from $20 to $40 an acre, while most all the general farming lands sell for from $50 to $200 an acre or more,

and the well-drained, highly improved Muck lands near towns and railroads sell for $400 to $1,000 an acre.

SOILS

There are two groups of well-drained normally developed upland soils in Kalamazoo County. Much the larger area consists of light-colored soils, ranging from light brown to brown. A smaller area, represented by two types, consists of dark-brown soils. In both cases the color below a depth of 8 to 12 inches is some shade of brown, ranging from yellowish or grayish to faintly reddish.

Associated with the well-drained soils are numerous areas, some of them of considerable size, which have developed under conditions of imperfect to poor drainage. These soils are all somewhat dark in color, ranging from dark brown to black.

The well-drained mineral soils of the county are acid in reaction to a depth of 2 to 5 feet, and the dark-brown soils developed under prairie conditions are strongly acid, while the dark-gray to black mineral soils in poorly drained situations are alkaline or only slightly acid. The loamy sands and many of the sandy loams are relatively low in nitrogen, phosphoric acid, and potash.

On the basis of the foregoing statements it is evident that the broadest possible grouping of the soils of the county would place them into: (1) Those that are uniformly oxidized throughout the whole soil section, showing that during their development they have not been subjected to the influence of water-logging, and (2) those that are not uniformly oxidized or almost wholly unoxidized throughout their profile, showing that they have been developed under the influence of a high water table.

Group 1 may be further subdivided into two broad groups: (*a*) Those with light-colored surface soils (brown) and (*b*) those with dark-colored surface soils.

The soils of subgroup (*a*) have developed under a cover of mixed hardwood forest, while those of subgroup (*b*) have developed under a cover of grass. The former are "forest" soils while the latter are "prairie" soils.

In the first group, developed under a rather heavy cover of hardwood forest, the profile in virgin areas consists of 2 to 3 inches of dark-colored surface material, underlain by a subsurface layer of light-brown or yellowish-gray material, 8 to 18 inches thick, usually becoming slightly heavier with depth. This grades into a deeper yellowish brown to reddish-brown, heavier material, ranging from a loamy sand in the lighter soils to a reddish-brown clay loam in the heavier types. This layer varies in thickness from 4 to 14 inches, and usually varies with the composition and texture of the parent material. This generally grades downward into lighter textured material and then into the unweathered parent material. The soils having a reddish-brown layer are classed as Fox and Bellefontaine soils, and those with yellowish and yellowish-brown, friable subsoil are classed with the Plainfield and Coloma soils. These soils are found throughout the county.

The soils of the second group, developed under prairie conditions and good drainage, are dark colored to depths of 8 to 12 inches, and the underlying horizons or layers have essentially the same profile as

the Fox soils. The heavy layer is more typically buff brown in color than reddish brown. The main difference consists of the greater thickness of the dark-colored surface soil, due to its being developed under prairie instead of timber. These soils are found in the southern, northeastern, eastern, and central parts of the county and are mapped as Warsaw soils.

The soils of the third group, which were developed under poor drainage conditions, are represented by the Brady, Maumee, and Newton soils, which differ from each other largely in the shade of color of the surface soils and in the composition of the substrata. Another poorly drained soil, which consists of recently accumulated alluvium, has a brownish surface soil with a grayish-brown and rusty mottled appearance at a depth of a few inches and is mapped as the Griffin loam. The soils composed of organic accumulations underlain by sand, clay, or marl are also poorly drained.

The soil-forming materials of Kalamazoo County have been accumulated mainly by glacial action, modified in places by water and wind. The underlying rocks, mostly sandstone and shale, were covered to varying depths, in many places hundreds of feet, by glacial débris. The glacial drift was derived from igneous and metamorphic rocks, such as granite, gneiss, schist, quartzite, and diorite, transported long distances; and from sedimentary rocks, such as sandstone, limestone, and shale.[2] The glacial material was deposited in the form of terminal and ground moraines, eskers, kames, and nearly level outwash plains and till plains.

The soils of Kalamazoo County have been grouped into soil series according to characteristics of the soil profile, such as the number of horizons or layers, their color, structure, arrangement, thickness, and chemical composition, the geology of the soil material, and drainage conditions. Each series is divided into individual soil types according to the texture or the relative coarseness or fineness of the surface soil.

The soils of the county that are developed wholly or mainly upon material deposited directly by glacial ice are included in the Bellefontaine, Conover, Crosby, Rodman, and Coloma series.

The Bellefontaine series is developed throughout the terminal-moraine, ground-moraine, and outwash sections of the county. The surface soils are light brown, underlain by a brown to reddish-brown and yellow, friable, sandy, or gritty clay subsoil. The substratum is a mixture of sand, gravel, and bowlders, with a small proportion of silt and clay. The Bellefontaine sandy loam and loam are mapped.

The Conover series is not yet well defined. In this survey it includes a loam type with light-brown to brownish-gray surface soil, underlain by a yellow to yellowish-brown material slightly heavier than the soil.

The Crosby series consists of brownish-gray to light-gray surface soil, an ashy-gray, mottled subsurface layer, and a yellowish-brown, heavy, tough subsoil. The material is decidedly acid, except in the lower subsoil, which is calcareous and more friable. The topography is level to gently undulating and drainage is deficient.

[2] Leverett, Frank. Surface geology and agricultural conditions of Michigan. Mich. Geol. Survey, publication 25, 1917.

The Rodman series is characterized by light-brown to brown surface soils underlain by sand, gravel, and cobbles, and carrying considerable limestone. This series comprises soils having the roughest topography in the county, occurring as hilly moraines or occupying the slopes and breaks in the outwash areas. The Rodman gravelly sandy loam was mapped.

The Coloma series comprises light-brown to brownish-gray surface soils over a yellow or yellowish-brown, incoherent to loosely coherent sandy subsoil, acid in reaction to depths of 3 feet or more. The substratum consists mainly of sand, with a variable content of clay, gravel, and bowlders. Three types were mapped—the fine sand, loamy sand, and sandy loam.

The soils occupying the broad filled-in valleys, terraces, and outwash plains, derived largely from water-laid drift material, are included in the Fox, Warsaw, Plainfield, Oshtemo, Brady, Maumee, and Newton series.

The soils of the Fox series have grayish-brown to brown surface soils, with a yellowish-brown to reddish-brown compact subsoil consisting of a mixture of sand, gravel, and colloidal clay. This is underlain by and sharply separated from the substratum of stratified beds of gravel and sand, which contain a large proportion of limestone fragments. The topography is level or gently undulating to gently rolling, and drainage is good. The Fox loam, gravelly loam, sandy loam with a gravelly phase, and silt loam are mapped.

The soils of the Warsaw series are dark brown to nearly black to a depth of 8 to 14 inches, with a brown, buff, or yellowish-brown compact upper subsoil. This is underlain at 18 to 24 inches by reddish-brown sand, gravel, and clay, which passes at depths of 30 to 40 inches into stratified beds of sand and gravel, containing some limestone material. It is similar to the Fox series in topography and geological relations, but differs from it in having a darker surface color, due to a higher content of organic matter, and a less marked reddish cast of color in the compact horizon. The Warsaw loam and silt loam are mapped.

The types of the Plainfield series comprise dry sandy soils, light grayish brown to brown in the surface soil, with a yellowish incoherent or only loosely coherent subsoil of about the same texture as the soils. The substratum is sandy and gravelly and not highly calcareous. The surface is level to gently rolling. Drainage is good to excessive. The sand and sandy loam are mapped.

The Oshtemo series is characterized by darker surface soils, higher in humus content than the Plainfield. It differs from the Fox series in having a less marked development of the clayey subsoil layer. The loam and sandy loam types are mapped.

The Brady types have brownish-gray to dark brownish gray surface soils, underlain by mottled gray, brown and yellow sandy clay to clay, grading at 24 to 30 inches into water-logged gravel and sand. The topography is level and the drainage is poorly established. The Brady loam occurs in this county.

The surface soils of the Maumee series are very dark brownish gray to black to a depth of 10 to 15 inches, underlain by a gray, drab, to bluish-gray, sandy subsoil, mottled more or less with yellow and brown. The dark color of the surface is due to the high per-

centage of organic matter present. The topography is level. Natural drainage is poor. The silty clay loam type is mapped.

The Newton series consists of brownish-gray or dark-gray surface soils, 6 to 8 inches deep, underlain by a gray, yellow, and brown mottled subsoil, grading from almost solid gray or drab in the upper part to yellow at 20 to 30 inches. In some of the lighter types the soil is underlain by interstratified layers of sand, silt, and clay. The substratum consists of stratified beds of sand and gravel, generally resting on some heavier material. The topography is level. Natural drainage is usually poor. The Newton loam, sandy loam, silt loam, and silty clay loam types were mapped.

The Griffin series consists of types with brown surface soils grading into a mottled subsoil. The soil material comprises recent alluvium without any definite profile. The land is naturally wet or poorly drained.

Thirteen soil series are represented in Kalamazoo County by 25 soil types. In addition, Muck, with two phases, is mapped. The soils are described in detail in subsequent pages of this report. Their distribution is shown on the accompanying soil map. The table below gives the actual and relative extent of each type.

Areas of different soils

Soil	Acres	Per cent	Soil	Acres	Per cent
Fox loam	59,328	16.5	Conover loam	6,784	1.9
Muck	45,568	14.8	Plainfield sand	6,080	1.7
Shallow phase over sand	5,248		Crosby loam	6,016	1.7
Shallow phase over marl or marly clay	2,496		Fox gravelly loam	4,480	1.2
Bellefontaine sandy loam	36,160	10.0	Maumee silty clay loam	4,160	1.2
Fox sandy loam	30,976	9.3	Newton silty clay loam	3,840	1.1
Gravelly phase	2,560		Coloma sandy loam	3,328	.9
Bellefontaine loam	31,552	8.8	Oshtemo loam	2,816	.8
Warsaw silt loam	22,784	6.3	Oshtemo sandy loam	2,432	.7
Coloma loamy sand	19,008	5.3	Newton sandy loam	1,728	.5
Rodman gravelly sandy loam	16,704	4.6	Griffin loam	1,280	.4
Newton loam	12,288	3.4	Brady loam	1,152	.3
Fox silt loam	10,944	3.0	Coloma fine sand	576	.2
Warsaw loam	9,728	2.7	Newton silt loam	384	.1
Plainfield sandy loam	9,280	2.6	Total	359,680	

BELLEFONTAINE SANDY LOAM

The Bellefontaine sandy loam consists of 6 to 10 inches of a brown to grayish-brown sandy loam, underlain by a light-brown sandy loam which extends to a depth of 12 to 24 inches. This passes into a layer of reddish-brown sand, gravel, and clay, 4 to 12 inches thick and sufficiently coherent and retentive to be an important factor in maintaining a satisfactory moisture supply in the soil. Below this layer, usually beginning at 22 to 30 inches, is a brown sand and gravel, which becomes more gravelly and stony and of lighter color with depth. Gravel in varying quantities and sizes occurs in both soil and subsoil, and there is a scattering of gravel, cobbles, and large stones on the surface. The large piles of bowlders in the fields indicate that the stones have been in sufficient abundance to interfere with cultivation. In only a few places do they remain on the surface in sufficient quantities to hinder cultivation. At a depth of 4 to 6 feet the type is

underlain by gray sand, gravel, and cobbles, and more or less fragmental limestone.

In some included areas the subsoil is a loamy sand instead of a sandy loam, and the reddish-brown layer is a sandy loam instead of sandy clay loam. In places the type includes spots of Bellefontaine loam. Locally on eroded slopes and knolls the reddish-brown layer is exposed.

The Bellefontaine sandy loam occurs chiefly in irregular areas scattered throughout the northwestern, central, northeastern, and southeastern parts of the county. It is typically developed about 4 miles northwest of Kalamazoo, where it occupies a continuous area 6 miles long and 4 miles wide in the widest place. Several other bodies have an area of 3 to 5 square miles each. Many patches too small to show on the soil map were included with the Coloma types or the Bellefontaine loam.

The topography of the Bellefontaine sandy loam ranges from rolling to hilly and rough. Owing to the rolling topography, porous nature of the soil, and loose gravelly substratum, drainage is excellent and in places excessive.

The type is not considered an important agricultural soil. It is adapted to special crops rather than general farming, but all staple crops are grown. About 80 per cent of the type is under cultivation. The remainder supports a tree growth consisting chiefly of oak, with some hickory, hard maple, beech, and elm. The type does not give good yields of wheat and corn, but fair yields of rye and potatoes are obtained. The best farmers on the smoothest areas of this type obtain fair yields of all staple crops. Some varieties of grasses do fairly well, Canadian bluegrass producing the best pasture, especially in dry seasons. Vegetables are grown to some extent and give satisfactory results. Alfalfa is beginning to be an important crop. This type is well adapted to apples.

Corn yields 10 to 40 bushels, averaging about 20 bushels per acre; rye, 10 to 25 bushels, averaging about 18 bushels; wheat, 8 to 20 bushels, with an average of about 10 bushels; oats, 15 to 35 bushels, averaging about 20 bushels; beans, 8 to 20 bushels. Potatoes yield 70 to 150 bushels per acre.

Most of this type is handled in the same way as the Bellefontaine loam, but it can be plowed sooner after rains than the loam. On the best farms the crops are cultivated often during dry seasons to conserve moisture. A few brown sandy-clay spots that have been exposed by erosion, often the result of careless handling, have enough clay in them to clod if plowed when wet. Commercial fertilizer is not in general use, but some farmers use acid phosphate or a mixture, particularly for wheat, corn, and potatoes. Liming is essential for the most successful growing of alfalfa and clovers. Occasionally clover is turned under as green manure.

Land of the Bellefontaine sandy loam sells at $30 to $150 an acre, depending mainly on location and improvements.

Agricultural conditions on this type are good in some places but very poor in others. The soil needs organic matter and a systematic crop rotation, including a legume crop. The rougher areas are better adapted to forest or pasture than to cultivated crops.

The table below shows the results of mechanical analyses of samples of the surface soil and three sections of the subsoil of the Bellefontaine sandy loam:

Mechanical analyses of Bellefontaine sandy loam

Number	Description	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
		Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
301424	Soil, 0 to 4 inches	1.8	13.0	14.7	39.9	6.4	18.4	5.8
301425	Subsoil, 4 to 14 inches	9.2	30.2	12.6	24.4	1.8	17.3	4.5
301426	Subsoil, 14 to 24 inches	2.8	11.4	12.6	31.6	5.6	19.7	16.2
301427	Subsoil, 24 to 36 inches	3.4	19.4	24.2	32.2	3.6	7.7	9.4

BELLEFONTAINE LOAM

The Bellefontaine loam, to a depth of 8 to 10 inches, as seen under average field conditions, is a brown to grayish-brown loam, with a lighter grayish color when dried out. The subsurface layer is a yellowish, more compact loam, and this passes into a reddish-brown sandy clay or clay containing more or less gravel and stones. The lower part of the 3-foot section is normally a yellowish-brown sandy material passing into a gray sand and gravel substratum, which is generally calcareous. Cobblestones and large bowlders occur on the surface and in the soil mass. Where these stones interfere with cultivation they are picked up and put into piles. In places the surface is a rather dark brownish gray to dark grayish brown loam to silt loam. The surface soil in many depressions is dark in color, too dark for true Bellefontaine material, but these areas were not large enough to warrant separate mapping. In the southeastern township of the county the soil mapped as Bellefontaine loam is yellow in the subsoil layer, and otherwise more closely resembles the Hillsdale and Miami types than the Bellefontaine.

The Bellefontaine loam is widely distributed throughout the eastern half of the county and occupies a few areas in the western and northern parts. The largest continuous area lies 4 miles west of Kalamazoo and contains about 8 square miles. The type occupies terminal and ground moraines and the surface is undulating to hilly. The slopes on the greater part of it are not steep enough to interfere with the use of farm machinery. Both surface and internal drainage are good, except in small depressions or potholes in which the soil belongs to other types.

The Bellefontaine loam has an aggregate area of more than 31,000 acres in Kalamazoo County, and about 90 per cent of it is under cultivation or used as pasture. The original hardwood forest consisted chiefly of oak, maple, beech, hickory, walnut, and elm.

For general farming this is one of the strongest soils in Kalamazoo County. It is well adapted to all staple crops. Corn, small grains, grasses, alfalfa, and clover do well. Apples, cherries, pears, and other fruits succeed, though they are grown only in a small way. The principal crops are corn, wheat, oats, rye, and hay. Beans and potatoes occupy a considerable acreage, and alfalfa, clover, and barley also are produced. Corn yields range from 30 to 70 bushels, averaging about 40 bushels per acre. Wheat does well on this soil

and yields from 14 to 35 bushels per acre, with an average of about 20 bushels. The yield of oats usually ranges from 25 to 60 bushels per acre, averaging about 35 bushels, and yields of 80 bushels have been reported. Rye yields from 15 to 22 bushels; barley yields from 20 to 50 bushels, and beans 10 to 25 bushels per acre. Potatoes give a yield of 70 to 200 bushels per acre. The yields of hay average about 2 tons per acre in favorable seasons. Bluegrass does well. Alfalfa is becoming an important crop, yielding as high as 4 tons per acre per season.

A rotation practiced on most farms is corn, oats, wheat, and timothy or clover left in sod one or more years. It is sometimes difficult to get a stand of red clover, but when the soil is limed clover does well. Crops of clover are turned under as green manure by some of the better farmers. It is necessary to use lime, prepare a good seed bed, and inoculate the soil to obtain a good stand of alfalfa.

Land of this type sells at prices ranging from $75 to $150 an acre, depending mostly on improvements and location.

The Bellefontaine loam, with good management, can be kept in a high state of productiveness indefinitely. Liming the soil, keeping more livestock, turning under green crops, systematic crop rotation, and thorough preparation of the land are matters that should be looked to in maintaining the productiveness of this soil.

CONOVER LOAM

The soil of the Conover loam is a grayish-brown loam with a depth of about 8 inches, underlain by a yellowish-gray loam, which passes at 12 to 24 inches into mottled yellowish, brownish, and gray friable sandy clay loam.

Other soils than the typical Conover are included in the area shown on the soil map. In many places the mottlings are not seen and the subsoil is yellow and no heavier than the soil. Where the soil grades into the associated Bellefontaine soils the surface is more brown; where it grades into Crosby and Newton types the surface soil ranges from gray to dark gray; when associated with the Maumee types it is dark gray and the subsoil is more or less mottled. Cobbles and some gravel are found scattered over the surface and mixed with both soil and subsoil.

This type occupies an intermediate position between the Bellefontaine types in the ground-moraine section of the county and the flat, low, poorly drained soils. It occurs on gentle slopes or gently rolling areas. Drainage is generally good except in a few places where the lower part of the slope is nearly level and adjacent to some of the poorly drained soils.

The Conover loam is not extensive, but it is an important soil in the southeastern part of the county. It is a good general farming soil. About 95 per cent of it is in cultivation. The original tree growth consists chiefly of hard maple, beech, hickory, oak, and elm.

Corn, wheat, oats, hay, and clover are the important crops. Alfalfa, rye, potatoes, and barley are also grown. Corn yields from 25 to 50 bushels, with an average of about 40 bushels per acre. Wheat yields 10 to 25 bushels, with an average of about 18 bushels per acre. Hay yields from 1 to 2 tons and oats from 25 to 35 bushels per acre.

Commercial fertilizer is not generally used, although some farmers are applying acid phosphate at the rate of 200 to 300 pounds per acre for wheat.

This type sells at $50 to $125 an acre, depending mostly on location and improvements. Near Fulton it is held at $100 to $150 an acre.

By incorporating more organic matter, through the turning under of green crops and heavy applications of barnyard manure, and by using lime and a good grade of commercial fertilizer, the yields could be increased considerably.

CROSBY LOAM

The Crosby loam consists of 3 to 6 inches of a gray to grayish-brown friable loam, which typically passes into a light-gray layer varying in thickness from 3 to 6 inches and in texture from a fine loam to silt loam. Below this layer appears a mottled yellow, gray, and rusty-brown, sticky sandy clay, which extends downward to a depth of about 20 to 30 inches. The lower part of the subsoil is water-logged brownish-gray sand, clay, and gravel. Fine to medium gravel is present in both soil and subsoil. The substratum consists of gray, stratified gravel and sand. In the uncultivated areas the surface for 2 or 3 inches is a dark gray. In many places the surface soil is gray to a depth of 7 to 10 inches, with no light-gray subsurface layer. In some places the subsoil is a rather plastic sandy clay.

The Crosby loam is confined to the southeastern part of the county, where it occurs in small scattered areas. A few small areas of Crosby silt loam were included with the loam as mapped. The type is developed in flat, poorly drained country. The surface is level to slightly sloping or depressed. Artificial drainage is usually necessary for satisfactory farming.

The Crosby loam, when well drained, produces satisfactory yields of most of the general farm crops. About 90 per cent of it is in cultivation or used for pasture. The forest growth consists chiefly of swamp white oak, ash, elm, soft maple, and hickory. The principal crops are corn, oats, hay, and pasture grasses. Wheat, rye, and other crops are grown to some extent. Corn yields from 20 to 50 bushels, with an average of about 35 bushels per acre; oats 20 to 35 bushels, and sometimes as much as 50 bushels; timothy and clover mixed 1½ to 3 tons per acre; wheat 10 to 20 bushels; and rye 12 to 20 bushels. In wet seasons crop yields are light.

Land of this type is usually sold in connection with other types and ranges in value from $50 to $100 an acre.

The chief need of the Crosby loam is better drainage. Much of this type is already drained by open ditches and on many farms it is tile drained. The organic matter in the soil should be conserved and increased.

RODMAN GRAVELLY SANDY LOAM

The Rodman gravelly sandy loam consists of a grayish-brown to brown surface soil, from 5 to 8 inches in depth, underlain by a mass of gravel and cobbles, which normally includes a large proportion of limestone. The surface texture is variable, ranging from sandy loam to loamy sand, with varying quantities of gravel on the surface.

Rodman gravelly sandy loam occurs on the breaks in the rough outwash areas and as eskers and kames in the morainic section of the county. It represents the land of roughest topography, ranging from rolling and strongly rolling to rough, broken, and steep. Drainage is excessive, and in many places the run-off is so rapid that gullies are formed. The original surface soil over much of the type has been removed. This soil is poorly adapted to farming because of the steepness of the slopes and the extreme stoniness.

The Rodman gravelly sandy loam is not generally regarded as agricultural land. Probably 60 per cent of it has been cleared and is used for orchards or pasture. In some sections fruits do well, and if properly handled such crops would give good returns on the smoother parts of the type. Some vegetables are grown in a small way where the topography will permit cultivation. Part of the large area south of Pretty Lake is used for fruits, particularly grapes, and to a small extent for general farming, but the yields are low. Alfalfa makes a good growth. This type constitutes land well adapted for woodlot forestry, especially in the roughest areas. The forest growth consists chiefly of oak, hard maple, beech, hickory, ash, and elm.

COLOMA FINE SAND

The surface soil of the Coloma fine sand has a depth of about 7 inches and is a grayish-brown to yellowish-brown mellow fine sand to loamy fine sand. This layer is underlain by pale-yellow loose fine sand extending to a depth of 3 feet or more.

The total area of this type is less than a square mile. The largest body is in the eastern part of the county on the Calhoun County line. Other patches are located in the morainic belt in the northwestern part of the county. The topography is gently rolling to rolling, and drainage is good.

The Coloma fine sand has a very low value for general farming. In places little or no vegetation is seen because of the drifting of the sand by wind. Rye was the only crop seen growing on this soil during the course of the survey. Tree fruits, grapes, and watermelons would probably give the best returns from this soil. In Van Buren County it is used for peach and grape production.

COLOMA LOAMY SAND

The Coloma loamy sand consists of 6 to 9 inches of grayish-brown to brown mellow loamy sand to sandy loam, underlain by a pale yellowish brown to light-brown friable loamy sand to sand to a depth of more than 3 feet. In places gravel and bowlders are scattered over the surface. Locally a reddish-brown friable sandy clay material is encountered in the substratum. The surface has a grayish cast when dry. Small spots of Bellefontaine sandy loam and Coloma sandy loam are included with this type.

The Coloma loamy sand has its largest development in the western part of the county. One area, about one-fourth mile wide in the narrowest place and more than 2 miles wide in the widest, extends southwest and south from Gerald School for about 10 miles. Another large area, extending southwest from Bonnie Castle Lake, averages over 1 mile in width and about 7 miles in length. Another

area lies on the western edge of the big moraine, extending from Finch School in a southwest direction for about 4 miles, with one interruption by a narrow strip of Muck. Other bodies are mapped throughout the morainic sections of the county.

The topography of this type is gently rolling to rolling, and, owing to the open structure of both soil and subsoil, drainage is excellent and in places excessive.

The Coloma loamy sand is not an important soil for general farming, but is held in high esteem for special crops. About 80 per cent of it has been cleared; the rest supports a tree growth chiefly of oaks. Probably 40 or 50 per cent of the type is in cultivation.

Peaches, grapes, and vegetables are the important special crops, and the soil seems to be best adapted to these. Corn, rye, and potatoes are the more important general farming crops. Cantaloupes, watermelons, tomatoes, beans, wheat, and alfalfa are minor crops. Corn yields from 10 to 20 bushels, rye 10 to 15 bushels, and potatoes 30 to 70 bushels per acre. Rye is sown in the peach orchards and grape vineyards as a cover crop.

Fertilizers are not in general use at present, but experience and experiments indicate that the type responds to their use and that a material increase in yield may be expected. Peaches and grapes usually receive applications of barnyard manure, and generally the soil is limed.

Land of this type sells at $50 to $250 an acre, depending upon the state of improvement and nearness to good roads. The higher price is paid for areas well suited to the production of peaches and grapes.

COLOMA SANDY LOAM

The surface soil of the Coloma sandy loam consists of brownish-gray, light-brown to brown, mellow, medium loamy sand to sandy loam, with a depth of 6 to 10 inches. The upper subsoil, to a depth of 20 to 25 inches, is a compact brownish-yellow or yellowish-brown sandy loam. This passes into a yellowish-brown heavy sandy loam, which grades into a yellow, loose, loamy sand to sand at about 30 inches. At a depth of 6 to 12 feet a bed of gray sand and gravel is encountered. This in places is calcareous. On the surface and throughout the soil there are varying quantities of gravel and a few large stones, but these are not abundant enough to interfere seriously with cultivation. This type is closely associated with the Coloma loamy sand and the Bellefontaine sandy loam and as mapped includes patches of both.

The Coloma sandy loam occurs in a few comparatively small areas. In the western part of the county is an area north of Pretty Lake and one north of Rix School and there are some others here. In the eastern part of the county a relatively important area lies 1½ miles south of Eagle Lake. The topography of this type is rolling to hilly, the slopes are usually smooth, and drainage is thorough.

About 95 per cent of the Coloma sandy loam is under cultivation, and the rest supports a forest chiefly of oak, maple, and hickory. Corn, potatoes, wheat, oats, rye, and hay are the principal crops. Beans are grown with fair success. Corn yields 20 to 50 bushels, averaging about 25 bushels; potatoes yield from 75 to 200 bushels, and

more when well manured. Wheat yields 8 to 20 bushels, oats 15 to 40 bushels, rye 10 to 20 bushels, and hay one-half ton to 1½ tons. Early truck and vegetables do well. Fruit growing is an important industry. Apples, peaches, and grapes do well. Alfalfa is successfully grown, the yield ranging from 2 to 4 tons per acre per season on well-managed soil.

FOX GRAVELLY LOAM

The Fox gravelly loam has a surface soil of light-brown loam to sandy loam containing a high percentage of rounded gravel. This is underlain by a reddish-brown layer containing more clay and passing abruptly at 18 to 24 inches into gray loose sand and gravel.

The Fox gravelly loam occurs mostly in the central and northeastern parts of the county, the greater proportion being found just west, south, and east of Kalamazoo. It is developed on the rougher outwash plains and terraces and has a gently rolling to strongly rolling topography. The land is well drained.

This is an inextensive and unimportant soil type and most of it is in pasture. General farm crops do fairly well on this soil. Corn, wheat, clover, and rye are the principal crops. Fair yields of alfalfa and sweet clover may be obtained. On some of the more rolling areas the run-off has caused erosion. The type occurs in association with other upland soils, and in many cases the cropping system is controlled by these soils. The tree growth is the same as on the Fox loam.

FOX SANDY LOAM

The surface soil of the Fox sandy loam consists of a grayish-brown to brown sandy loam or loam, with a depth of 8 to 10 inches, passing into a yellowish-brown sandy loam, which extends to a depth of 18 to 24 inches. Below this is a layer of reddish sand, gravel, and clay, locally known as hardpan, ranging in texture from a sandy loam to sandy clay loam, and generally varying from 4 to 15 or 20 inches in thickness. The substratum consists of stratified beds of gray sand and gravel. The surface soil is friable and easy to keep in good tilth.

In places there is some gravel on the surface and through the soil mass. Locally the surface soil is heavier, approaching a light loam in texture. Small spots of the Fox loam, Fox gravelly loam, the gravelly phase of the sandy loam, and the Plainfield sandy loam are included with this type because they were too small to map separately.

Fox sandy loam is distributed throughout the county. The largest areas are located north of Weeds Lake, near Hampton Lake, and north of Austin Lake. Other areas of considerable size are found near Alamo, north of Evergreen School, on the Kalamazoo River terrace, around Howard and Barton Lakes, and along the St. Joseph County line south of Vicksburg. It occurs on outwash plains, in old valleys of glacial origin, and on stream and lake terraces. The surface generally ranges from nearly level to undulating or gently rolling and in many places is hilly and broken near streams. A few kettle holes occur throughout the type, but the underdrainage is usually sufficient in such areas to carry off all the surplus water.

Drainage is well established over all the type. On some of the steeper slopes slight erosion has occurred, but gullies have not formed to an appreciable extent.

The Fox sandy loam is a fairly good agricultural soil, though not as valuable as the Fox loam. Practically all the type is now under cultivation. The original tree growth was mostly oak. General farm crops are grown and give fair yields. The principal crops are corn, potatoes, rye, wheat, beans, and alfalfa. Timothy and clover are grown to some extent. The type is well adapted to truck farming, and part of it is devoted to garden crops, strawberries, raspberries, and tree fruits. Corn yields from 20 to 50 bushels per acre, with an average of about 30 bushels; oats, 20 to 45 bushels, averaging about 35 bushels; wheat, 10 to 20 bushels; rye, 12 to 25 bushels; potatoes yield from 90 to 200 bushels; beans, 8 to 20 bushels; alfalfa, from 3 to 5 tons per season; and timothy and clover together, 1 ton to 2 tons, with an average of 1½ tons.

The Fox sandy loam requires less labor to produce a mellow seed bed and can be handled under a wider range of moisture conditions than the Fox loam, but about the same cultural methods are followed. Some commercial fertilizer is used. Lime is being used with beneficial results. All the available barnyard manure is applied, but it is not sufficient to supply the necessary organic matter. Some farmers plow under crops for green manuring. This land sells for $45 to $125 an acre, the average price being about $65.

Much of the Fox sandy loam is low in organic matter. Since the manure supply is not sufficient, green-manure crops, such as rye, clover, and buckwheat, are needed. Crops sometimes suffer from drought in dry seasons.

Fox sandy loam, gravelly phase.—The Fox sandy loam, gravelly phase, differs from the type in that it has a higher percentage of gravel scattered over the surface and mixed with the soil mass. It has the same origin and topography and drainage as the typical Fox sandy loam. The same crops are grown and the yields are about the same. The phase can be improved by the methods recommended for the Fox sandy loam, and the land has about the same range in value.

FOX LOAM

The surface soil of the Fox loam in cultivated fields consists of 8 to 10 inches of grayish-brown to brown gritty loam. Below this is a layer, 10 to 20 inches thick, of yellowish-brown to very light brown loam. The lower subsoil, a layer 1 to 3 feet thick, consists of reddish-brown gravelly sandy clay. The substratum, usually 3 to 5 feet below the surface, consists of stratified beds of gray gravel and sand with a high percentage of calcareous material. The profile in virgin areas differs in that the surface layer to a depth of 2 to 4 inches is a dark-brown mellow loam, owing to the accumulation of organic matter. In some places there are small quantities of gravel on the surface or in the surface soil, but the type is almost entirely free from bowlders.

The Fox loam is the most extensive and most widely distributed soil type in the county. Some of the largest areas lie between Kalamazoo and Richland and on the west side of Gull Lake. Other large

areas lie south of Kalamazoo, throughout the south-central part of the county, and in the southwestern part. Many other comparatively large areas are scattered throughout the outwash plains and lake and river terraces.

The topography of this type varies from level to slightly undulating, gently rolling, or rolling, the latter condition occurring near lakes and streams. The natural drainage on practically all of the Fox loam is good. The sand and gravel strata afford excellent underdrainage. Only a few low places or kettle holes are sometimes too wet to be used for cultivated crops.

The Fox loam is one of the most important soils of the county and nearly all of it is under cultivation. The original forest growth consisted mainly of hardwoods, chiefly oaks, with beech, hard maple, hickory, and walnut less abundant. This type is well adapted to stock raising and general and dairy farming. The principal crops are corn, wheat, oats, hay, and clover. Wheat has always been an important crop and was grown almost continuously on the same fields until a few years ago. Alfalfa is becoming an important crop, yielding from 2 to 4 tons of hay per acre per season. Potatoes are grown and in favorable seasons yield from 100 to 150 bushels or more per acre. Beans are sometimes grown in small patches. They yield about 15 bushels per acre. Corn yields 30 to 80 bushels, with an average of about 35 bushels; wheat 10 to 40 bushels, averaging about 22 bushels; oats 25 to 60 bushels, with an average of about 40 bushels; timothy and clover mixed yield 1 to 2 tons of hay; timothy alone, 1 to 1½ tons.

The Fox loam is a little more retentive of moisture than the sandy loam type. It is not subject to surface wash and is easily kept in good tilth. With good cultural methods it can readily be maintained in a high state of productiveness. When the soil is limed it is suited to clover and alfalfa. Commercial fertilizer is used to some extent by some of the more up-to-date farmers, and many of them use lime or ground limestone, especially for alfalfa and clover.

The Fox loam is valued rather high, the prices ranging from $75 to $250 an acre and averaging about $125 or more.

FOX SILT LOAM

The soil of the Fox silt loam in virgin areas has 2 to 4 inches of brown mellow silt loam underlain by a light grayish brown heavy silt loam, which passes into brownish or buff-colored clay to clay loam with a reddish cast, and this into a brown to reddish-brown layer of clayey sand. The substratum consists of sand and gravel loose and incoherent in structure.

The profile of the Fox silt loam is essentially the same as that of the Fox loam, except that the buff-colored layer is somewhat more compact in structure and the depth to the reddish-brown layer is usually greater. In some places the heavy clay loam section grades into sticky sand and gravel without the presence of a reddish-brown layer. Locally the surface soil is somewhat darker colored than that of the Fox loam or Fox sandy loam. This type was forested, but it appears in places that the change from a prairie condition to forest has taken place in comparatively recent times, inasmuch as the resemblance to the Warsaw profile is marked. Small areas of the

Fox loam and Warsaw silt loam are included with the Fox silt loam as mapped in this county.

The type is developed on broad outwash plains and terraces through the county. The largest areas are found 3 miles southeast of Kalamazoo, 2½ miles south of Comstock, in the extreme southwestern part of the county, one-half mile east of Oshtemo, 1 mile west and 1 mile north of Climax. Smaller areas occur in other places in the county. The type in general is level, usually with less variation than the Fox loam, although some of it is gently undulating to gently rolling. The natural drainage is good, but not as thorough as in the Fox loam. The upper subsoil does not permit the downward movement of water very freely, owing to the heavy texture, but the natural drainage is sufficient for all crops except in a few depressions where artificial drainage is necessary for cultivated crops.

The Fox silt loam is one of the most important soils of the county. It is not as extensive as the Warsaw silt loam, but is relatively as important agriculturally. Practically all of it is under cultivation. The original forest growth consisted chiefly of hardwoods, much the same as on the Fox loam, but in many of the prairielike places the forest growth was light. Some of the areas are locally known as "bur oak openings," a scattering growth of bur oak being the only tree growth on such areas.

The Fox silt loam is an excellent soil type, being equally as productive as the Warsaw silt loam. Corn, wheat, oats, hay, and clover are the principal crops. Dairy farming, hog raising, and stock feeding are carried on to some extent. Alfalfa, rye, potatoes, beans, and barley are also successfully grown. Corn yields from 40 to 80 bushels, with an average of about 55 bushels per acre; wheat 15 to 50 bushels; and oats 30 to 70 bushels, with an average of about 45 bushels.

The Fox silt loam is naturally well supplied with organic matter and the other elements necessary for plant nutrition, but the growing of such crops as corn and wheat continuously on the same fields has to a certain extent reduced its productiveness. This soil is not as easy to handle as the Fox loam. It clods if plowed too dry or too wet, and is harder to pulverize and get in a good physical condition. The same care as to handling under proper moisture conditions must be exercised as on the Warsaw silt loam.

The Fox silt loam is valued as high as any general farming land in the county and sells at prices ranging from $100 to $350 an acre.

WARSAW LOAM

The Warsaw loam to a depth of 9 to 12 inches is a dark-brown to very dark brown mellow loam, rich in humus or organic matter, passing into a lighter brown heavy loam to silt loam, which extends to a depth of 15 to 18 inches. Below this the subsoil is a reddish-brown or yellowish-brown, gritty, sandy, or gravelly clay loam. The lower part of the soil profile is a brownish or yellowish sand, underlain by beds of stratified sand and gravel. In some places the clay loam horizon extends to a depth of 24 to 30 inches, passing directly into stratified beds of sand and gravel, which consist in part of limestone material.

The Warsaw loam occurs mainly in association with the Warsaw silt loam. A large area lies 2 miles west and northwest of Vicksburg. Other areas are south of Kinney School, 1 mile south of Carpenter Corners, west of Galesburg, and 2½ miles southwest of Galesburg. It has a flat to undulating and gently rolling topography and the surface drainage is good. Owing to the porous nature of the lower subsoil the underdrainage is excellent and in a few places excessive.

The Warsaw loam is not so extensive and important as the Warsaw silt loam. About 95 per cent of it is under cultivation or used for pasture. This type is adapted to general and dairy farming. It is used for the same crops as the silt loam, but the yields are not quite as high, except for alfalfa, which seems to succeed better than on the silt loam. Corn, oats, wheat, and hay are the principal crops. Corn yields 30 to 70 bushels per acre, averaging about 45 bushels; oats 30 to 60 bushels, with an average of about 40 bushels; wheat 10 to 30 bushels, and hay 1 to 2½ tons. Potatoes, rye, and barley are grown, and alfalfa is becoming an important crop. On areas where the sandy and gravelly material is near the surface the crop yields are not as heavy as on the areas of heavier subsoil.

The Warsaw loam can be plowed, with less danger of clodding, under a wider range of moisture conditions than the silt loam. The surface of this type is not quite so dark in color as the silt loam and the soil is not so productive. Methods of improvement used on the Warsaw silt loam will apply to this type.

Land of the Warsaw loam type is held at slightly lower prices than the silt loam, ranging from $100 to $300 an acre. Most of this type is near villages or towns.

WARSAW SILT LOAM

The Warsaw silt loam consists of 8 to 15 inches of dark-brown to nearly black silt loam, grading to a somewhat heavier material of lighter brown color. This passes into a yellowish-brown to slightly reddish brown heavier layer, consisting of clay with some sand and gravel, and this in turn grades into a slightly sticky reddish-brown mixture of sand, gravel, and clay. The substratum appearing at 30 to 48 inches consists of loose sand and gravel, consisting in part of limestone material. During dry periods the more clayey layer becomes compact and hard, and is known locally as hardpan.

The distinguishing characteristics of this soil are the dark color and high content of humus, the unusual depth to which this dark color extends as compared with the soils developed under forest, and the compact nature of the subsoil at depths of 12 to 20 inches. The soil is fairly well supplied with the common elements of fertility—nitrogen, phosphorus, potassium, and calcium—is moderately retentive of moisture, and for the most part strongly acid in reaction at the surface.

The Warsaw silt loam is the most extensive prairie soil in the county. By far the largest area lies in Prairie Ronde and Schoolcraft Townships. This area is the largest body of any one type of soil in the county. Other comparatively large areas are mapped near Grand Prairie School, west of Kalamazoo, in Gull Prairie, in

the vicinity of Richland, and in Climax Prairie. Other small areas occur around Carpenter Corners, Indian Field Corners, east of Oshtemo, and in the Gourdneck Prairie, 2 miles northwest of Vicksburg. The areas around Schoolcraft, Climax, Richland, and Grand Prairie School are typical.

The Warsaw silt loam occupies flat, plainlike areas, slightly undulating in places. It is prairie land, although originally it supported a few scattering bur oaks and some hazel brush. Owing to the pervious nature of the geological formation underlying this type it is as a rule well drained. Although the heavy upper subsoil retards somewhat the percolation of water, crops are never damaged by an excess of moisture in the soil.

The Warsaw silt loam is one of the most important agricultural soils in the county. It is the strongest and most productive soil for general farm crops. Practically all of it is under cultivation. The type is devoted to general and dairy farming, and in some places to stock raising. The principal crops are corn, wheat, hay, and oats. Corn yields 45 to 100 bushels per acre, wheat 12 to 40 bushels, oats 35 to 70 bushels, timothy hay 1 to 2 tons, and mixed hay 1½ to 2½ tons. Rye, barley, potatoes, and alfalfa are grown in a small way. Cattle and hogs are fairly evenly distributed over the type. Most all the farmers have small orchards of pears, apples, and peaches, but this type is not very well adapted to fruit growing. Vegetables are grown for home use.

The Warsaw silt loam requires heavy machinery and work stock for plowing, but the top soil is fairly mellow or loamy and does not present any special tillage difficulties. The farmers in past years did not practice a systematic crop rotation, using the same fields for wheat several years. They have begun using a crop rotation consisting of corn the first year, followed by oats, then wheat with timothy sown in the wheat, the land being allowed to remain in sod one year to several years. Very little commercial fertilizer is used. All the available stable manure is applied. Liming has increased yields of the staple crops and is essential in getting a stand of clover and alfalfa.

The Warsaw silt loam is held at a higher price than any other general farm soil in the county. The areas are located mainly around villages and towns and the price ranges from $150 to $350 an acre. The deep, rich, and productive soil, the location, and the topography make this one of the most valuable soil types in Kalamazoo County.

By a systematic practice of crop rotation, liming the soil, and careful management this type will continue to be highly productive. Deeper plowing and the growing of more clover and alfalfa would be beneficial. The indications are that commercial fertilizers can be used profitably.

PLAINFIELD SAND

The surface soil of the Plainfield sand is a light-brown to grayish loamy sand, 7 to 10 inches deep. When dry the surface has a grayish cast. Beneath the surface soil the sand is yellowish or light yellowish brown and a little more coherent owing to a higher percentage of fine matter; at 24 to 30 inches it becomes a lighter shade of color and contains less colloidal matter. The substratum is sand mixed

with more or less gravel. In places there is some gravel scattered over the surface and mixed with the soil mass. The Plainfield sand is low in average content of moisture, comparatively low in fertility, and moderately to strongly acid in reaction to depths of 3 feet or more. It is easy to handle with light implements.

The Plainfield sand occurs in rather small scattered areas chiefly in the western half of the county. Two bodies lie along the Van Buren County line southwest of Daugherty Corners, and between Camp Custer and the Kalamazoo River. Important areas also are mapped at Texas Corners and Finch School. The type is developed on outwash plains and stream terraces. The surface ranges from flat to undulating and gently rolling. Some areas have an uneven surface owing to potholes.

The Plainfield sand is unimportant for general farming but seems to be well adapted to certain fruits. About 85 per cent of the type is cleared of its forest and is used mostly for the production of general farm crops or for pasture. Corn, rye, and potatoes are the main crops. Peaches, grapes, raspberries, and strawberries are grown to some extent. Alfalfa is also grown on well-manured fields after the addition of lime. Truck crops such as melons, cucumbers, tomatoes, and other vegetables are grown. With heavy applications of barnyard manure, potatoes yield from 70 to 150 bushels per acre. The yields of corn, oats, wheat, rye, and other staple crops are low. The original forest growth was dominantly white, red, black, and scarlet oak.

This land sells at $25 to $50 an acre, depending upon location, improvements, and topography.

PLAINFIELD SANDY LOAM

The Plainfield sandy loam, to a depth of 6 to 10 inches, consists of a brown, light-brown, or grayish-brown loamy sand to sandy loam containing variable but usually small quantities of organic matter. The subsoil is a yellowish-brown to brownish-yellow sandy loam, loamy sand, or, in many places, sand. In other places a brown slightly sticky sandy loam is encountered in the lower part of the 3-foot section. The subsoil is usually more sandy and open structured than the surface soil. Some gravel occurs in places on the surface and throughout the soil mass. The type is quite gravelly near streams and kettle holes. The substratum consists of stratified sand and gravel and is not highly calcareous.

The Plainfield sandy loam as mapped in this county comprises soil which on the whole is sandier, more pervious, and less productive naturally than the Fox sandy loam. It is similar to the Plainfield sand, except that the surface soil is slightly more coherent and has a higher content of organic matter. Some spots of Plainfield sand and of Fox sandy loam are included in the areas mapped as Plainfield sandy loam.

The Plainfield sandy loam occurs in a few good-sized areas around West Lake, between Portage and Sugarloaf Lake, near Texas Corners, and in the northwestern part of the county. Several smaller areas are mapped in other places in the county. It is developed on lake and stream terraces and on glacial-outwash plains. The surface is level to gently undulating, becoming rolling to hilly near the

streams and lakes. Drainage is good to excessive. The open structure of the subsoil allows the moisture to drain away easily and in dry seasons crops suffer from drought.

The Plainfield sandy loam is relatively inextensive. About 90 per cent of it is in cultivation or in pasture; the rest supports a forest growth consisting chiefly of oak and maple, with some hickory and elm. The type is especially adapted to early truck crops, including potatoes, melons, strawberries, and raspberries. These crops are grown commercially near Portage and West Lake. The greater part of the type is used for general farming, corn, wheat, rye, alfalfa, oats, and hay being the principal crops. The soil is rather droughty and the crop yields vary greatly with the seasons. In favorable seasons the returns are slightly lower than on the Fox sandy loam. Corn yields from 15 to 40 bushels per acre, wheat 8 to 15 bushels, rye 10 to 20 bushels, alfalfa 2 to 4 tons per acre per season, oats 12 to 30 bushels, potatoes 80 to 200 bushels, hay one-half ton to 1½ tons, and beans 8 to 20 bushels.

OSHTEMO SANDY LOAM

The surface soil of the Oshtemo sandy loam consists of 10 to 14 inches of brown sandy loam, normally carrying small quantities of gravel. The upper subsoil is a yellowish-brown sandy loam to a depth of 22 to 30 inches, grading below into a light-brown gravelly sand, and this within a few inches into beds of grayish gravel and sand. The underlying unweathered material is moderately to strongly calcareous. The type differs from the Plainfield sandy loam in having a deeper and browner surface soil and also in having a calcareous substratum. It differs from the Fox sandy loam mainly in not having any pronounced compactness or reddish color in the upper subsoil or heavy layer.

The Oshtemo sandy loam occupies terraces and filled-in valley areas, where the material is of mixed origin, with limestone as an important constituent. The surface is nearly level and drainage is generally good.

This type has a small development in the county and therefore is not important agriculturally, although nearly all of it is under cultivation. It is used for all general farm crops with satisfactory results. Corn, rye, beans, potatoes, and wheat are the principal crops grown. Corn yields from 30 to 50 bushels, rye 15 to 25 bushels, beans 5 to 15 bushels, potatoes 70 to 100 bushels, and wheat 10 to 20 bushels per acre. This soil is easy to handle and retains its moisture remarkably well in dry seasons. All the available stable manure is applied to this soil, but as yet very little commercial fertilizer is being used.

The Oshtemo sandy loam, when sold separately, brings from $40 to $100 and more an acre.

The requirements for improving this soil are the same as for the other sandy loam soils in the county. The incorporation of organic matter by turning under crops as green manure and liming would prove beneficial.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of the Oshtemo sandy loam:

Mechanical analyses of Oshtemo sandy loam

Number	Description	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
		Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
301421	Soil, 0 to 9 inches	4.0	19.2	21.6	40.1	2.4	9.0	3.7
301422	Upper subsoil, 9 to 23 inches	9.9	18.5	20.2	40.6	1.6	5.9	3.5
301423	Lower subsoil, 23 to 36 inches	17.8	43.0	19.6	12.4	.8	3.0	3.5

OSHTEMO LOAM

The surface soil of the Oshtemo loam consists of 10 to 15 inches of brown mellow loam. The subsoil is a light-brown or yellowish-brown loam to a depth of 24 to 36 inches, which may be somewhat compact and have a slight development of a heavy layer in the lower part immediately above the gravelly substratum. The substratum is composed of stratified beds of sand, gravel, and cobbles, consisting in part of limestone material. The type differs from the Fox loam in having a deeper soil with a more pronounced brown color, and in not having a heavy-textured subsoil. The color and depth of the soil and the character of the substratum are different from those of the Plainfield types.

The Oshtemo loam occurs as small, narrow areas distributed through the central and northeastern parts of the county. It occupies flat to gently sloping or gently undulating areas occurring as terraces along streams, and as low bench lands, or colluvial accumulations, at the base of slopes and on the floors of narrow valleys. The natural drainage is good. Some of the soil included in these areas is not materially different from the Warsaw loam and Fox loam. Small areas of wet soil belonging to other types have also been unavoidably included.

The Oshtemo loam has a small total acreage, but all of it is under cultivation. The general farm crops do well. Corn, wheat, oats, clover, hay, alfalfa, potatoes, and rye are the important products. Beans are grown to a small extent. The usual crop rotation is practiced on this type without the use of much commercial fertilizer. This land sells at $75 to $200 an acre, the price depending mostly on the location.

The results of mechanical analyses of samples of the soil and upper and lower subsoil of the Oshtemo loam are shown in the following table:

Mechanical analyses of Oshtemo loam

Number	Description	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
		Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
301488	Soil, 0 to 12 inches	1.0	7.2	8.4	28.2	12.6	32.6	10.2
301489	Upper subsoil, 12 to 26 inches	.2	4.6	8.3	57.2	11.0	12.9	5.8
301490	Lower subsoil, 26 to 36 inches	.3	3.5	6.4	59.6	11.4	12.7	5.9

BRADY LOAM

The surface soil of the Brady loam consists of 8 to 12 inches of brownish-gray loam. The upper subsoil to a depth of 16 to 24 inches is a yellowish or light yellowish brown loam to heavy loam slightly mottled with gray. This grades into a gray and brown mottled, compact loam to clay loam, extending to a depth of about 30 inches. Below 30 inches is a gravelly and sandy substratum which carries a high percentage of limestone material. In places the surface soil is a grayish loam to silt loam to a depth of about 9 inches and passes abruptly into the heavy subsoil.

The Brady loam occurs in small areas in the southeastern and central parts of the county. It occupies mostly low stream terraces, filled-in valleys, and outwash plains. The topography is flat to slightly uneven and the natural drainage poor.

Most of the Brady loam is in cultivation. It is inextensive but is a good soil, when drained, for all general farming. It is especially suited to corn and grasses. In favorable seasons large yields are obtained.

MAUMEE SILTY CLAY LOAM

The Maumee silty clay loam consists of dark-brown or nearly black clay loam to silty clay loam, with a high content of organic matter, passing at a depth of 9 to 14 inches into a dark bluish gray or drab silty clay and at about 20 inches into bluish-drab plastic clay slightly streaked with yellow and brown stains. In some places the subsoil may be a blue plastic clay to a depth of 3 feet or more; in other places the lower part of the 3-foot section may be yellowish or yellowish brown with gray and bluish mottlings. The clay subsoil is plastic when wet and almost impervious to water. In a few places sandy or gravelly layers may occur in the lower part of the 3-foot section. Locally the surface is quite mucky. Small spots of Muck, Newton silty clay loam, and Newton loam are included with this type.

The Maumee silty clay loam occurs in small strips scattered through the eastern part of the county and in a few spots in other parts of the county. It has nearly a flat surface and usually lies a little lower than the associated Newton types. The natural drainage is poor. The type is closely associated with the Muck soils.

The Maumee silty clay loam has a small total acreage in this county and therefore is not important in its agriculture. The soil is naturally rich and productive. About 70 per cent of it has been cleared of forest growth. Much of it is used for pasture. The original forest consists chiefly of elm, ash, soft maple, swamp white oak, shagbark hickory, and linden or basswood. This type is adapted to general farming. Corn, hay, clover, and oats do well. Corn yields from 30 to 60 bushels, averaging about 45 bushels per acre. The yield of hay is 1½ to 2½ tons. Clover not infrequently returns 3 tons per acre. Oats yield 25 to 40 bushels, averaging about 30 bushels per acre.

This type of soil is valued at $25 to $100 an acre, the price depending on drainage and location. If tile drained, it usually brings a higher price.

Good drainage is the principal need on the Maumee silty clay loam. After the land has been drained an application of lime is beneficial.

NEWTON SANDY LOAM

The Newton sandy loam is a dark-gray to dark-brown mellow sandy loam, with a depth of about 7 inches, underlain by a compact sandy loam subsurface, passing into a brown, mottled with gray, slightly sticky sandy loam, which extends from about 10 to 24 inches. The lower subsoil usually consists of dull-gray to brownish-gray loose sand and gravel. In places the surface soil is rusty brown to brownish gray and the subsoil has a rusty-brown layer and yellowish sand in the lower part of the 3-foot section. These patches would have been mapped as Saugatuck sand if they had been large enough to separate. The soil is acid, but the substratum may contain some calcareous material.

The Newton sandy loam occurs in small bodies mostly in the northwestern part of the county near the Van Buren County line. Two small bodies are in the southeastern part of the county. The surface is nearly flat. Drainage is poorly established owing to the high water table.

This type is an unimportant soil. Only a small percentage is under cultivation in the county, although a great deal of it is cleared and used for pasture.

The results of mechanical analyses of samples of the different layers of the Newton sandy loam are given in the following table:

Mechanical analyses of Newton sandy loam

Number	Description	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
		Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
301433	Soil, 0 to 7 inches	5.1	19.5	18.7	31.9	3.4	14.9	6.7
301434	Subsoil, 7 to 10 inches	6.5	25.1	21.1	33.0	2.9	8.4	3.5
301435	Subsoil, 10 to 24 inches	3.0	14.4	16.6	45.5	3.8	11.0	6.0
301436	Subsoil, 24 to 36 inches	10.2	35.3	22.5	24.3	1.9	3.6	2.4

NEWTON LOAM

The Newton loam has a surface soil of dark-brown to dark grayish brown mellow loam to heavy fine sandy loam, ranging in depth from 6 to 10 inches. The subsoil to depths of 20 to 30 inches is a mottled yellowish-brown and gray loam to clay loam, passing below into a grayish sandy loam to sandy clay loam or gravelly sandy loam, which extends to a depth of 3 feet or more.

The soil is moderately acid. Variations occur in this type as found 1 mile north and one-half mile west of Finch School, where the soil is a very fine sandy loam underlain by a very fine sandy clay which extends to 3 feet or more. Spots of Newton sandy loam, Newton loamy sand, Newton silty clay loam, and Maumee loam too small to warrant separation also are included.

The Newton loam is derived from water-laid material. It has its largest development in the southeastern and northwestern parts of the county, but occurs also in areas scattered through the central part. Its surface is flat or nearly flat and the natural drainage is poor. In areas associated with the Plainfield soils the subsoil is more sandy and in those in the southeastern part of the county it is heavier than typical.

The type is not so very extensive but of some importance in the agriculture of the county. Corn, oats, and hay are the chief crops. Corn is grown with good results, especially in dry seasons, yielding from 25 to 40 bushels per acre without the use of commercial fertilizer. Oats produce 30 to 50 bushels per acre. A large proportion of the land is used for pasture. Land of this type sells at $75 to $125 an acre.

NEWTON SILT LOAM

The Newton silt loam consists of 6 to 10 inches of dark brownish gray, friable silt loam, moderately high in organic matter. The subsoil to a depth of 20 to 30 inches is a mottled yellow, brown, and gray silty clay or sandy clay.

Only one area of this type is mapped. This lies near the northwest corner of the county. The topography is nearly level and drainage is naturally poor.

The Newton silt loam is of minor importance in the county owing to its small area.

NEWTON SILTY CLAY LOAM

The surface soil of the Newton silty clay loam consists of about 8 inches of dark grayish brown to nearly black heavy silt loam to silty clay loam, underlain by a drab-gray or steel-gray, heavy silty clay loam to silty clay mottled with brown, which passes at a depth of 20 to 40 inches into gray, yellow, and brown sand, gravel, and clay. The substratum consists of clay, sand, and gravel. Included with this type are small bodies of Newton loam and Maumee silty clay loam and a few areas that are somewhat mucky at the surface.

This type has its largest development in the southeastern part of the county. A few small areas are found in the northwestern part and east of Cooper. The topography is nearly flat, with slight elevations and depressions, and as a result the soil is poorly drained.

The Newton silty clay loam is not an important type, on account of its small extent. It is naturally a strong soil. About 70 per cent of it is in forest, and only a small proportion of the cleared land is being farmed. The original tree growth consists chiefly of elm, hickory, poplar, oak, ash, ironwood, and linden. Both the thinly forested and cleared areas are used mainly for pasture and are well adapted for this use. Where cultivated, corn, oats, hay, and barley are the principal crops. Some wheat is grown. Corn and oats, when properly handled on the better drained areas, produce from 30 to 50 bushels per acre. The use of fertilizer is not general.

This type sells for $50 to $100 an acre in the better drained areas, and $30 to $50 in the poorly drained sections.

Better drainage is the chief need of the Newton silty clay loam. A good many drainage ways have been cut through this soil, but more canals and ditches are needed.

The following table gives the results of mechanical analyses of samples of the soil and upper and lower subsoil of the Newton silty clay loam:

Mechanical analyses of Newton silty clay loam

Number	Description	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
		Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
301430	Soil, 0 to 5 inches	1.2	3.6	3.6	15.2	4.0	42.6	29.8
301431	Upper subsoil, 5 to 14 inches	.4	2.8	5.3	26.0	5.6	37.7	22.1
301432	Lower subsoil, 14 to 36 inches	.1	1.1	1.4	6.8	2.8	47.8	40.0

GRIFFIN LOAM

The Griffin loam consists of a layer of dark-brown to grayish-brown loam to fine sandy loam, 8 to 12 inches thick, underlain by a lighter brown sandy loam to a depth of 20 to 30 inches, below which there are layers of gray to rusty-brown material containing masses of blue clay. The surface soil in the wetter parts is nearly black and is prevailingly silty in texture. In the better drained parts the texture varies from a loam to a sandy loam.

The Griffin loam is confined to the first bottoms along the Kalamazoo River. It is composed of recent deposits laid down by the streams during overflow. It has a flat surface, and 80 per cent of it is poorly drained.

This type is inextensive and only small spots are being cultivated. It is used mostly for pasture and seems well adapted to this purpose. On the better drained spots bluegrass does well, affording excellent pasturage. The poorly drained places support a growth of wild grasses, with elm, willow, and sycamore trees.

MUCK

Muck consists of soil composed largely of decayed organic matter. In some of the uncultivated areas a peaty condition exists, the material in such places being composed almost entirely of vegetable matter showing very little decomposition. The typical Muck, as mapped in Kalamazoo County, is mellow and black at the surface. The deposits attain a depth of 3 feet or more and in the lower parts have more the nature of Peat. The material of the peaty areas, where the decomposition has been retarded, is brown, more fibrous and generally more acid. Minor variations are due to surface admixture of sand and clay.

Muck occurs in all parts of the county in areas ranging in size from a few acres to several thousand acres. Many small bodies are not large enough to be shown on the map. A few areas occur along slopes, where seepage has favored a heavy growth of vegetation.

The areas of Muck are flat or depressed and wet. In many cases they lack outlets, and it is difficult to provide the drainage necessary to fit them for cultivation.

Only a small proportion of the land is under cultivation. The better drained, well-decomposed Muck areas are important for the

production of celery and other vegetables; they are valued also as a source of hay and for growing peppermint and spearmint.

Much of the land is cleared of trees and bushes and is used for summer pasture. The dark alkaline, or high-lime, Muck affords pasture, mainly bluegrass, for about six months. The Muck that has the best natural drainage supports a growth of ash, elm, soft maple, and poplar. The growth on the wetter, more peaty areas consists of tamarack, willow, rushes, flags, cat-tails, huckleberry, sedges, and other water-loving plants.

Hay is probably the best general crop grown on the typical Muck, the yields ranging from 1½ to 3 tons per acre. Small grains have a tendency to produce too rank a growth of straw and are likely to lodge and produce light yields.

By far the greater part of the Muck in cultivation is devoted to celery, peppermint, spearmint, onions, carrots, beets, radishes, parsnips, lettuce, spinach, cabbage, and cauliflower. Most all vegetables do well on this soil. The largest acreage is used for the production of celery and vegetables, especially in the vicinity of Kalamazoo, Comstock, and Portage.

When the Muck lands were put in cultivation in former days, some of the farmers burnt over the land, but this practice is now considered injurious and is seldom followed. Commercial fertilizers and manure are used on Muck land for all special crops. Manure is shipped in from the Chicago stockyards.

Muck, shallow phase over sand.—Muck, shallow phase over sand, differs from the typical Muck in that the black organic surface soil rests on a gray or brownish-gray sand and gravel at depths of from 12 to 36 inches. It occurs in close association with the typical Muck and is used mostly for pasture and general farm crops.

Muck, shallow phase over marl or marly clay.—The shallow phase underlain by marl or marly clay is considered a better soil than that underlain by sand, but the two occur associated in such small spots that in many places they could not be separated. It is usually alkaline in reaction. In some places the marl is taken out and spread over the land.

SUMMARY

Kalamazoo County is situated in the southwestern part of Michigan. It has an area of 562 square miles, or 359,680 acres. Its topographic and physiographic features are typical of a glaciated region, ranging from rolling or hilly morainic belts to broad areas of level to gently undulating country.

The drainage of the county is mainly through the Kalamazoo River and its tributaries. The southern part of the county drains into the St. Joseph River in St. Joseph County. All the drainage ultimately reaches Lake Michigan.

There are many swamps in the county and numerous lakes and ponds, but the uplands are generally well drained.

The elevation of the county ranges from about 700 feet above sea level, where the Kalamazoo River leaves the county, to 1,040 feet on the highest point of a moraine in Oshtemo Township.

Kalamazoo County was organized in 1829. The greater number of the early settlers came from New York, Pennsylvania, Virginia,

and Ohio. The population in 1920 was 71,225, of which nearly 31.9 per cent was rural. The rural population is fairly evenly distributed over the county; the average density is 40.5. Kalamazoo is the largest town and is the county seat.

Kalamazoo is a good local market, and Chicago and Buffalo and numerous other cities are important outside markets, especially for celery.

The climate is characterized by mild summers and cold winters. The rainfall is usually sufficient for all crops grown. The mean annual rainfall is 34.41 inches and the mean annual temperature is 47.9° F. The average length of the growing season is 153 days.

The agriculture of Kalamazoo County consists chiefly of the production of cereals, hay, and vegetables, although dairying is becoming an important industry. Corn, wheat, rye, oats, hay, potatoes, and vegetables are the leading crops.

The 1920 census reports a total of 3,161 farms in the county, with an average size of 98.7 acres. These farms included 86.7 per cent of the area of the county. Seventy-nine per cent of the land in farms was improved. Land values range from $15 to $350 or more an acre.

Kalamazoo County lies in a typical glaciated section of southern Michigan. The soils have been grouped into series according to color, structure, origin, topography, and drainage conditions. The series are divided into soil types according to texture. Thirteen series, exclusive of Muck, are represented by 25 types and one phase in Kalamazoo County.

The Bellefontaine, Conover, Crosby, Rodman, and Coloma soils are developed on glacial drift or moraines.

The Bellefontaine soils have a rolling to hilly and rough topography and the drainage is excellent to excessive. General farm crops do well on these soils.

The Conover loam has a gently sloping to rolling surface and fair drainage. This soil is adapted to all staple crops.

The Crosby loam occupies level or depressed areas in the glacial-drift region. When drained it produces well in dry seasons.

The Rodman gravelly sandy loam includes the roughest land in the terminal moraine section and also occupies the steep broken slopes in the outwash areas. Drainage is excessive.

The Coloma series includes soils of rolling to hilly topography and good to excessive drainage. They are devoted to peaches, grapes, berries, truck, and general farm crops.

The Fox, Warsaw, Plainfield, Oshtemo, Brady, Maumee, and Newton soils occupy filled-in valleys, terraces, and outwash plains.

The Fox soils occur on level to undulating and gently rolling terraces or outwash plains. Drainage is good. These soils are well adapted to general farming, dairying, and stock raising.

The Warsaw soils are dark-colored prairie soils. They have level to slightly rolling surfaces, and, owing to the open substratum, are well drained. These are among the strongest soils in the county and nearly all in cultivation.

The Plainfield soils are light sandy soils better suited to growing truck and other special crops than to general farming.

The Oshtemo soils are developed on low terraces or filled-in valleys. They have a level to gently sloping topography and good drainage, and are used mainly for staple crops, which give good yields.

The Brady loam is a nearly level soil which is good for hay and corn after being drained.

The Maumee silty clay loam occupies level, poorly drained areas. When drained it is used for corn, oats, clover, and hay.

The Newton series consists of soils that have in general a flat surface and prevailingly poor drainage. When drained they are well suited to staple crops.

The Griffin loam is developed in small areas along the Kalamazoo River and is unimportant.

Muck includes several grades of organic soils which have a flat surface and naturally poor drainage. Large areas have been reclaimed by ditching. The more completely decomposed black Muck is a valuable soil, peculiarly adapted to the production of special crops, such as celery, onions, cabbage, and other vegetables, peppermint, and spearmint.

Accessibility Statement

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

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

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

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

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

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