U. S. DEPARTMENT OF AGRICULTURE.
BUREAU OF SOILS—MILTON WHITNEY, Chief.

SOIL SURVEY OF NEWTON COUNTY, INDIANA.

BY

N. P. NEILL AND W. E. THARP.

[Advance Sheets—Field Operations of the Bureau of Soils, 1905.]

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1906.

U. S. DEPARTMENT OF AGRICULTURE.
BUREAU OF SOILS—MILTON WHITNEY, Chief.

SOIL SURVEY OF NEWTON COUNTY, INDIANA.

BY

N. P. NEILL AND W. E. THARP.

[Advance Sheets—Field Operations of the Bureau of Soils, 1905.]

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1906.

[PUBLIC RESOLUTION—No. 9.]

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

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

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

Approved, March 14, 1904.

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

CONTENTS.

	Page.
Soil Survey of Newton County, Indiana. By N. P. Neill and W. E. Tharp	5
Location and boundaries of the area	5
History of settlement and agricultural development	6
Climate	8
Physiography and geology	9
Soils	11
Marshall fine sandy loam	12
Marshall loam	15
Marshall fine sand	18
Miami black clay loam	19
Clyde loam	20
Clyde fine sand	22
Newton fine sand	25
Miami fine sand	27
Kaskaskia loam	28
Swamp	28
Peat	29
Agricultural methods	32
Agricultural conditions	34

ILLUSTRATIONS.

FIGURE.

	Page.
Fig. 1. Sketch map showing location of the Newton County area, Indiana	5

MAP.

Soil map of Newton County sheet, Indiana.

SOIL SURVEY OF NEWTON COUNTY, INDIANA.

By N. P. NEILL and W. E. THARP.

LOCATION AND BOUNDARIES OF THE AREA.

Newton County lies in the northwestern part of Indiana, bordering the Illinois State line. It is bounded on the north by Lake County, from which it is separated by the Kankakee River; on the east by Jasper County; on the south by Benton County, and on the west by the State of Illinois. Newton County is quite regular in outline. Its

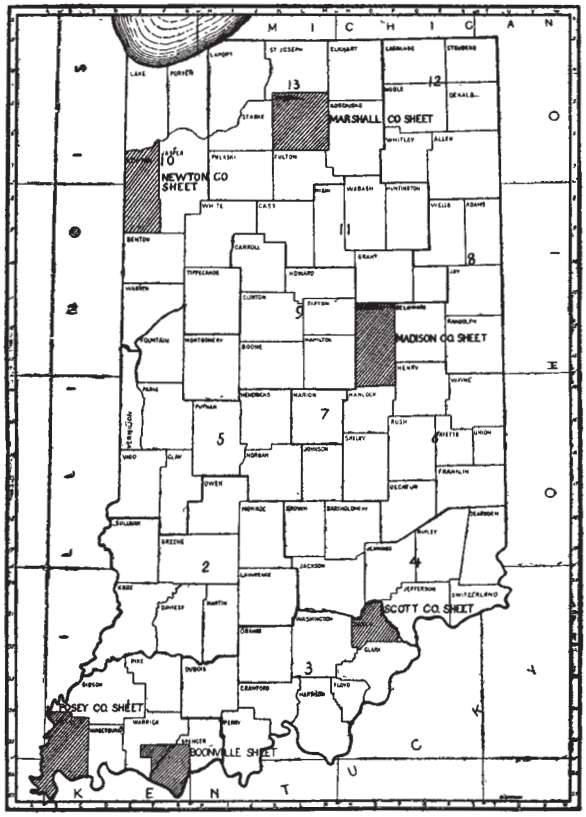

FIG. 1.—Sketch map showing location of the Newton County area, Indiana.

average length north and south is 30 miles and its average width east and west is 13 miles. The area included within these boundaries is 251,448 acres, or, approximately, 393 square miles.

Goodland, Kentland, and Morocco are the principal towns in the county.

HISTORY OF SETTLEMENT AND AGRICULTURAL DEVELOPMENT.

The original county of Jasper, which was organized in 1838, formerly embraced the territory included within the present limits of Newton and Jasper counties. Owing to the large size of the county and the great distance of the outer portions, especially the western, from the county seat, it was divided. The separation was made in 1859, with the county seat of Newton County located at Kent, now Kentland.

It is quite difficult to determine who were the first settlers to come into this locality. The county was originally a wet, marshy country, covered for the most part with a heavy growth of prairie grass, with some timber along the streams, and inhabited by a large number of fur-bearing animals. These animals attracted the early hunters and trappers into this section of the State, and in some cases temporary settlements were made along the streams.

Prior to 1850 society had little organization. The population was small and scattered over considerable territory, except in one or two localities. The principal early settlements were made on timbered areas along the Iroquois River, in the eastern part of the county. The early settlers came principally from southern Indiana, but most of them were natives of Virginia, Kentucky, Pennsylvania, and Ohio. In later years, as the county became better developed, the immigrants came chiefly from New York, Maryland, and Illinois. The growth and development of the county was at first greatly retarded by trouble with the Indians and later by a class of outlaws who made this territory their field of operation.

Aside from these retarding influences the prairie fires were the most dreaded of all early contingencies with which the settlers had to deal. Various means were resorted to for protection against these fires, but often, when driven by high winds, they would leap any barrier that could be constructed, and buildings, crops, and all improvements would be destroyed, and the settler was often fortunate to escape with his life.

Prior to 1860 the county had no railroads, no newspapers, and but few inhabitants. About 1853, however, the county began to develop gradually, and the advent of the railroad in 1860 gave its growth a decided impulse.

The early settlers brought only the actually necessary outfits with which to begin farming operations in this new territory. They generally came in wagons drawn by horses or oxen, and as a rule followed old trails made by the Indians. The roads over which they passed were bad and at times almost impassable, and under such conditions only the necessities of life were brought with them. The farmers depended upon the near-by villages or settlements for such farming

implements as could be obtained. The plow then used was a crude, ungainly implement and not capable of breaking up prairie lands. For this reason the early inhabitants settled on the timbered areas along the streams. Here the land had been heavily shaded and was free from the tough grass roots of the prairie, and when cleared was more easily cultivated. But as it became necessary to break up the prairie lands a heavy sod plow was developed, and while it was a crude, poorly constructed implement, nevertheless it revolutionized the farming of early days. The plow consisted of a beam 10 or 15 feet in length, a share that would cut about 2 feet in width, and a moldboard made of iron bars. It generally required six yoke of oxen to draw it, but the expenditure of all this labor was usually repaid the first year. The second year a "cary" or two-horse side plow was used, which, together with the hoe, was the only implement used until harvest time, when the reap hook, cradle, scythe, and flail were employed.

Each settler brought his cattle and horses with him. Horses were used at first, but later oxen proved to be more serviceable in breaking up new land. A few hogs were raised, which furnished the farmer with meat and occasionally added a little to his income. The wild prairie grass furnished feed for most of the stock, and only a small amount of corn was fed.

Corn was generally the first crop planted. It was dropped in the edge of the furrow while the sod was being turned under. The crop produced was small and of inferior quality. Wheat was occasionally grown, but not very successfully. It generally grew too rank or succumbed to attacks of insects or unfavorable climatic conditions.

The agricultural development of the county was at first greatly retarded by the lack of local markets and the great cost of transporting the produce to distant ones. Later, however, as public roads were improved and the towns and local markets were built up development became more rapid. Morocco, the oldest town in the county, was established in 1851. In 1860 the town of Kent, now Kentland, was founded, and in the following year Goodland was laid out.

In later years, as the prairie lands were being put under cultivation, the settlers aimed to improve first such lands as possessed good natural drainage, avoiding wet and poorly drained areas. Corn, oats, wheat, and hay were the chief products. Wheat formerly produced good yields, but in later years its production proved unsuccessful. The great freeze of 1871–1873 was the death blow to wheat growing in this county. Several attempts were afterwards made to produce this cereal, but they were generally unsuccessful.

In 1871 wild land was valued at $20 an acre, and in 1872 it was worth $25 an acre. During the five years following land advanced in price in proportion to the amount of improvement put upon it. The wet season, which covered a period from 1882 to 1886, brought the

price of land down to about $10 or $15 an acre. The farmers then began tiling and draining the lands, and since that time land has gradually advanced in price.

Fifteen years ago cattle and hogs were raised more extensively than at present. The low price of beef and pork, together with the prevalence of hog cholera, was the cause of the decrease in their production. During recent years, however, the stock industry has been gradually improving and at present a large proportion of the county, particularly the northern, is devoted chiefly to stock raising and dairying.

CLIMATE.

No data giving the normal monthly and annual temperature and precipitation of Newton County were obtainable. The appended table gives the weather records taken at Rensselaer, which is only a few miles east of the area, and Hammond, which is situated in the county north of Newton:

Normal monthly and annual temperature and precipitation.

Month.	Rensselaer.		Hammond.		Month.	Rensselaer.		Hammond.	
	Temperature.	Precipitation.	Temperature.	Precipitation.		Temperature.	Precipitation.	Temperature.	Precipitation.
	° *F.*	*Inches.*	° *F.*	*Inches.*		° *F.*	*Inches.*	° *F.*	*Inches.*
January	32.6	2.91	23.4	2.37	August	74.5	2.30	71.0	1.97
February	24.8	3.00	22.2	2.10	September	66.2	1.59	65.4	2.70
March	41.6	5.05	36.0	.....	October	57.8	3.03	54.6	1.79
April	51.0	2.03	47.2	2.64	November	44.6	3.43	38.0	2.15
May	62.8	3.36	58.5	4 68	December	29.8	2.78	26.2	2.38
June	69.2	5.61	68 8	3.95	Year	52.6	38.97	48.8	.....
July	76.4	3.88	73.7	2.64					

The climate of Newton County is humid. The rainfall is quite evenly distributed throughout the year. During the growing season it is greatest during the months of May, June, and July, averaging about 4.28 inches for each month, the heaviest precipitation occurring during the month of June, averaging 5.61 inches. The total yearly precipitation is 38.97 inches.

The average annual temperature is about 52.6° F. The coldest months of the year are December, January, and February, the average temperature for these months being 29° F. There are periods during the winter months when the temperature falls considerably below the average, but such cold periods seldom last more than a few days.

The warmest period of the year occurs from June to August, the average temperature being 73.3° F. During these months the temperature often rises as high as 90° F., but such warm periods only last for two or three days at a time.

A very important and characteristic feature of the climate is the

occurrence of strong winds during the late spring and early fall months. Periods of strong winds often extend over a number of days and during the latter part of the growing season, especially if the rainfall is light, these hot dry winds sweeping over the area rob the soil of considerable moisture and crops are more or less injured.

The average date of last killing frost in the spring is April 30 at Rensselaer and April 20 at Hammond; the average date of first killing frost in the fall is October 5 for the former place and October 23 for the latter. On the low wet lands of the area frosts generally occur later in spring and earlier in fall than is shown by the above dates.

PHYSIOGRAPHY AND GEOLOGY.

The area surveyed lies north of the hydrographic basin of the Wabash River. It is separated from this basin by a low ridge, the northern slope of which embraces a small portion of the southern part of the county. The surface in this locality is slightly undulating and rolling and occasionally broken by small narrow valleys which have been formed by streams having a northerly direction. The general fall is to the north, and as the Iroquois River is approached the surface becomes more level. This portion of the area embraces a part of the typical prairie lands of the northwestern part of Indiana, and the surface for the most part represents a level plain. It is, however, quite frequently broken by small ridges. They occur most frequently along the eastern border of the area north of Goodland, although a number of them are scattered over this portion of the county. The ridges have a general east and west trend and vary in elevation from 10 to 20 feet above the mean level of the surrounding territory. The most important of these ridges occur on each side of the Iroquois River in Washington and Jefferson townships. Here they flank a narrow valley through which the river flows. They are well defined and extend back on each side of the stream for an average distance of about one-fourth mile.

The valley formed by this stream is narrow and only for a part of its course are second bottoms developed. These occur within the eastern half of the area, where the valley has an average width of about one-eighth mile. North of the Iroquois River, and particularly in the eastern part of Washington Township, the surface is almost a dead level with only a slight fall to the south. The western part of this township is more rolling and hilly.

The most conspicuous topographic feature of the county is the broad ridge which crosses it in a northeasterly and southwesterly direction about 5 or 6 miles north of the Iroquois River. This ridge forms the watershed between the waters of the Iroquois and Kankakee rivers, and is referred to geologically as the Iroquois moraine. The surface

of this moraine is decidedly undulating and rolling, and rises to an average elevation of about 700 feet above sea level. It has an average width of about 4 or 5 miles, being somewhat wider in the eastern than in the western part of the area.

North of this ridge the general fall is toward the north. The general aspect of this part of the county is that of a low, marshy plain, broken by innumerable hills and ridges of various elevations and a few swampy depressions. This district is plainly lacustral in its characteristics. The sloughs, swamps, and marshy areas indicate the beds of ancient lakes, and the low sand ridges mark, in many cases, old shore lines. Some of the beach lines can plainly be traced in the areas of Newton fine sand.

The prominent topographic features of this section are the many small hills and ridges scattered over the area. They are largely the result of wind action, and vary in height from 2 to over 150 feet and in breadth from less than 100 feet to over 1 mile. Between these ridges narrow strips occasionally occur with nearly a plane surface. Some of these ridges, particularly those having a low elevation, occur in clusters or are grouped together in the form of a chain.

The land bordering the Kankakee River is somewhat lower than it is farther back from the stream and is under water a greater part of the year. A more detailed description of the surface features of the county will be given later in the descriptions of the various soil types.

The drainage waters of the southern part of the county, south of the Iroquois Ridge, empty into the Iroquois River. This stream flows in a southwesterly direction across the county about 4 miles north of Kentland. North of the ridge the greater proportion of the drainage water flows to the north and empties into the Kankakee River. However, a part of these lands is drained by the Beaver Creek ditch, which flows in a westerly direction and empties into the Iroquois River in Illinois. This stream formerly drained the old Beaver Lake district.

Later the old State ditch, which is now known as the Beaver Lake ditch, was built and the waters of this district were turned into the Kankakee. The Beaver Lake ditch is the largest stream emptying into the Kankakee in Newton County. A number of other smaller ditches have been constructed which drain into this river.

The glacial drift that occurs over the area south of the northern base of the Iroquois moraine is correlated with the late Wisconsin drift sheet.[a] The surface material consists of sand, sandy loam, and loam, except in cuts or on the more pronounced slopes of some of the ridges constituting the Iroquois moraine, where the unweathered till is exposed. The drift varies in depth from 60 to 150 or more feet, and

[a] Monograph No. 38, U. S. Geological Survey.

is composed of a mixture of clay, sand, and gravel in varying proportions, with gravel generally increasing in size and amount with depth. Associated with this material are deposits of pure sand and gravel. Many of these gravel knolls have been opened and the gravel used for road building.

Large glacial bowlders also occur scattered over the surface of the greater part of the area, particularly on the prairie lands, and in a few areas on the moraines. These bowlders, which consist chiefly of granites, occasionally occur so plentifully as to interfere with cultivation, but in most cases they have been removed from the fields.

Another but much smaller moraine extends east from Percy Junction to the eastern boundary of the area. This ridge, which is composed largely of sand, forms the most southern of the sand areas of Newton County. Other sand areas occur north and northwest of these ridges, but they have no definite connection with one another or with the one just described.

North of the Iroquois moraine the soils are largely of lacustral origin and belong to the Lake Kankakee period. The flat areas are largely composed of sand, and heavy peat beds are quite common. In some areas peaty material is found underlying the sand, which denotes a period or interval of emergence or exposure to the atmosphere between the withdrawal of the ice sheet and the deposition of the sand over these deposits.

In a few areas in the southern part of the county Niagara limestone is found at a depth of only a few feet. In section 25 of Jefferson Township limestone is quarried and used for road building. The limestone is covered over with glacial material and has played no part in the formation of the soils of the area.

SOILS.

Eleven distinct soil types were recognized and mapped in the area surveyed. Each of the types is quite distinct in its typical form, although, as in nearly all glaciated areas, minor variations from the true type occur. The line of demarcation between the various soils is generally quite well defined, but in some cases the transition from one type into another is gradual and occasionally almost imperceptible. The typical prairie soils of the area are separated from the original marsh soils, which occupy the northern part of the county, by the Iroquois moraine. Covering this moraine and south of it four distinct types are recognized, while to the north of it and including the soils mostly of lacustral origin seven types are found.

The following table shows the extent of the several types:

Areas of different soils.

Soil.	Acres.	Per cent.	Soil.	Acres.	Per cent.
Marshall loam	81,856	32.8	Swamp	3,648	1.4
Clyde fine sand	61,048	24.4	Miami black clay loam	1,792	7
Marshall fine sandy loam	42,560	16.8	Clyde loam	960	.4
Miami fine sand	32,704	13.0	Kaskaskia loam	832	.3
Peat	10,368	3.9	Total	251,448	
Marshall fine sand	9,792	3.9			
Newton fine sand	5,888	2.4			

MARSHALL FINE SANDY LOAM.

The soil of the Marshall fine sandy loam consists of a medium to fine sandy loam, with an average depth of about 14 inches. It generally contains a very high percentage of organic matter, and to this is due its characteristic black or dark-brown color. As the depth of the soil increases the amount of organic matter gradually decreases and the color becomes correspondingly lighter. The texture of the soil is quite uniform, but the depth varies from about 8 to 20 inches, depending upon topographic position. On the crests of knolls and ridges it is generally of a more sandy nature and is more shallow than in the depressions, where, besides being usually deeper, the texture is somewhat heavier, in some cases approaching a silty loam. This is not always the case, however, and a few areas were found in which the soil on the higher elevations of the type was heavier than that occupying the lower areas. This latter variation generally occurs where the soil is quite shallow and rests directly upon bowlder clay. In this case considerable of the underlying clay has become more or less mixed with the soil, giving it a somewhat heavier character. The color of the soil in these localities is also somewhat lighter than it is in typical areas.

At a depth of about 14 inches the soil grades into a medium to fine yellow sandy loam subsoil, in which there is generally found considerable clay. The subsoil gradually becomes heavier with depth, grading into a mottled yellow sandy clay, which is quite sticky when wet and which usually extends to a depth of 36 inches. In some instances, however, the percentage of sand increases with the depth of the subsoil, and occasionally a layer of sand, seldom over 2 or 3 inches in thickness, is encountered. Such areas as these generally occur in the vicinity of sand ridges. These sandy layers are in turn underlain by a sandy clay varying in color from light or orange yellow to gray. The subsoil varies to a marked degree in different parts of the county. This fact is of considerable importance, inasmuch as it has a controlling influence upon the character and yield of crops grown. Generally till is encountered beneath this type of soil at a depth of from 3 to 4 feet.

It consists of a mixture of clay, sand, and gravel of varying proportions, with gravel generally increasing both in size and quantity with depth. In the upper portions of this till the gravel is about the size of a pea, while at lower depths it varies in size from a fraction of an inch to 3 or 4 inches in diameter. Occasionally some fine gravel occurs on the surface of the type, but this is of little or no consequence. A few large bowlders are also found on the surface of this soil, but in most cases they are directly associated with the Marshall loam. In certain areas of the Marshall fine sandy loam, especially where the surface is very rolling or hilly and particularly on the crests of some of the moraines, the till is covered only to a depth of a few inches by fine sandy loam. This feature is especially noticeable in sections 32 and 33 of Jackson Township. Here the till, consisting chiefly of clay mixed with some sand and considerable gravel, outcrops on the slopes of the ridges. The color is generally reddish yellow, occasionally slightly mottled. The till found underlying the soil of lower levels is generally light yellow.

The following table gives the average results of mechanical analyses of typical samples of this soil type:

Mechanical analyses of Marshall fine 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.*
12780, 13127	Soil	0.4	2.2	8.6	40.7	13.3	21.8	13.0
12781, 13128	Subsoil.....	.3	3.0	8.0	41.7	13.8	20.3	13.0

The Marshall fine sandy loam occurs almost wholly north of the Iroquois River, being the chief type occupying the Iroquois moraine. In this locality it occurs in one body continuous across the county, though interspersed with many areas of other soil types. In no case is it found north of the northern base of this ridge. A few comparatively small areas occur as isolated patches south of the Iroquois River. They occupy the more elevated positions or ridges in the Marshall loam areas. The two largest of these bodies occur along the Iroquois River in Jefferson and Washington townships.

The surface of the greater proportion of the area occupied by this type is undulating and rolling. In only one or two instances is the surface level, and in these cases the level areas are comparatively small. The most conspicuous topographic features of this type are the two large ridges on each side of the Iroquois River in Jefferson and Washington townships. The isolated areas in the southern part of the county occur mostly as small ridges, seldom over 4 or 5 feet above the level of the surrounding country, while in sections 25 of Jefferson Township and 30 of Grant Township the type occurs as one large knoll.

The character of the surface of the Marshall fine sandy loam affords excellent natural drainage, but it is a generally recognized fact that artificial drainage greatly increases the productiveness of the soil, particularly where it is underlain by a heavy subsoil. The lighter areas, especially where the subsoil is sandy, are not so much in need of artificial drainage, but nevertheless it should be encouraged on both the light and heavier phases of this type, inasmuch as crops suffer materially from an excess of moisture during wet seasons.

The soil for the most part is derived directly from the glacial till, but some areas have been formed by the mixing together of the fine sand and loam types, forming in this case the transitional phase between the Marshall fine sand and the Marshall loam. In addition to this there has been incorporated in the soil a very high percentage of organic matter through decay of a luxuriant growth of vegetation.

The Marshall fine sandy loam is one of the most productive soils in the area and is adapted to a greater diversity of crops than is at present grown upon it. The type in this locality is devoted chiefly to the production of corn and oats, the staple crops of the county. Bluegrass grows very well, and timothy and clover are grown to some extent, but it is generally quite difficult to obtain a good stand of clover on account of the dry, hot winds and dry weather which often follow the removal of the nurse crop. Wheat is grown only on this soil. Its production, however, is limited, owing to poor and uncertain yields. Very few vegetables are grown, except for home use. Potatoes do fairly well, but their yield is uncertain. Only the early varieties of this crop are grown. Of the small fruits, berries do best on this type. Some currants are grown, but they do not yield well. Sour cherries and apples are the principal orchard fruits produced.

The average yields of the crops produced on this soil vary somewhat in different parts of the county, depending largely upon the character of the subsoil and climatic conditions. During dry seasons that portion of the type possessing a heavy subsoil generally gives the better results, inasmuch as it is able to withstand droughts better, while during unfavorably wet seasons the areas having a light subsoil and better drainage give the better results. In former years this type produced on the average about 50 bushels of corn and an equal quantity of oats to the acre. During recent years, however, there has been a gradual falling off in the yields of crops grown, until the average of corn and oats produced seldom exceeds 35 or 40 bushels. The yields, however, vary considerably with different seasons. The estimated yield of wheat is given at about 12 or 15 bushels, if grown under favorable conditions. Timothy and clover average from 1 to 1½ tons per acre. Potatoes vary considerably, and, although as many as 200 bushels have been produced, the average yield is about 50 bushels per acre.

The manurial requirements of this type were investigated, using a large sample from a field three-fourths of a mile south of Morocco. The soil is a black to dark-brown medium fine sandy loam and the field is well drained. It has been in cultivation for more than twenty years, corn and oats being the chief crops. Small to medium quantities of stable manure are used, but no other fertilizers. Yields of both corn and oats average about 40 bushels per acre.

The results of the examination of this sample by the wire-basket method indicate that stable manure has a large effect in increasing the growth of crops, and that sulphate of potash and nitrate of soda used either alone or in combination have very little effect. Lime and acid phosphate, either separately or in combination with the above-mentioned fertilizers, failed to give any appreciable increase in growth. These results were obtained under favorable climatic conditions for the crop and with the soil in the best possible physical condition. They indicate that the practice of the locality in applying barnyard manure is commendable.

MARSHALL LOAM.

The Marshall loam, to an average depth of about 14 inches, consists of a dark-brown or black loam. The soil generally becomes heavier with depth, and under field conditions the texture appears rather silty, due in part to the presence of a very high percentage of organic matter which is everywhere found in this soil, and to which is also due its characteristic dark color.

The depth of the soil varies in different localities, depending largely upon topographic position. In the local depressions and in the more level areas the soil is much deeper than the average, ranging from 16 to 18 inches, and in some cases to 24 inches. In such areas the soil is generally of a somewhat heavier nature than that occurring on the more uneven places. On the low knolls and ridges the depth of the soil varies from 6 to 8 inches, and the texture is more sandy, occasionally approaching a heavy sandy loam. Near the main streams and over areas affected more or less by erosion the type is generally a heavy loam, with the color lighter than in the typical areas, the depth in this case being also less. This phase is particularly well developed along the Iroquois River.

The line of demarcation between the soil and subsoil is generally well defined. At a depth of from 12 to 14 inches the soil grades into a yellow light clay loam in which the clay content increases with depth. The color is often a mottled yellow in the lower portions, and occasionally this material extends to a depth of over 3 feet. In most cases, however, at a depth of from 25 to 30 inches it grades into a sandy clay in which the sand content is large, and finally, at from 30 to 36 inches, there occurs a layer of sand and fine gravel mixed with

a sufficient amount of clay to give it a sticky consistency when wet. As a rule the deeper subsoil is a heterogeneous mass of clay, sand, and fine gravel, and this generally comes to within 36 inches of the surface. Occasionally some fine gravel is found on the surface and scattered through the soil, but this occurs in limited areas and does not affect the agricultural value of the land. Large glacial bowlders are found scattered over some areas of this soil, in some areas so plentifully as to interfere with cultivation, though in most cases they have been removed from the fields.

There are a number of unproductive spots in the Marshall loam that are locally called "alkali spots." Their unproductiveness, however, is not due to the presence of alkali salts. Before this part of the county was drained these areas, which occupy depressions too small to be shown on the map, were known as "sink holes" or "quicksand" areas, and the soil is now generally somewhat more sandy than the neighboring productive lands, while the subsoil is largely composed of sand. Liberal applications of stable manure increase the productiveness, and large quantities of straw have been burned on them with good results.

The average results of mechanical analyses of typical samples of fine earth of this type are shown in the following table:

Mechanical analyses of Marshall 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.*
12784, 13107, 13111.	Soil	0.6	3.2	4.4	21.6	9.1	36.8	23.9
12785, 13108, 13112.	Subsoil.....	.9	4.1	4.8	20.4	9.2	33.1	27.3

The Marshall loam occurs most extensively developed in the southern part of the county, embracing the greater proportion of the area south of the Iroquois moraine. It occurs as one continuous body over this part of the sheet, while north of this main body are found isolated areas covering the local depressions in the morainic ridge. Like the Marshall fine sandy loam, this soil does not occur north of the northern base of this ridge.

The surface of the Marshall loam is mainly a level plain sloping gradually toward the Iroquois River, which crosses the county from east to west. In the extreme southern part of the county the surface is gently rolling and occasionally broken by shallow valleys, formed by the small northward-flowing streams. As the river is approached the surface becomes more level. North of the river the surface is almost a dead level, with only a slight fall toward the south. In many areas the surface is broken by a number of low sand and sandy loam ridges, seldom exceeding an elevation of 6 or 8 feet above the sur-

rounding levels. Where these ridges are of sufficient size they have been shown as different types of soil.

The drainage conditions of this soil vary in different parts of the county, depending to a marked degree upon the topographic features. On the more rolling areas the natural drainage features are well developed, while over the more level areas artificial drainage has to be resorted to in order to insure the production of good crops. Most of these lands can be economically drained, and already a large proportion of their area is tiled. There are a number of small ponds, sloughs, and depressions which have little or no outlet, and while some of these can be and have been economically reclaimed, it is doubtful if many can be profitably drained, as the cost of constructing outlets sufficient to secure good fall would probably exceed the value of the land.

The Marshall loam is derived from glacial material correlated by Leverett with the late Wisconsin drift sheet. Mingled with the soil and subsoil are many pebbles and bowlders. The bowlders, which consist chiefly of granites, are directly associated with this soil and in only a few cases were they found on any other type. To the material deposited by the glaciers large quantities of organic matter have been added by the decay of a luxuriant growth of prairie vegetation which formerly covered this region.

The Marshall loam is admirably adapted to the production of corn and oats, and up to the present time has been devoted almost exclusively to the cultivation of these crops. The yields vary widely with the season, but the average for corn is about 40 bushels and for oats from 35 to 45 bushels per acre. The yields were formerly higher than at present, having declined as a result of the almost continuous production of these two crops for the last twenty or thirty years. Timothy and clover are grown to some extent, but considerable difficulty is often experienced in getting a good stand of these crops. They are very frequently sown together and yield from 1 to 2 tons per acre. Bluegrass does very well and is often sown in connection with white clover and used for pasture. Fruits and vegetables are grown only for home use. Apples and cherries, with some of the small fruits, chiefly berries, produce the best results. Irish potatoes, as well as most of the early vegetables, can be successfully grown, but up to the present time have been raised only for home consumption.

A test was made to determine the manurial requirements of this type, using a large sample collected about 1½ miles west of Goodland. The soil here consists of a dark brown to black heavy silt loam, and the sample was taken to a depth of 6 inches. The land has been in cultivation for from twenty to thirty years, the chief crops being corn and oats with some grass. Moderate applications of stable manure are used, but no other fertilizers. Yields of both corn and oats average about 40 bushels per acre, while hay averages about 1½ tons per acre.

The results of the examination of this sample by the wire-basket method indicate that stable manure has a large effect in increasing the growth of the crop. Results obtained with nitrate of soda, sulphate of potash, acid phosphate, and lime, used separately and in various combinations with each other, were small, and were no greater when two or more of these substances were used in combination than when one was used by itself.

These results are held to be applicable only to the field from which the sample was taken, but it may be stated that they agree well with the experience of farmers upon this type of soil.

MARSHALL FINE SAND.

The Marshall fine sand, to a depth of from 10 to 20 inches, consists of a medium to fine sand, varying in color from light to dark brown, according to the proportion of organic matter present. The color generally becomes lighter as the depth increases, changing to yellow, but the texture of the subsoil remains about the same as that of the surface soil, though generally possessing less coherency. The loamy nature of the soil, particularly in the first 6 inches, is due in part to the presence of a small percentage of silt and clay, but chiefly to the presence of a relatively large amount of organic matter. The yellow subsoil generally extends to a depth greater than 3 feet, but occasionally at from 25 to 30 inches it becomes a mottled yellow, streaked with gray and white sand.

The Marshall fine sand is fairly uniform throughout its occurrence in the area, the chief variation being the presence of some fine gravel. It is seldom, however, that gravel is found upon the surface, though in some areas it is frequently encountered at a depth varying from 20 to 36 inches or more. The gravel is fine, seldom exceeding 3 or 4 inches in diameter, and is used quite extensively for road building.

The following table shows the results of mechanical analyses of typical samples of this soil type:

Mechanical analyses of Marshall fine sand.

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.*
12782	Soil	0.0	1.7	7.5	52.6	19.2	9.8	9.1
12783	Subsoil	Trace.	1.6	9.0	53.3	18.3	9.1	8.7

The Marshall fine sand is confined to the hills and ridges, but occurs throughout the area surveyed. It is most typically developed in the eastern part of the county, where the ridges are low and narrow, seldom exceeding an elevation of from 10 to 20 feet above the lowest depressions in their immediate vicinity, and varying in breadth from 200 to 300 feet to nearly one-half mile. The type frequently caps the

more elevated areas in the Marshall fine sandy loam. The natural drainage conditions are good. In some areas the drainage is excessive, and while it retains moisture well for a soil of this character, crops often show the effects of drought.

The Marshall fine sand is of glacial origin, but the exact manner of its formation is not understood. It is probable that the materials represent deposits of glacial outwash made during the recession of the ice sheet, which have since been modified to some extent by the action of wind.

Corn, oats, rye, and timothy are the principal crops grown on this soil. The yields are generally small and uncertain, but are larger in wet seasons than in dry. The soil is well adapted to the production of vegetables and melons, and their cultivation should be encouraged.

MIAMI BLACK CLAY LOAM.

The surface soil of the Miami black clay loam, which is the heaviest type found in the area, consists of a heavy loam or clay loam, carrying silt and clay in about equal proportions. The average depth of the soil is about 18 or 20 inches, but in some cases, especially in the central parts of the areas, the depth may be as much as 2 feet. Relatively large quantities of organic matter are found in the soil, and to this is due its prevailing black or dark-brown color. As the depth increases the percentage of organic matter decreases, and at 8 to 14 inches the color has a bluish or grayish tinge. The soil is very cohesive and when moist pulls up in large masses around the auger. If allowed to dry without stirring it has a tendency to puddle and bake, and cracks from 1 to 2 inches across and from 1 to 2 or more feet in depth intersect the surface in all directions. If plowed when too wet large clods form, which are difficult to pulverize until moistened again by rain.

At from 18 to 20 inches below the surface the soil grades into a heavy clay loam subsoil, in which the clay content increases with depth. The color of the upper part of the subsoil varies from light to dark gray, depending largely upon the percentage of organic matter present. Generally at a depth of about 20 or 25 inches the subsoil grades into a light-gray or mottled-yellow sticky, impervious clay, which extends to a depth of 3 feet or more.

The following table gives the average results of mechanical analyses of this type:

Mechanical analyses of Miami black 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.*
12969, 13131.....	Soil	0.1	7.3	6.6	17.9	5.8	34.4	27.8
12970, 13132.....	Subsoil.....	.1	.9	1.4	6.0	2.4	27.2	61.4

The following sample contained more than one-half of 1 per cent of calcium carbonate ($CaCO_3$): **No. 12970, 1.83 per cent.**

The Miami black clay loam occupies only a very small percentage of the area surveyed. It occurs as basinlike depressions between the low hills and ridges and is most typically developed north of the Iroquois River, occupying only limited areas scattered over that part of the county covered by the Iroquois moraine. The surface is generally level, but in some cases a few small shallow ponds and sloughs occur, the result of obstructed drainage.

Owing to the level character of the topography of this type and to the imperviousness of the soil and subsoil the natural drainage conditions are very poor. In a number of cases artificial drainage has been employed, and this should be done wherever practicable.

The material composing the Miami black clay loam is primarily of glacial origin, but since its deposition it has undergone considerable modification. Prior to the construction of drainage systems sufficient to carry off the surplus water the areas occupied by this type were covered with swamps and marshes. Through the growth and decay of a luxuriant vegetation a large amount of organic matter has been incorporated in the soil, the rapid oxidation of which was prevented by the moisture conditions. Some of the finer particles of soil have been washed into these depressions from the surrounding higher land, and this has had considerable effect on the texture of this type.

The Miami black clay loam is considered one of the best types in the area for the production of corn. When well drained and with favorable climatic conditions it produces on the average about 45 bushels per acre. Although there is danger from lodging, the average yield of oats is estimated at from 35 to 40 bushels per acre. This type is also well adapted to the production of clover and timothy, the latter yielding from 1 to 2 tons of hay per acre. Only the better drained areas are suited to clover, because in the low wet areas the clover heaves badly.

CLYDE LOAM.

The soil of the Clyde loam is a heavy loam or clay loam, varying in depth from 18 to 30 inches. It is of a decidedly black color, owing to the presence of a very large proportion of organic matter, which is generally well distributed throughout the soil profile. The quantity gradually decreases, however, with depth, and the color becomes correspondingly lighter. In some cases, at from 12 to 20 inches, the color is a dark-reddish or brownish yellow, due probably to the oxidation of iron. Iron occurs quite abundantly in the soil and subsoil of this type in irregular masses, varying in size from a fraction of an inch to 1 foot or more in diameter.

Variations in the texture of this type occur near the borders of the sand ridges, where the soil is mixed with varying amounts of sand and approaches a heavy sandy loam. The transitional zone between this

soil and the sandy soil is generally quite narrow, and in some cases the line of demarcation is sharply defined.

The subsoil varies in different parts of the area. Near the outer margin it generally consists of medium to fine sand, the latter grade predominating. The upper portion of the subsoil is of a very sticky nature, due to its relatively high clay content, and the color is generally dark gray. With increase in depth the material generally becomes lighter, both in color and texture, grading into white or gray sand at 40 inches. In the central parts of the area the soil becomes deeper and the subsoil much heavier. Here the soil consists of a heavy clay loam to an average depth of about 24 inches, below which occurs a sticky impervious clayey subsoil, becoming heavier with depth. The color of the latter is generally somewhat lighter than that of the soil, although it contains a high percentage of organic matter. In general the subsoil upon drying breaks up into roughly cubical blocks, resembling in this particular an adobe soil. Where excavations for large drainage ditches have been made the walls remain almost perpendicular and are only slightly affected by erosion.

Underlying the subsoil proper at a depth of about 6 feet is a layer of peat. The layer is about 3 feet thick and is in turn underlain by an impure marl which contains small fragments of shells and some organic matter. This marl extends to an undetermined depth.

The following table shows the average results of mechanical analyses of typical samples of this type of soil:

Mechanical analyses of Clyde 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.*
12971, 13135, 13137...	Soil	0.1	6.2	5.6	19.0	4.8	38 8	25.1
13138.....	Subsoil...	.0	2.6	3.8	9.8	5.2	49.5	29.3

Only one area of this type of soil occurs in Newton County. It is found about 10 miles northeast of Morocco and lies almost wholly in the west central part of Colfax Township, a small extension reaching westward into McClellan Township.

The surface of the type is practically level, with only a slight fall toward drainage lines, and, as a result, the natural drainage is very poor and has to be supplemented by artificial drains in order to insure the production of good crops. A large proportion of the area is already reclaimed. All of the area can be economically drained, and large crop yields will be sure to follow the construction of a comprehensive drainage system.

The Clyde loam is of lacustrine origin. Prior to the construction of large drainage outlets for the surplus water the area embraced by

this soil probably formed a small lake, and the accumulation of the finer material held in suspension by the waters feeding it has given rise to this peculiarly situated body of heavy soil. During low water or probably after there had been a sufficient filling in of this depression so that only a shallow pond remained, conditions were such as to favor the growth of a heavy vegetation, and through the decay of this vegetation a large amount of organic matter has been added to the soil.

The Clyde loam is very productive, and when properly drained and cultivated produces even larger crops than the Miami black clay loam. It is well adapted to the production of oats, rye, timothy, clover, and bluegrass, and is considered one of the best corn soils in the area, to which crop it is largely devoted. The average yield of corn is variously estimated from 40 to 50 bushels per acre. Forty bushels of oats is given as the average yield per acre, but, as on the Miami black clay loam, the growth of straw is heavy, and the grain often l dges. Rye is grown only in limited areas, yielding from 20 to 25 bushels per acre. Clover and timothy are grown to some extent on this soil, and the yields compare favorably with those produced on the Miami black clay loam. Bluegrass makes a thrifty growth, and is used largely for pasture.

CLYDE FINE SAND.

The Clyde fine sand is the prevailing type in the northern part of the county. The soil consists of a dark-gray to black medium to fine sand, in which the latter grade predominates. The depth varies from 4 to 20 inches, depending upon the depth to which the organic matter extends. Along the boundaries of the type, and especially next to areas of Peat, organic matter is found in larger proportions and in some cases occurs to a depth of more than 3 feet. The presence of this high percentage of organic matter gives the soil a loamy texture, and areas are occasionally referred to locally as "semimuck." As the more central parts of the areas are approached the percentage of organic matter becomes proportionally less and the depth to which it extends decreases, until in some cases it is confined to the upper 5 or 6 inches. From this point the soil gradually passes into the Newton fine sand, in which there is practically no organic matter in the surface soil.

At varying depths, as above mentioned, the soil grades into a subsoil having about the same texture as the soil, but containing a much smaller percentage of organic matter. In areas where the soil extends to a considerable depth the subsoil is generally a dark-gray fine sand, which usually becomes lighter in color as the depth increases. Where the soil extends to a depth of only a few inches the subsoil is generally gray in the upper portions but grades into light-gray and occasionally white or yellow-mottled sand at an average depth of about 15 or 18 inches. In areas where considerable iron is found in the subsoil the

color generally has a reddish-yellow or brownish tinge and is occasionally mottled. In other areas, at a depth of about 25 or 30 inches, the subsoil is composed of a brownish-colored Peat in which the vegetable fiber is quite easily distinguished. This peaty layer generally extends to a depth of over 3 feet, although occasionally it is only a few inches in thickness and is in turn underlain by a dark-colored sand in which the amount of organic matter is very large.

The following table shows the average results of mechanical analyses of typical samples of this type:

Mechanical analyses of Clyde fine sand.

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.*
12973, 13139	Soil	0.0	1.8	10.6	60.0	9.2	12.6	5.8
12974, 13140	Subsoil.....	.0	1.7	12.4	69.1	6.7	5.5	4.6

The Clyde fine sand is found throughout the northern half of the county, occurring practically as one continuous body, although much broken by bodies of other types, extending north from the northern base of the Iroquois moraine to the Kankakee River. The surface is practically level, the elevation seldom varying more than 5 or 6 feet. A few low undulations occur, and in some cases small ponds or swampy depressions are found, but the surface is generally flat.

In general the type possesses poor natural drainage. Considerable difficulty is often experienced in the construction of artificial drainage channels, both on account of the level character of the surface and the filling of the ditches by sand, which underlies the greater part of this territory, and by material washed in from the lateral drainage ditches. This last difficulty can, however, be largely overcome by the construction of culverts across the mouths of the lateral drains, thus preventing the banks from being washed away at these particular points. In some localities it is practicable to turn the drainage waters into existing channels. In the northwestern part of the county the upper end of the Houseworth and Riner ditch is connected to the upper end of a branch of the old Beaver Lake ditch, and here the drainage waters flow in either direction. Lower down from the headings of these ditches the fall becomes greater and the drainage is generally much better. The Clyde fine sand is generally improved by drainage. In fact it is necessary to drain this soil before successful agriculture can be practiced. The cost of constructing a comprehensive drainage system will necessarily be large; but the land, if properly managed, should yield a profitable return on the investment.

The Clyde fine sand represents areas which have been formed by the action of water. While primarily of glacial origin, the sand composing

this type has probably been transported by stream currents to its present position from sand areas to the north and east, and deposited while this part of the area formed a lake. As the lake was gradually filled up or drained, conditions became such as to favor the formation of a large amount of organic matter.

The crop value of the Clyde fine sand varies in different parts of the area, depending largely upon the proportion of organic matter present. Areas in which the organic content is small are devoted chiefly to pasture, while those in which the proportion is greater and where the soil is impregnated to greater depths produce the staple crops of the county with a fair degree of success. The average yields are gradually decreasing from year to year, and will continue to do so as the organic matter in the soil is consumed. The yield of corn, which ten or twelve years ago was as high as 50 bushels, is now estimated at from 10 to 30 bushels per acre. The yield of oats, which was formerly much higher, is now on the average about 20 or 30 bushels per acre. Potatoes do well during favorable seasons, but unless the land is well drained the crop is often waterkilled or rots before coming up, during wet seasons. The average yield of this crop is estimated at from 125 to 200 bushels per acre. Some rye is grown, and yields from 10 to 20 bushels. It is generally sown as a nurse crop for timothy, which does very well on the heavier areas, yielding from three-fourths to 1½ tons per acre. Clover is not grown to any extent, inasmuch as it is generally winterkilled. Sugar beets have been successfully grown on this soil, but at present no attention is given to their production. Small fruits do well, and it is considered an ideal soil for strawberries. It is also a fine truck soil, but up to the present time little attention has been paid to this industry. The greater part of this type is devoted to pasturage. The poorly drained areas are generally covered with "sour grass," which is seldom eaten by stock, unless other grasses are short. Near the Miami fine sand areas and occasionally on the low knolls the vegetation consists of a natural growth of different varieties of oak. Bluegrass is generally found growing quite luxuriantly on the better drained areas.

In order to obtain an idea of the manurial requirements of this type a large sample was collected about 2½ miles north of Morocco. The soil in this particular field consists of a black sand, containing a large admixture of organic matter, but so incoherent that when dry it blows and shifts to some extent. The surface is very level, and it holds considerable water despite its porous texture. The field from which the sample was taken has been in cultivation for from fifteen to twenty years. Corn and oats are grown in regular rotation, and form the sole crop interests. Small amounts of stable manure are used, chiefly on the corn, and no other fertilizers. Yields of both corn and oats average about 30 bushels per acre.

The results of the examination of this sample by the wire-basket method indicate that stable manure has a moderate effect in increasing the growth of crops; that nitrate of soda and sulphate of potash give a small increase, and that nitrate of soda, sulphate of potash, acid phosphate, or lime used alone or in combination (except as above), have little or no effect. These results were obtained under favorable climatic conditions for the crop and by having the soil in the best possible physical condition, and, while held to be strictly applicable only to the field from which the sample was taken, they substantiate the general farm practice on this type of soil in Newton County, where considerable barnyard manure is applied to the fields with beneficial results and practically no mineral fertilizers are used.

NEWTON FINE SAND.

The Newton fine sand resembles the type just described to a remarkable degree, the chief difference being in the percentage of organic matter. The organic content is generally very small and in most cases is not sufficient even to color the soil, while in the case of the Clyde fine sand, as we have seen, the organic content is generally large.

The soil of the Newton fine sand, to a depth varying from 10 to 36 inches or more, is composed chiefly of fine sand. Around the outer margin of the areas the soil generally extends to a depth of over 3 feet. The color is a light gray, grading into mottled yellow in the lower depths. Occasionally some organic matter is found in the first 3 or 4 inches, but the amount is generally so small as to have practically no effect upon the soil. In the more central parts of the soil bodies, at a depth varying from 10 to 20 inches, a layer of sand is encountered which contains a high percentage of organic matter, and in some cases this layer consists almost entirely of Peat. The layer varies in thickness, but seldom exceeds 6 inches, and it is not unusual to find two and sometimes three such layers in the subsoil, in which case they are generally much thinner and occur from 6 to 15 inches apart. The subsoil underlying these layers is generally a black fine sand containing considerable organic matter and very similar in character to that underlying the Clyde fine sand.

Along the range line between McClellan and Colfax townships the type occurs in the form of dunes, and the texture of the soil in this case is fine sand to a depth of over 3 feet. It is much finer than the sand composing the level areas, and the color is also much lighter, varying from light gray to white.

The boundary between this type and the Clyde fine sand, as a rule, is difficult to establish, inasmuch as the types grade almost imperceptibly from one into the other. Generally in areas in which the organic matter extends to a depth of over 4 or 5 inches the soil is classified with the Clyde fine sand, while if less it is mapped as Newton

fine sand. In some cases, however, the line of demarcation between the two types is sharply defined, being marked by a slight rise of 2 or 3 feet.

The following table gives the average results of mechanical analyses of typical samples of this type:

Mechanical analyses of Newton fine sand.

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.*
13040, 13151, 13152...	Soil.....	0.0	0.8	4.1	87.7	5.5	0.6	0.9
13153.....	Subsoil...	.0	.8	3.3	79.3	9.5	5.0	1.8

The Newton fine sand occupies only a small percentage of the area surveyed, occurring most typically developed in one large area, about 7 miles north of Morocco, in the northeastern part of McClellan Township. Another but much smaller area is found in the north central part of Lake Township, bordering the swamp area along the Kankakee River. The type represents a part of the floor of an old glacial lake. The surface is a few feet below that of the Clyde fine sand, and, while it is generally level, it is broken by numerous ponds and swampy depressions, and occasionally cut by old drainage lines. A number of old beach lines which cross this part of the county from northeast to southwest are quite easily distinguished, and in some cases rise to an elevation of 2 or 3 feet above the general level of the surrounding lands. In the eastern part of the area occurring in McClellan Township, and particularly along the range line between this and Colfax Township, where the dunes already mentioned occur, the area has a desertlike appearance. These dune areas have an elevation of from 3 to 20 feet above the mean surface level of this part of the county.

The natural drainage conditions, as in case of the Clyde fine sand, are poor, and over a greater part of the area the water table seldom exceeds a depth of 3 feet, while at the time this part of the county was surveyed, water was found on the surface over a considerable area.

The Newton fine sand owes its origin to the same agencies as the Clyde fine sand. As evidenced by the layers of peaty deposits, it is quite probable that prior to the deposition of the sand now constituting the surface soil, this territory was only partially submerged at different periods, during which there was a heavy growth of vegetation. Subsequently the water of the lake rose again and completely submerged this territory, and layers of sand were deposited over this vegetation.

None of this soil is at present under cultivation, and its only use is as pasture. It is for the most part covered with water-loving grasses,

willow, and birch. The higher and better drained areas are either almost free from vegetation or covered only with a sparse growth of bunch grass. Wherever the native vegetation dies out or is removed the sand drifts badly.

MIAMI FINE SAND.

The Miami fine sand consists of a loose, incoherent medium to fine sand, with a minimum depth of more than 3 feet and a maximum depth of over 100 feet. It varies in color from light brown in the upper portions of the soil to yellow at lower depths, the former color being due to the presence of a very small amount of organic matter, which is found especially in the local depressions between ridges and on some of the more level areas. On the more rolling areas there is practically no organic matter in the soil, and this and the absence of gravel are the chief features distinguishing this type and the Marshall fine sand.

The average results of mechanical analyses of typical samples of this type are given in the following table:

Mechanical analyses of Miami fine sand.

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.*
12975, 13154, 13155, 13156.	Soil	0.0	2.4	15.5	65.4	10.2	3.2	3.2

The Miami fine sand is distributed over the northern portion of the county. The areas vary from a few acres to over 3 square miles in extent and occur as islandlike bodies in the level sand areas. The surface is very irregular, consisting of rounded hills and ridges, from 2 to more than 150 feet in height. Owing to the physical character of the soil and its rolling topography, natural drainage over most of these areas is excessive, and vegetation often suffers from lack of moisture.

The origin of this soil is largely due to the action of winds, though it is probable that during the early stages of development wave action also played an important part in its formation. On account of the loose, open character of the soil and the unstable or drifting nature of this material it has little agricultural value. It is for the most part covered with a native growth of timber, chiefly scrub white and black oaks, hazel brush, black gum, sumac, and a few quaking aspens. On some of the lower, moister areas bluegrass is found. Only a few areas of the Miami fine sand are farmed. Sorghum is grown to some extent for home use and melons and early potatoes do well. Some rye and corn are produced but the yields are very small. Fruit is grown to some extent and is said to do fairly well.

KASKASKIA LOAM.

The surface soil of the Kaskaskia loam is a brown loam or silty loam, with a depth varying from 18 to 24 inches. The texture of the soil is quite uniform, although it is heavier in some of the depressions farthest from the river than it is on the higher areas or near the present channel. The soil is generally quite friable and readily cultivated.

The subsoil is generally a loam, although some sections exhibit but a slight difference between the soil and subsoil. In most cases, however, the sand content increases with depth. The percentage of organic matter in both the soil and subsoil is less than is usually found in alluvial types. A large amount of iron is usually present, which sometimes gives the subsoil a mottled appearance.

The average results of mechanical analyses of typical samples of this type are given in the following table:

Mechanical analyses of Kaskaskia 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.*
13103, 13105	Soil	0.2	0.7	0.7	9.2	13 9	53.1	22.0
13104, 13106	Subsoil.....	.1	.5	.5	9.1	18.6	51.7	19.4

This type occupies only a limited area along the Iroquois River in the eastern half of the county. It constitutes the flood plain of this stream and is confined to the oxbows and to narrow strips along some of the less crooked parts of the channel. It is seldom more than a few feet above low water and is subject to overflow. Numerous depressions and sloughs occur, which mark the course of former stream channels, having been deposited by the river during high water. The current is here too sluggish to transport any but the finer materials, so that the type is remarkably free from coarse sand and pebbles.

The Kaskaskia loam is largely devoted to pasture. Some of the areas are planted to corn and during favorable seasons yield from 40 to 50 bushels per acre. Oats and potatoes can be successfully grown, though there is always danger from overflow.

SWAMP.

The classification of Swamp is based upon topographic position and drainage conditions rather than upon the physical character of the materials of which it is composed. The texture varies in different parts of the areas from a light sandy soil to a heavy clay loam, though the greater proportion is a black sand, very similar in character to that of the Clyde fine sand. A constant feature is the extremely large admixture of more or less decayed vegetable matter.

With the exception of one small body occurring in the western part of Beaver Township the Swamp is confined to a strip from one-eighth to over 1 mile wide along the Kankakee River, in the extreme northern part of the county. It is low-lying and generally level, though somewhat broken by old stream channels and small lakes, or lagoons, and is poorly drained and under water most of the year. Owing to its slight elevation above the river it can not be drained economically.

The areas are largely the result of poor drainage. Along the river it has been slightly modified by the deposition of fine material brought down during high water. Through the growth of a heavy vegetation a large amount of organic matter has been added.

Except along the streams where there is a heavy growth of timber, chiefly birch, oak, poplar, and willow, the native vegetation consists of a host of moisture-loving plants, such as reeds, rushes, sedges, etc. None of the Swamp is under cultivation. When the river is low some areas become dry enough to allow the cutting of hay, and such areas are also used to some extent for pasturage.

PEAT.

A very important and characteristic feature of the northern part of the county is the frequent occurrence of quite extensive Peat deposits. They consist of brown peaty material, in which the percentage of combustible material is extremely high. In consistency the soil varies from a coarse, raw, fibrous Peat through all stages of decomposition to that of Muck. The Muck areas occur, however, to a limited extent around the outer margins of these deposits. The soil in this case consists of more thoroughly decomposed vegetable mold mixed with varying amounts of mineral matter and extends to a depth seldom exceeding 3 feet. The typical Peat is much deeper, generally extending to a depth of 10 or 12 feet.

The texture of the subsoil varies from a medium to fine sand in which the percentage of organic matter is quite low. It varies in color from dark to light gray, and in some cases is slightly mottled. In a few localities the underlying material is a light-blue or gray clay, while in others it is a marl. Such areas as these are, however, quite limited and occur only as local variations.

The Peat occurs most typically developed northeast of Morocco, in Beaver, McClellan, Colfax, and Lincoln townships. A few small areas occur west and southwest of this town on the Iroquois moraine. The general character of the surface of these tracts is level, with only a slight fall toward drainage lines. Over some areas the surface has a hummocky appearance, due to the presence of small tufts or bunches of grasses and other vegetation. The hummocks seldom exceed 12 inches in height. Large holes and depressions often occur, especially in areas which have been burned.

The Peat has been formed by the gradual accumulation of organic remains in low wet places. During depositions the materials were more or less under water, which has retarded decomposition, and the vegetable fiber in most cases is yet easily distinguished.

The drainage of the areas of Peat is an important problem to the land owners in this section of the county. The areas usually have a fall of from 2 to 5 feet per mile toward the main drainage lines, and while a large amount of water accumulates in the spring, both from the melting of snow and from spring rains, it is practicable to remove this by the construction of wide deep ditches. It is believed that open ditches even for the lateral drains would prove more effective than tile. The little drainage channels in the soil would form more quickly and the excess water would be removed more rapidly. After the land is once thoroughly drained tiling would undoubtedly prove effective. Large tracts of the Peat have been drained, dredges being used to dig the main ditches across the lowest depressions of the areas or along such lines as would give the greatest possible fall. These ditches vary in width from 12 to 15 feet and in depth from 10 to 12 feet. A few laterals have been constructed which are as large as the main channels and into which sublaterals are run, but in most cases the laterals are much smaller and irregularly placed, generally at intervals too great to be effective. A glance at the map accompanying this report will show the main drainage channels of the county as well as of the Peat areas.

The cost of constructing the existing drainage systems has been great, so it is most desirable that immediate returns be secured on the capital invested. In some cases the results obtained from growing crops on the Peat have been most gratifying; in others they have been most discouraging. It has been the experience of most of the farmers that the Peat generally produces fairly well for two or three years after being reclaimed, when its productiveness begins to decline, each succeeding crop being poorer than the one preceding. On the other hand, some of the areas improve with cultivation, although the improvement is gradual. There are also areas that have never produced well, the crops being generally small and frequently failing to mature. It has also been observed that the productiveness of the Peat areas is correlated in some way with the state of the organic matter present and that as soon as the marsh sod, leaves, trash, etc., plowed under, become thoroughly decayed or consumed the yields of the crops grown cease to be profitable.

Corn is most extensively grown upon these soils the first few years. The yields of the first crop or two are quite large, though the corn produced is of poor quality. The kernels do not generally fill well and are often chaffy. The yield and quality of the succeeding crops are generally poorer, the ears are smaller and do not fill well, and the

stalks are small. Later crops frequently do not produce any ears, and during the growing season the stalks turn yellow and growth is checked. In some areas the first crop grown is of this character, and spots giving like results occur even in the best areas, where no difference in drainage conditions or other cause can be assigned for the difference in the growth of the plants. A very few farmers have built silos, and thus utilize the inferior products of the Peat, but such a method can hardly be practiced to good advantage except on a dairy farm.

Very frequently this soil produces a rank growth of stalk or straw, as the case may be, in which the grain does not fill out well. Timothy and bluegrass may be grown wherever the drainage is reasonably good, but neither of these grasses is so profitable as corn. Special truck crops will do well on the Peat, but few landowners have either the inclination or experience to attempt their cultivation. This has led to considerable experimental work on these soils with corn, but the results so far obtained have not proven entirely satisfactory, although somewhat larger yields have been produced.

The general conclusion reached is that these and similar soils in Illinois, Wisconsin, and other parts of Indiana are in need of potash,[a] and in some cases potash, phosphoric acid, and stable manure should be applied to make them productive.[b]

The results obtained last season on an experimental plot in the southeast corner of section 35, McClellan Township, under the direction of the Indiana experiment station, show that two plots upon which muriate of potash and sulphate of potash were applied, respectively, produced at the rate of 48.9 bushels and 40.5 bushels per acre. Where no fertilizer was added the yield was 36.4 bushels. Another plot, where 1 ton of coarse straw was applied, produced at the rate of 58.5 bushels per acre, or about 10 bushels more than the plot fertilized with muriate of potash.

It would seem from these results, together with the generally observed fact that these soils produce well until the marsh sod, etc., is destroyed, that the Peat of the area is not lacking in plant food, and that the low yields are due to some unfavorable condition, which was alleviated by the addition of coarse straw. While potash improves these soils it seems quite probable that the beneficial results are not due to the plant food thus added, but to some other effect it has upon the soil.

While this type of soil is less extensive than many in the area, its peculiar condition after a few years' cultivation, as discussed above, made it advisable to select this as one of the types for investigation as to manurial requirements. For the purpose of carrying on this line of work, several samples of the soil were collected from sections 1 and

[a] Buls. No. 93 and 95, Illinois Exp. Sta.

[b] Twenty-first annual report, Wisconsin Exp. Sta.

2, township 29 north, range 9 west. The soil here consists of brown mucky peat, varying from 30 to 40 inches in depth and usually underlain by sand. Where the samples were taken the water table varied from 2 to 3 feet below the surface.

The results obtained upon this soil by the above-mentioned method indicate that both stable manure and green manure are decidedly beneficial. Sulphate of potash gave a large increase in growth, whereas lime, nitrate of soda, and acid phosphate had little or no effect. These results are in accord with the conclusions of the experiment stations cited above.

When thoroughly reclaimed the Peat should be well adapted to corn, potatoes, onions, celery, cranberries, and similar crops. Owing to the high percentage of nitrogen present it has a particular adaptation to corn, rape, and the grasses. It is an ideal timothy soil, producing from 1 to 1½ tons per acre, and bluegrass does exceedingly well and is used for pasture. The chief difficulties encountered in farming the Peat areas, aside from the conditions already discussed, are wetness in the spring, danger of frost, and the accumulation of excessive amounts of nitrates. Even when well supplied with open drains the soils are often too wet to allow early sowing of crops, and it frequently happens that crops have to be planted two and occasionally three times before a stand is secured. This necessarily so shortens the growing season that there is danger of frost before the crops mature. The excess of nitrates, which tend to stimulate stalk and leaf growth, often causes oats and other grains to lodge badly, and this makes the type in general unsuited to these crops, although under the most favorable conditions they often do well.

AGRICULTURAL METHODS.

The cultural methods generally practiced in the area pertain largely to the production of corn and oats. In the preparation of the soil for corn, which generally follows oats, the land is plowed deep in the fall, generally as soon as the oat crop is removed. Nothing more is done with the soil until spring, when, as early as the season will permit, it is disked and harrowed. The corn is then planted, generally with a check planter, in rows about 3 feet 6 inches apart, later leaving three or four stalks in each hill. Very frequently the ground is harrowed after planting, and, in addition, is cultivated three or four times during the season. Implements with small shovels and other attachments adapted to shallow cultivation are preferred by most of the farmers to those which do deeper work or leave the land in ridges.

The corn is generally planted in May, although corn planted as late as June 10 will yield well, providing the season is favorable. A small part of the crop is cut with binders and subsequently shredded or

husked from the shock, but the greater part is gathered from the standing stalks. Since a very few farmers in the southern part of the county feed cattle or have much stock of any kind, the greater part of the corn produced is sold at the nearest elevators. Occasionally some of the corn stover is harvested for feed, but the practice is not general.

In growing oats the seed is generally sown broadcast on land that has been in corn the previous year without any preparation of the soil. The disk is then used to pulverize the surface and cover the seed. The crop is sown as early as the season will permit, and is harvested the latter part of July. The grain is seldom stacked, but is thrashed from the shock soon after it is cut.

In seeding lands to grass and clover it is the general practice to use oats as a nurse crop, but the success of this method depends almost wholly upon climatic conditions. Upon the removal of the nurse crop the young plants are exposed to the hot sun and winds, and growing in a soil already largely exhausted of its moisture, can make but feeble growth unless moisture conditions remain favorable. If these crops become fairly well established they will endure very unfavorable conditions, which frequently occur during the winter months. There is, however, considerable danger of the clover heaving, and this condition is largely responsible for the small acreage of this crop.

Rye is sown in the fall on land that has been in corn during the growing season. The usual date of sowing is about September 20, and of harvesting about July. It is quite generally used in the northern part of the county as a nurse crop for timothy. Timothy in this section is occasionally sown in the fall without a nurse crop, and the first cutting of hay is harvested the following spring.

A large proportion of the soils in the northern part of the county are in pasture or hay. Most of this grass is utilized in cattle feeding, which is conducted on an extensive scale by companies and a few wealthy landowners. Light-weight cattle are purchased on the Chicago markets, shipped in here, and fed for a few months. This method has proven more profitable than raising calves. The cattle feeders purchase all the corn produced in this section of the county, and in addition import a considerable quantity of cotton-seed meal for feeding purposes.

Aside from the use of stable manure and the occasional plowing under of a green manure crop, the soils of the area receive practically no fertilizers. A few farmers in the east-central part of the county and a few of those farming areas of Peat buy some commercial fertilizers, but as a rule the quantity used is very small.

No systematic rotation of crops is practiced in the area. The general system followed is to plant corn one year and sow to oats the

following year, then back to corn again. In some cases the farmers do not alternate corn and oats from year to year, but plant to one crop, generally corn, for a period of years. Occasionally a clover crop is grown and plowed under for green manure. It is generally recognized that this crop will keep up the fertility of the soils if not sown at too great intervals. The growing of this crop for green manuring should be encouraged wherever it is possible to secure a fair stand, and it should be introduced into the rotation once every three or four years at least.

Under the present system of farming the soils have decreased in productivity and are gradually becoming poorer from year to year. Land which formerly produced 60 or 70 bushels of corn is now producing 30 or 40 bushels per acre. And it is not exceptional to find even lower yields if climatic conditions have been unfavorable.

This matter is of great importance to the landowners of the area, and the necessity of methods less exhaustive to the soils is generally recognized. The trouble can easily be obviated by a proper system of farm management, which should be installed before the lands become poorer in crop-producing power. More stock should be raised to consume all the products of the farm and make more manure to be applied to the lands, a systematic rotation of crops should be practiced, and leguminous crops should be raised to supply nitrogen and increase the organic content of the soil. If this were practiced, the soils would not only at once produce better crops than can be grown at present, but they would gradually increase in productivity from year to year.

AGRICULTURAL CONDITIONS.

The resources of Newton County are almost wholly agricultural. The soils, although not as productive as formerly, give good yields, and from the general appearance of the country the farming class is in prosperous circumstances. During the last decade the price of land has steadily advanced. The valuation of all farm lands, according to the State assessor's report for 1904, is $5,396,360, while that of buildings is placed at $705,180. These figures represent less than 40 per cent of the actual value of the farms of the county.

Very few farmers are in debt, and in 1903 there were only 80 farm mortgages on record. The farm houses, especially upon farms operated by the owners, are well built, and in many cases are handsome residences. The barns are large, substantially built, and painted, while the other outbuildings are usually well kept. Most of the lands are inclosed by fences or hedges, wire and osage orange being most commonly used.

More than one-half of the farms of the area are operated by tenants who are usually compelled by the lease to grow certain specified crops. The larger estates are generally divided up into a number of farms

which are rented. These estates are usually looked after by a manager or foreman, whose duty it is to supervise the work of the different farms and to see that the terms of the leases are carried out.

The usual rent for good land varies from two-fifths to one-half of the grain delivered at the nearest elevator, and when a cash rent is asked from $3.50 to $5 an acre for pasture and hay lands. In a few cases renters have to pay house rent, which is often as high as $50 a year. On the larger estates, especially on those where stock is raised, the usual rent is two-fifths of the crop delivered at the home place. In some cases the landowners have the tenants feed cattle for them, buying the tenant's share of the crops for feeding purposes and paying him from $30 to $50 a month for feeding and caring for the stock.

Most of the farms are the property of men who have moved to the towns, and there are also a good many which represent investments or inheritances.

There are four estates in the county which have more than 5,000 acres under one management, and a number of others which include more than 3,000 acres. Small farms of 20 or 40 acres are comparatively few, and the greater number vary in size from 160 to 240 acres.

The value of the land depends almost altogether upon the drainage conditions and the character of the soil. The Marshall loam and Marshall fine sandy loam have the highest value, frequently selling for $125 an acre. The Clyde fine sand and Clyde loam sell for about $50, while the Miami fine sand and Newton fine sand are worth much less. Poorly drained areas of Swamp and other soils, used mostly for pasture, vary greatly in price, but seldom exceed $25 or $35 an acre.

There is no particular scarcity of farm labor in the county, but many farmers complain of the difficulty of securing permanent help, inasmuch as few young men seek farm employment except as a temporary occupation. The usual wages are about $25 a month, with board. Day labor, especially during harvest, commands $2 or more a day.

The principal products are limited in variety, but there is considerable difference in their quality. The best corn, grown on the Marshall loam and Marshall fine sandy loam, is usually graded as "No. 3" on the Chicago market, but that grown on the more sandy soils is much inferior in weight and feeding value. A similar difference is observed in the oat crop, but very often the quality of the best grain is materially reduced by being thrashed from the shock instead of from the stack after being allowed "to go through the sweat."

In 1904 this county produced 2,247,965 bushels of corn and 1,462,269 bushels of oats. The land devoted to these two crops was 119,630 acres. The total acreage of clover for the same year was 1,748, while that devoted to timothy was about 12,000 acres. The production of

wild grass on the poorly drained lands is a very important item. The quality is rather poor, but the native varieties are gradually giving place to bluegrass, wherever the water table is permanently lowered.

The live-stock interests are confined chiefly to the feeding of cattle on the cheaper lands of the northern part of the county. There are very few farmers who do not have two or more milch cows and fatten a number of hogs each year, but the income from these sources is far less than the county is easily capable of producing. A large number of excellent draft horses are raised, which usually bring a good price on the market. At the present time the price of horses is high, good draft types selling for $150 to $200, and a good team, well mated, bringing from $300 to $400. In only a few cases is special attention given to the production of any kind of high-grade live stock.

The fact does not seem to be generally recognized that the soils of the area are adapted to a wider diversity of crops than is at present grown upon them. Neither is the fact appreciated that certain crops are grown upon soils which are unsuited to them, and that the poor yields almost invariably secured are not so much due to the natural unproductiveness of the soil as it is to the fact that the soil is not adapted to their production.

The Marshall loam is well adapted to corn and oats. Timothy and clover can be raised on this type, but the climatic conditions are generally such as to make the production of these crops uncertain. Barley, flax, and millet have been produced on this soil type in other areas, but the success of growing these crops in this county would depend largely upon climatic conditions. The same can be said of the Marshall fine sandy loam and the Clyde loam, but in addition wheat can be grown upon the former under suitable conditions. The Miami black clay loam is generally recognized as a corn and grass soil. Clover will also do well on this type, particularly on the better drained areas.

Corn and oats are also grown upon the level sandy soils of the northern part of the county, but these soils are not well adapted to these crops and the yields are generally very poor. Hay and rye are grown on these soils, but the yields are generally light except on areas in which the soil contains large amounts of organic mattnr. These sandy soils are particularly well adapted to small fruits and truck crops. Wherever drainage conditions are favorable the Clyde fine sand offers exceptional advantages for small fruit and truck growing. Newton fine sand probably offers the same advantages, but a large amount of organic matter must first be incorporated in this soil to make it produce well. A few farmers have already engaged in the small fruit and truck business with encouraging results.

Locations may be selected where grapes, plums, and pears will do well. A fruit farm in the Clyde fine sand has averaged during the last two years over 3,000 quarts of strawberries per acre under ordi-

nary field conditions, and large yields of early potatoes, cabbage, and other vegetables have also been reported.

The sandy soils of the area are also well adapted to pasture, and a large percentage of them in the northern part of the county is devoted to grazing. The Miami fine sand areas have at present little agricultural value, but they can be made to produce successfully such crops as small fruits, early potatoes, and truck.

While there are no large towns within the borders of the county, transportation facilities to Chicago and other cities east and west are very good. There are three railway lines direct to Chicago, which is about 80 miles distant. In addition to the small towns, there are a number of grain elevators located along the railroads, so that the farmers have only a short distance to haul the grain to a shipping point. The public roads are generally kept in good repair, and many miles of these have been covered with gravel or crushed stone.

NRCS Accessibility Statement

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

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