

Issued June 29, 1914.

U. S. DEPARTMENT OF AGRICULTURE,

BUREAU OF SOILS—MILTON WHITNEY, Chief.

IN COOPERATION WITH THE STATE OF INDIANA DEPARTMENT OF GEOLOGY.
EDWARD BARRETT, STATE GEOLOGIST.

SOIL SURVEY OF HAMILTON COUNTY,
INDIANA.

BY

LEWIS A. HURST, OF THE U. S. DEPARTMENT OF AGRICULTURE,
AND E. J. GRIMES, R. S. HESLER, AND H. G. YOUNG,
OF THE INDIANA DEPARTMENT OF GEOLOGY.

J. E. LAPHAM, INSPECTOR IN CHARGE NORTHERN DIVISION.

[Advance Sheets—Field Operations of the Bureau of Soils, 1912.]



WASHINGTON:
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1914.

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LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF SOILS,
Washington, D. C., June 24, 1913.

SIR: During the field season of 1912 a soil survey was made of Hamilton County, Ind. This work was done in cooperation with the State of Indiana, Department of Geology, Edward Barrett, State Geologist, and the selection of the area was made after conference with State officials.

I have the honor to transmit herewith the manuscript report and map covering this work, and to recommend their publication as advance sheets of Field Operations of the Bureau of Soils for 1912, as authorized by law.

Respectfully,

MILTON WHITNEY,
Chief of Bureau.

Hon. D. F. HOUSTON,
Secretary of Agriculture.

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MAP.

Soil map, Hamilton County sheet, Indiana.

SOIL SURVEY OF HAMILTON COUNTY, INDIANA.

By LEWIS A. HURST, of the U. S. Department of Agriculture, and E. J. GRIMES, R. S. HESLER, and H. G. YOUNG, of the Indiana Department of Geology.

DESCRIPTION OF THE AREA.

Hamilton County is situated slightly north of the geographic center of Indiana and is bordered on the north by Tipton County, on the east and south by Madison, Hancock, and Marion, and on the west by Boone and Clinton Counties. It is approximately a square, with its sides 20 miles in length, and has an area of 399 square miles, or 255,360 acres.

In topography it varies from a level till plain to an undulating and sometimes hilly surface, the latter being found only in the vicinity of stream courses, or where the more prominent moraines exist. Moraines are not very common in any part of the county, but they are more numerous in the western part than elsewhere, the most

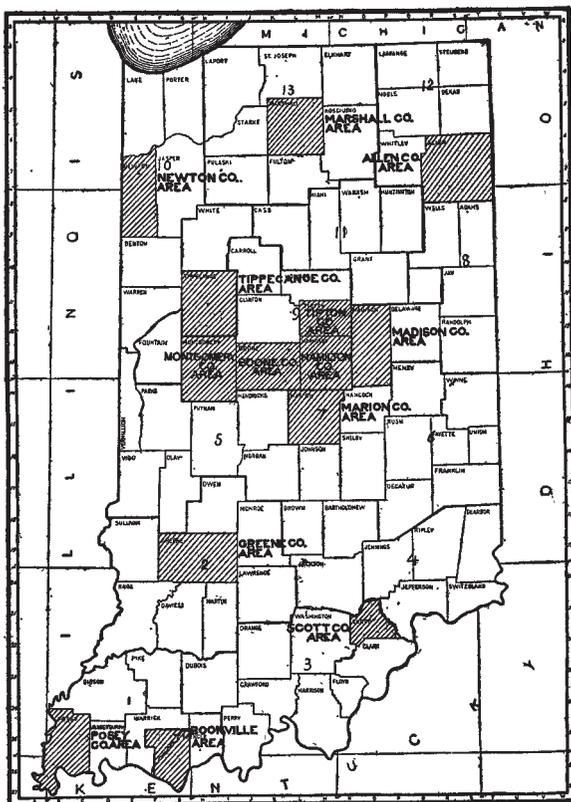


FIG. 1.—Sketch map showing areas surveyed in Indiana.

prominent one being situated north of Sheridan. The roughest country lies along Hinkle Creek, in the vicinity of Deming. The banks along the larger streams are usually precipitous, ranging in height from 30 to 100 feet or more. They generally rise in two distinct terraces to the broken country, which along most of the streams

merges rapidly into the broad level plain. There are numerous old filled-in valleys in the area, indicating that the preglacial topography was much more irregular than the existing topography. Among the more prominent topographic features of the county is an old valley or glacial channel on the west side of the West Fork White River, below Noblesville, and a similar valley above the city on the same side of the river. Another feature of note is a broad depression extending northeast and southwest and connecting the valley of the West Fork White River with that of Prairie Creek. The valleys of Fall and Mud Creeks are joined by a similar depression.

The county has a range in elevation of 150 feet. The western part lies between 900 to 950 feet, and the eastern part from 800 to 850 feet above sea level. The general slope of the surface is from north to south.

In the northern part of the county the surface is in general more level and the drainage less mature than the southern part. Thus the greater dissection of the latter region produced a more rolling surface. This is especially true near the junction of the smaller streams with West Fork White River.

The drainage is discharged through the West Fork White River and its tributaries. The river enters the county from the east, about 5 miles from the north boundary, and leaves it near the center of the southern border. The overflowed first-bottom lands along this stream are generally narrow and bordered by broad level terraces with steep escarpments from 10 to 30 feet in height.

The principal tributary of West Fork White River in the county is Cicero Creek, which empties into West Fork White River south of Noblesville. This creek has a remarkably narrow channel and a winding course. The flood plain is bordered on each side by bluffs 20 to 40 feet in height. Cicero Creek with its tributaries, Little Cicero, Little Wersel, and Hinkle Creeks, drains about 150 square miles of the area. The drainage of the northeast section of the county is into West Fork White River through Duck Creek and its tributaries and Pipe Creek. Stony Creek and its branches drain the central eastern portion, Fall Creek and its tributaries the southeast section, and Little Eagle and Williams Creeks the southwest section. Drainage of the extreme northwest part of the county is performed by Prairie Creek. The valleys of Little Eagle and Williams Creeks are bordered by heavy drift deposits. Along Cool Creek the surface is quite broken, while Stony Creek has developed a second terrace along the greater part of its course.

As stated previously, the regional drainage of the southern part of the area is better developed than that of the northern. In the latter region numerous inequalities were formed in the surface by

glaciation. These depressions filled with water and existed under natural conditions as swamps or ponds.

Hamilton County was organized in 1823, the first settlement having been made a few years earlier. The section first developed lay along West Fork White River in the central and southern part of the county. Most of the immigrants came from Ohio, Kentucky, Virginia, and Pennsylvania. In 1820 a settlement was made on the present site of Noblesville, the county seat, and in 1823 this town was founded. The greatest influx of settlers came in 1857, when the Peru & Indianapolis Railroad was built from Indianapolis to Noblesville. The construction of this road greatly stimulated agricultural development by opening up new markets and increasing the price of farm products.

In the early period Indianapolis and Lafayette were the chief markets, though cattle were sometimes sold at Cincinnati and hogs at Madison. At the present time Indianapolis, situated in Marion County on the south, is the leading market and trading center for the county.

The population of the county has grown steadily since its settlement, and according to the census of 1910 it is now 27,026. Of this number more than 12,000 live in Noblesville and the other towns and villages of the area. The remaining population is distributed rather evenly over the rural sections.

Noblesville, with a population of 5,073, is the county seat and largest town in the county. It is located on West Fork White River 20 miles north of Indianapolis. It is not only the center of a rich agricultural section from which it draws much of its support, but the site of several important manufactories.

Sheridan, in the northwestern part of the county, with a population of about 1,200, is the next largest town. Cicero, Atlanta, and Arcadia, situated north of the county seat, Westfield in the western part of the county, and Carmel in the southern part, are thriving towns with populations between 500 and 1,000. In addition to these towns there are 14 other smaller towns and villages in the county. All of the towns and villages of the county depend mainly upon agriculture for their existence, though a few of them draw part of their support from manufacturing industries. The manufacture of condensed milk is carried on at Sheridan, and in the vicinity of the town dairying has become the chief agricultural industry. Arcadia has a canning establishment and a glass factory. At Westfield there is a cannery and a mill for the manufacture of sorghum and cane molasses.

The shipping facilities of the county are excellent. The Indianapolis and Michigan City division of the Lake Erie & Western Rail-

road runs north and south through the center of the county. The Central Indiana Railway passes through the area east and west, a little south of the center of the county. The latter railroad crosses the Lake Erie & Western at Noblesville. The former line furnishes the chief outlet for the products of the county. A main line of the Chicago, Indianapolis & Louisville Railway (Monon Route) enters the county near the southwest corner and traverses the southwest and central-western townships. Carmel, Westfield, Hortonville, and Sheridan are situated on this road. At Westfield it intersects the Central Indiana Railway. An interurban line of the Indiana Union Traction Co. traverses the county in a general north and south direction, passing through Carmel, Noblesville, Cicero, Arcadia, and Atlanta. It affords freight and express accommodations and is a valuable means of shipping dairy and other farm products to Indianapolis and other cities.

The present road system of Hamilton County has developed from the toll pikes which at one period prevailed in the county. A number of pikes radiate from Noblesville. Chief among these are the roads connecting the county seat with Fortville, Greenfield, Anderson, Pendleton, Lapel, Elwood, Tipton, Frankfort, Lafayette, Lebanon, and Indianapolis. Within recent years these pikes have been purchased by the county and thrown open to the public. At the present time they are the main highways. From time to time the sectionized road system has added new local roads wherever needed. As a result every part of the county is easily accessible. Most of the roads have been surfaced with gravel and are in excellent condition. There are unlimited quantities of gravel available for road and other construction.

In general the county presents a prosperous appearance, with neat farm houses and well-kept barns and outbuildings. Telephone lines, and rural mail routes connect all parts of the county. Excellent churches and schools are accessible to every section.

CLIMATE.

The average annual temperature of Hamilton County is 55° F., the absolute maximum 106° F. and the absolute minimum -25° F. Hot spells occur during June, July, August, and September, but rarely last any great length of time. Periods of extremely dry weather, with relatively high temperature, are sometimes experienced. Zero weather is not common, and periods of such low temperature seldom last more than a day or two.

The average annual precipitation for the county is 41.9 inches. May, June, and July are the months in which the greatest amount of rainfall occurs, but the precipitation is distributed rather uniformly through the year. The mean annual snowfall is 22.9 inches.

Sometimes the ground is covered for weeks or months, but generally the snowfall is periodical.

The length of the growing season is about 5½ months, the average date of the first killing frost in fall and the last in the spring being October 19 and April 16, respectively. During the period for which records have been kept, the earliest date of a killing frost in the fall was September 21, and the latest in spring May 22.

The following table gives salient climatic data of the region, as shown by the records of the Weather Bureau station at Indianapolis, about 20 miles from the center of Hamilton County:

Normal monthly, seasonal, and annual temperature and precipitation at Indianapolis.

Month.	Temperature.			Precipitation.			
	Mean.	Absolute maximum.	Absolute minimum.	Mean.	Total amount for the driest year.	Total amount for the wettest year.	Snow, average depth.
	°F.	°F.	°F.	Inches.	Inches.	Inches.	Inches.
December.....	33	68	-15	3.0	4.1	0.9	5.1
January.....	28	69	-25	2.8	1.6	4.9	6.9
February.....	31	72	-18	3.3	1.6	4.6	4.4
Winter.....	31			9.1	7.3	10.4	16.4
March.....	40	82		3.8	4.2	7.4	3.6
April.....	52	87	19	3.4	3.2	2.3	1.2
May.....	63	96	31	4.0	2.4	5.1	.1
Spring.....	52			11.2	9.8	14.8	4.9
June.....	72	100	39	4.4	3.5	7.5	
July.....	76	106	48	4.2	.8	7.5	
August.....	74	101	46	3.2	3.6	5.9	
Summer.....	74			11.8	7.9	20.9	
September.....	67	98	30	3.3	.7	3.9	
October.....	55	89	22	2.8	3.5	4.4	Trace.
November.....	42	76	- 5	3.7	1.2	2.3	1.6
Fall.....	53			9.8	5.4	10.6	1.6
Year.....	55	106	-25	41.9	30.4	56.7	22.9

AGRICULTURE.

At the time of settlement the region of which Hamilton County is a part was for the most part heavily forested with hardwoods. Interspersed in this forest were occasional open prairies and swamps. A considerable section of the county was originally poorly drained and unsuited for agriculture in its natural condition. A relatively large proportion of the land was, however, topographically well suited to farming. At the present time most of the forest has been removed and the poorly drained lands reclaimed.

The early settlers took up their claims along West Fork White River, as it gave them access to outside markets by rafts or flatboats. The bottom lands along the river were better suited to corn than to other grains, and this became the main crop. The bottom lands were subject to overflow and did not require fertilizing, and corn was grown upon the same land year after year without materially diminishing the yields. The uplands in the vicinity of the river were generally better drained naturally than the more remote uplands, and when first cleared large yields were obtained. The cost of draining the "black lands" and in many cases the lack of adequate drainage outlets precluded the early use of these lands. However, much of the later prosperity of the county came from the occupancy and development of these lands, which began about 1875 with the deepening, straightening, and widening of the natural drainage outlets by dredging.

Wherever the surface is level it generally has been necessary to make use of artificial drains. At first open ditches were employed, but the disadvantages of having the fields cut up with them led to the installation of tile drains. Thousands of dollars have thus been expended in reclaiming the so-called "black lands" and bottom lands along the shallower stream courses.

Corn has always been the main crop of the area and the aim of the majority of farmers is further to increase the production of this staple. The acreage of corn in 1879 was 60,479, with a total production of 2,233,158 bushels, or an average of about 37 bushels per acre. According to the census of 1910, the acreage had increased to 77,815 acres, from which a production of 3,857,667 bushels, or an average of about 50 bushels per acre, was secured. This increase in the yield per acre is due largely to the increase in corn acreage upon the "black lands" (Clyde soils), considerable areas having been drained and brought under cultivation in recent years. These soils produce approximately twice as much corn as the lighter colored clay soils (Miami soils). The increase is also due to better cultural methods, including fertilization and seed selection. Some commercial fertilizer is being used in the production of corn, but barnyard manure is chiefly employed. Fertilizers may be used with profit to increase the yields of corn, but other methods of maintaining the fertility of the soil should also be employed, such as crop rotation, green manuring, etc.

Selection of the variety of corn best suited to the soil on which the crop is to be grown is an important factor in increasing the yields. Too often no attention is given to this matter or to the testing of seed corn. The seed, to produce the best results, should be strong in vitality and the kernels graded to uniform sizes so as to drop evenly when used in the planter. In general, Reid's Yellow Dent, Leaming,

and Boone County White are well adapted to the climatic conditions of the county. The best varieties to grow on the different kinds of soil can best be worked out by the farmers themselves. The seed corn selected from the clay lands should be planted on the clay lands so far as practicable, and that selected from the "black lands" should also be kept for the black lands. Well-selected home-grown seed is generally preferable to any other on any soil. By this method it is believed that the quality and yields from these lands can be increased.

Corn is generally planted with the check drill so that it may be cultivated both ways, which frequently does away with hoeing. Three to four cultivations are usually given, although five are not uncommon. Riding cultivators are in general use. In the last few years a large proportion of the corn has been cut for ensilage. This practice is being extended as the value of silo feeding becomes better understood. The planting of cowpeas and soy beans in the corn for ensilage is being practiced extensively. The advantage of having a legume growth in connection with corn can readily be appreciated, as it adds organic matter and nitrogen to the soil.

The acreage in wheat in Hamilton County in 1879 was 36,988 acres, as compared with 30,827 in 1909. The average yield of the earlier year was about 21 bushels, and in the later about 18 bushels per acre. In order to produce the largest yields of wheat on the clay lands, which embrace the types of soil best suited to the crop, they should be subsoiled if possible every three years. The application of 2 tons or more of finely ground limestone to the acre, as recommended for corn, will be equally beneficial to the wheat crop. The general practice is to apply lime or finely ground limestone to the wheat lands prior to seeding. The effect is particularly noticeable upon the following clover crop, and subsequent wheat crops are benefited by the increased productiveness of the land, due to the addition of organic matter and nitrogen by the clover crop. More attention should also be given to the selection of suitable varieties of wheat for the soil and a proper grading of the seed. The rotation followed, the fertilization, treatment of seed for disease, and the combating of insects which attack the wheat are important factors in the production of this crop. The Purdue Experiment Station recommends the use of 300 pounds per acre of a fertilizer analyzing 2 per cent nitrogen, 8 per cent available phosphoric acid, and 2 to 4 per cent of potash. This can be applied at time of seeding by using a drill with fertilizer attachment. When clover has been turned under for corn and the latter is followed by wheat, an application of nitrate is generally advisable. This can best be supplied by a top dressing of nitrate of soda in the spring, using 50 to 100 pounds per acre. Where barnyard manure is used it is best to turn it under with the clover sod

preceding the planting of corn. The most profitable results from the use of commercial fertilizers with wheat are obtained where this practice is followed.

Oats are not generally considered a paying crop, but this grain fits in well with the customary rotation. The crop is valued chiefly for the straw, and when cut for hay it makes an excellent roughage feed to use in conjunction with ensilage. The ordinary yield of oats ranges from 30 to 40 bushels per acre. The growing of cowpeas and soy beans as a substitute for oats is being tried by some of the more progressive farmers. Oats are generally sown with an end-gate attachment at the rate of $2\frac{1}{2}$ to 3 bushels per acre.

The production of hay as shown by the 1910 census is only about one-fourth that of 1880. The number of acres of clover hay is given as 2,667, which means that only one acre in ninety is used for this purpose. It is evident from this that clover is not generally included in the rotation of crops; or if so, it is turned under without being cut for hay. The latter practice was not observed during the course of the survey.

The growing of alfalfa has received some attention in the county in recent years, but its value as a feed has evidently never been realized or its culture would be more general. It is especially well adapted to the second-bottom lands or high terraces along West Fork White River. However, with proper attention it can be grown on almost any soil in the county except the Muck. Even if it is not grown as a money crop its value as a nitrogen-storing agent should recommend its culture, especially upon the clay lands or lighter colored soils of the county. It is never advisable to sow alfalfa after the 10th of August, for unless it makes considerable growth before frost it is likely to winter-kill. It may, however, be sown as early as the latter part of April. Where it is sown on wheat land it is practicable to get the seed in between July 15 and August 10.

Hamilton County is becoming more and more a dairy country. There is no better hay for dairy stock than alfalfa. The crop also has a high value in the permanent upbuilding of the soil, particularly those soils which are lacking in humus, as is the case with all the light-colored soils of the area. Three to four cuttings a year can be made with a yield of 3 to 4 tons per acre.

To succeed with alfalfa it is necessary first that the land be well drained; second, that it be limed; third, that it be thoroughly inoculated; and, fourth, that it be thoroughly prepared and free from weeds.¹

With proper attention fruit growing can be made a profitable industry in this county, particularly in the southern part. It has not

¹ For detailed information regarding the growing of alfalfa, see Farmers' Bulletin No. 339.

flourished recently. There are many old and neglected orchards in the county, and diseases and insect pests spread from these and affect the more recent plantings. Modern methods of control and State inspection are needed to put the industry on a satisfactory basis.

Most of the farmers in Hamilton County follow some form of crop rotation. It should be the purpose of a crop rotation (1) to get larger yields and profits, directly or indirectly, (2) to distribute the work more evenly throughout the year, (3) to give a more certain and regular income than is possible with a one-crop system, (4) to maintain or, better, to increase the fertility of the soil, (5) to reduce to a minimum the injury from weeds, insect pests, and diseases that frequently accompany the shiftless methods of farming. The three main classes of crops to be considered in a rotation are, first, small grain; second, hay; and, third, cultivated crops. In planning a rotation it is necessary to consider the income, the needs of the land, the feed required by the stock, and the effect of each crop in the rotation on another. It is thus a question requiring more particular study of individual problems than can be given in the prosecution of the soil survey. Every rotation should, however, include at least one legume as a soil enricher.

The price of land has advanced rapidly in the last few years and but little of it can be bought for less than \$150 an acre, and where it is well improved from \$200 to \$225 is often asked. The more prosperous farmers are satisfied with their holdings and refuse to put a price upon their land. The demand for suburban property, particularly in the vicinity of the main transportation lines, will undoubtedly cause a steady advance in the price of land. As an index of the prosperity of the farmers it may be stated that mortgage indebtedness secured by farm property in the county decreased nearly 40 per cent between 1908 and 1909.

Farm hands are paid from \$20 to \$25 a month, with board, lodging, washing, and feed for a driving horse. Harvest hands and extra helpers receive from \$1.50 to \$2.50 per day. The manufacturing plants and public works in Indianapolis have drawn heavily upon the labor of the county, so that desirable farm labor is scarce. Most of the work is done by the owner and his family.

SOILS.

Hamilton County is covered with a mantle of till varying in thickness from a few feet in the eastern part of the area to as much as 300 feet in the north and west parts. The mean average thickness is about 100 feet.

The glacial till is a stiff, compact, clayey matrix, with which is mingled sand, gravel, and boulders in varying proportions. Some of the rock is of local origin, but other kinds, for instance, granite,

gneiss, and trap rocks, also found embedded in the till and strewn over the surface, have been brought from the Lake Superior region, whence they were carried by the ice. In the eastern half of the county the Niagara limestone underlies the glacial deposits, and this rock outcrops in the valley of West Fork White River, above and below Strawtown, and in the valleys of Fall and Stony Creeks. It appears near the surface at a few other points in the area. The Devonian rocks underlie the till in the western half of the county, but are not exposed at any point.

It is from the glacial till that the upland soils of the area have been derived. The alluvial soils or bottom lands represent stream-deposited material composed largely of wash from the upland soils. The underlying rocks have directly contributed little if any of the materials of which the soils of Hamilton County are composed, but they may have contributed to the ice-ground mantle covering the uplands from which the various types are derived.

The drift or till is largely of foreign origin and is more or less general in distribution. It is said to belong geologically to the late Wisconsin stage of glaciation and represents materials which were ground and mixed by the bodies of ice which in glacial time advanced over this region as a great ice sheet or glacier. On melting there was left a mass of finely ground rock material. Since this time the mantle of glacial débris has been acted upon by the various agencies of weathering—water, air, vegetation, change in temperature, etc.—and changed to give the present soils. The more uniform silty surface layer is frequently underlain at about 2 to 6 feet by sandy or gravelly material. This accounts for the high content of silt in the upland soils. The bottom lands along the larger streams are more sandy, owing to the wash, not only from the silty upland soils, but from exposures of the coarser substratum. Where the drainage has been more sluggish along the smaller streams the bottom lands are also quite silty.

Five series of soils were mapped—the Miami, Clyde, Fox, Waukesha, and Genesee. In addition the miscellaneous soils Meadow and Muck are encountered.

The Miami series is the most extensive in point of area. This series, including the Miami silt loam and Miami silt loam, flat phase, is characterized by the brownish color of the surface soil and the lighter brown or yellowish-brown color of the subsoil. The soils occupy undulating to gently rolling to nearly level, well-defined areas. The material is derived from glacial till.

The Clyde soils, which also represent an extensive upland series, including the loam and silty clay loam types, are derived from glacial till, but they differ from the Miami in having black soils rich in organic matter. They occupy poorly drained situations

which have favored the accumulation of organic matter. There has been considerable washing in of soil material over the depressions from the adjacent higher land.

The overflowed first-bottom lands were mapped as Genesee loam, Genesee silty clay loam, Genesee gravelly sandy loam, and as Meadow. The Genesee loam occurs mostly along West Fork White River and the larger streams, while the silty clay loam is found along Stony, Mud, and Fall Creeks and some of the smaller streams. The gravelly sandy loam occupies small areas along West Fork White River. The Genesee soils are composed of brown-colored alluvial material representing wash from the uplands which was deposited by stream overflow. The classification Meadow comprises alluvial material so variable in texture that satisfactory separation into definite types could not be accomplished. The material, in the main, possesses the characteristics of the Genesee.

The Fox and Waukesha soils are confined to the stream terraces, the second bottoms, which were built up by the overflow waters when the streams were flowing at higher levels than at present, just as the present first bottoms are being built up by additional deposits from local successive overflow. The Fox series includes the brown-colored terrace soils, while the Waukesha series includes the black soils. The Waukesha soils differ from the Sioux, which are also black terrace soils, in their mineralogical composition, containing less limestone material.

In the subsequent chapters the various types are described in detail. The extent of the various types is shown in the following table and their distribution on the accompanying map :

Areas of different soils.

Soil.	Acres.	Per cent.	Soil.	Acres.	Per cent.
Miami silt loam.....	33,664	67.9	Muck.....	1,280	0.5
Flat phase.....	140,416		Clyde loam.....	384	.2
Clyde silty clay loam.....	45,248	17.7	Genesee gravelly sandy loam.....	384	.2
Genesee loam.....	12,160	4.8	Fox gravelly sandy loam.....	320	.2
Fox loam.....	10,688	4.2	Poorly drained phase.....	64	
Genesee silty clay loam.....	6,208	2.5	Total.....	255,360
Meadow.....	3,008	1.2			
Waukesha silty clay loam....	1,536	.6			

MIAMI SILT LOAM.

The surface soil of the Miami silt loam, to an average depth of 10 or 12 inches, is a brown to yellowish-brown silt loam, grading into a darker silty clay loam. Below 18 to 20 inches the subsoil is a dark-brown, friable silty clay to sandy clay with an appreciable amount

of fine gravel. The content of sand and gravel increases with depth, so that below 3 or 4 feet a lighter colored gravelly loam is encountered. Erosion, which tends to remove the finer material from the till, has been the main factor in differentiating this soil from the flat phase.

This type occupies the more rolling uplands in the vicinity of the larger stream courses and the larger morainic ridges throughout the area. It is confined almost entirely to the southern half of the county, where the rivers and creeks have cut deeper into the glacial till plane, causing more active erosion in the vicinity of their stream valleys.

This type is rolling to hilly, the greatest relief being found along Hinkle Creek in the vicinity of Deming. No definite boundary exists between it and the flat phase, the change from one to the other being very gradual, both as regards texture and topography. The texture does not always follow the rolling topography, for even these rolling areas are sometimes quite silty and could easily be classed with the flat phase in this respect. In the vicinity of West Fork White River a level to undulating plain is sometimes encountered where the soil is darker in color than the flat phase, but otherwise like that soil. This intermediate phase is well drained and quite productive.

The Miami silt loam as a whole is probably better suited to fruit culture than to general farming, as it is often too rolling for the successful use of machinery. Existing orchards are profitable. The dark-colored phase described above is one of the best wheat soils of the county.

In some places this type is sufficiently steep to warrant its being terraced, but no terracing is practiced in the area to prevent washing of the hillsides. The steeper slopes should be kept in sod whenever it is practicable to do so.

Miami silt loam, flat phase.—The surface soil of the Miami silt loam, flat phase, to an average depth of about 8 inches, is a compact silt loam of light-brown color when wet, but having a grayish surface when dry. The soil below the surface is also frequently grayish yellow or creamy yellow when partly dry. Below 8 inches and to a depth of 12 to 15 inches the color changes to a mottled gray and brown, with a gradation in texture from the silt loam to a silty clay loam. Below this depth the subsoil is a yellowish-brown silty clay, grading into a darker brown friable silty clay containing an appreciable amount of sand and fine gravel. The darker brown material, boulder clay, is encountered at 24 to 30 inches, where the surface is level to gently undulating, and at 18 to 20 inches, where the surface is more broken or hilly. The soil under the latter condition, however, approaches more nearly the typical Miami silt loam. Areas of this kind are found generally in the vicinity of stream courses.

Below 3 or 4 feet the substratum gradually becomes lighter, both in color and texture, and at a depth of 8 or 10 feet a large percentage of the soil mass is made up of sand and gravel. Below this a stratum of drab to bluish clay is frequently encountered, which, in turn, is underlain by strata of sand and gravel. The latter condition is more general along the stream courses. The deposits are less stratified farther back from the stream valleys.

The Miami silt loam, flat phase, being derived from glacial till, is fairly uniform throughout the county, but slight local variations in the surface soil exist as the result of inequalities of drainage. Upon the crests of the knolls and ridges the soil is more sandy, with a few chert, granite, and quartz pebbles strewn upon the surface. Where it occurs as level or slightly undulating areas the surface soil often presents a leached or ashy colored appearance, due to its natural, poorly drained condition. It is not as productive as the better drained areas, in which the soil is darker colored. Where the drainage is inadequate the subsoil is mottled, cold, and heavy, while in the case of the better drained areas the subsoil is darker, frequently of a yellowish-brown color, and is more open and porous, allowing a freer circulation of air and water. Such conditions render it more productive.

The Miami silt loam, flat phase, is the most extensive soil in the county and includes a greater part of the better drained uplands. It is distinguished by its light color and is known locally as "clay" land. The term thus applied probably has reference to the tendency of the soil to clod if plowed when wet, as its texture is that of a silt loam and not a clay. The tendency of the soil to run together is due mainly to the insufficiency of organic matter.

The Miami silt loam, flat phase, is not only the most extensive but also the most widely distributed soil in the county, being found in all parts except along the larger streams, where a similar though lighter textured soil of rolling surface occurs. Throughout the northern half of the county the flat phase of the Miami silt loam is fairly evenly distributed with the Clyde silty clay loam, but in the southern, particularly the southwestern, portion of the county, the area of this soil far exceeds that of all others. In the more nearly level sections it occurs as low, flat ridges and knolls interspersed with the "black lands," or Clyde soils. The flat phase is best developed in the southwestern portion of the county along the Marion County line.

In the early settlement of the county the pioneers naturally preferred this soil to the "black lands," because of its better drainage. When first cleared it was darker in color than at present, being rich in humus, and was very productive. Continued cropping, frequently

without rotation, has largely depleted the humus supply. To this is due its light color or leached appearance, the low yields of certain crops, and the tendency of the soil to run together when wet and to bake or clod upon drying. The latter condition can never be remedied until sufficient organic matter has been incorporated with the soil to keep it loose and mellow. Liberal applications of finely ground limestone will aid in mellowing up this soil as well as help to stimulate the action of bacteria in storing nitrogen in the roots of clover and other leguminous crops. This soil showed a decided acid reaction wherever tests were made, indicating the need of lime. Applications of phosphatic fertilizers, either as ground phosphate rock or in the more soluble form of acid phosphate, should increase the yields. Subsoiling, supplemented by deeper plowing each year, will aid materially in increasing the water-holding capacity of the land.

The existence of the flat phase of the Miami silt loam in any particular field can usually be told by the early growth of corn, oats, clover, etc. It will be noted that the black-land areas, the Clyde soils, produce a much more vigorous growth of these crops, and this is reflected in the yields, a mean average for several successive years showing that the yields of corn, oats, and hay from the flat phase of the Miami silt loam are but little more than half as great as obtained from the Clyde silty clay loam. This is offset to some extent in the case of the grains by the better quality of the product of the Miami soil. This phase is well adapted to wheat, and the best soil in the county for that crop.

The growing of sorghum for sirup gives promise of being an important industry in the vicinity of Westfield. The lighter phase of this soil is particularly well adapted to this purpose, as it produces a mild-flavored, light-colored sirup.

While larger yields of tomatoes are obtained on the Clyde soils, a finer and more highly flavored tomato is produced on the lighter-colored soils, where the vine growth is less luxuriant. The tomatoes grown on the Miami are less subject to decay than those grown on the darker Clyde soils. Peas as well as tomatoes are grown on this soil for market and canning. Ground limestone or burned lime improve the yields and quality of the products.

A winter cover crop of some kind should always be sown upon this soil. Wheat is generally used for this purpose, but rye to be turned under in the spring where corn is to follow, makes an excellent crop for the purpose. If this practice is followed there will be less tendency for the soil to clod.

The Miami silt loam, flat phase, is not generally valued as highly as the black lands, the average price being about \$150 an acre. Adjacent to the towns and villages it commands a higher price. Some of the best improved farms in the county are located upon it, and where

up-to-date methods are being employed the returns from this soil are being increased, the crops being more certain than upon the Clyde soils.

The native forest growth consisted of beech, black walnut, white oak, yellow poplar, (tulip), sugar maple, white ash, chinquapin oak, red oak, shellbark hickory, hazel nut, pawpaw, redbud, wild plum, and dogwood. Only small scattered areas of forest remain.

CLYDE LOAM.

The surface soil of the Clyde loam, to an average depth of 10 inches, is a black loam to silty clay loam. This grades into a bluish-black silty clay loam. This in turn is underlain at 18 to 20 inches by a drab or gray silty clay, mottled with yellow or brown. In the lower depths the mottling is darker. Below 30 to 36 inches the subsoil becomes lighter in texture, being often a fine sandy clay. The water table is frequently encountered at this depth, so that the clay is soft and puttylike.

The dark color of the surface soil is due to the high content of organic matter. The soil when wet has a slightly pasty consistency for the same reason. The amount of this organic matter, however, is not sufficient to justify its correlation with the Muck, although the two are sometimes confused by the farmers.

The Clyde loam is commonly referred to as prairie land, similar lands being called wet prairies in other parts of the State and in Illinois. The term "prairie" as applied to these areas has reference to their original treeless condition. They represent depressions or swamp lands which in their natural state were covered with water a greater portion of the year. Hay was cut by the early settlers from the better drained areas, which constituted the chief source of this crop at that time. The native vegetation consisted largely of sedges, grasses, cat-tails, flags, "button bush," and willow. The annual decay of this vegetation has supplied the store of organic matter found in the soil.

Where the soil is loose and mucky it is generally "chaffy" or fluffy. Corn grown upon these areas burns or turns yellow before it is fully matured. This condition is more noticeable when the land is first put under cultivation. The free use of barnyard manure, deeper plowing, and thorough cultivation to increase aeration of the soil as much as possible, will tend to correct this chaffy condition. The liberal application of potash fertilizers is also recommended as a means of increasing the yields from this type.

The occurrence of this type in Hamilton County is limited to a small body west of Sheridan, which has been reclaimed by artificial drainage. It is used mostly for corn and oats. Being situated near the town of Sheridan, with ample railroad facilities, trucking would be more profitable, as this soil is particularly well adapted to cab-

bage, beets, turnips, Irish potatoes, cauliflower, celery, etc. The only other area mapped is located in sec. 8, T. 19, R. 5.

CLYDE SILTY CLAY LOAM.

The Clyde silty clay loam includes a greater part of what is known locally as the "black lands." It was originally of a semi-swampy nature, but in recent years it has been drained artificially and now constitutes one of the most productive types in the area. It is particularly well adapted to corn. The term "black land," as applied to this type, has reference to the dark color of the surface soil, the result of its high content of organic matter, which accumulated as vegetable remains when these areas were in a semiswampy condition.

The surface soil of the Clyde silty clay loam, to an average depth of 8 inches, is a dark-brown to almost black, heavy silt loam to silty clay loam. As the surface dries it has a grayish-black appearance. The dark color of the soil is proportionate to the percentage of organic matter present. The latter affects also the chemical and physical properties, the soil being enriched by this material, and its power to hold water increased. The subsoil from 8 to 20 or 24 inches grades from bluish black to drab or gray, with brown iron stains below 12 to 15 inches. The texture of the subsoil for the first few inches is a silty clay loam, which in turn is underlain by a stiff, plastic clay to a depth of 24 to 30 inches. Below this depth a gradual transition from the stiffer clay to a deeply mottled, lighter textured silty to fine sandy clay is encountered. Where this type follows the natural drainage channels it is generally underlain by sand and gravel at various depths, the average depth being 6 to 8 feet. The gravel and sand is usually highly stained with iron.

Although the Clyde silty clay loam is derived from the same materials as the flat phase of the Miami silt loam—glacial till of the late Wisconsin period—topographic differences are sufficient to form distinct types of soil. The former type occupies the lower lying areas or depressions in the uplands, originally deficient in drainage, while the better drained uplands are largely occupied by the flat phase of the Miami silt loam. During the early settlement of Hamilton County the Clyde silty clay loam was covered with water or semi-swampy during certain seasons of the year and little or no agricultural value was attached to these lands, but with the building of good roads and adequate drainage outlets the type has been gradually brought under cultivation and now includes some of the most productive and high-priced lands in the area. Farms often bring as much as \$200 to \$225 an acre and the selling price is frequently based on the number of acres of black land they contain.

The Clyde silty clay loam is darker in color and heavier in texture where the surface soil is only 6 to 8 inches deep. The percentage of organic matter is greater near the center of the areas or at the lowest point.

This type occurs widely distributed over the county, but the main bodies are confined chiefly to the northern and eastern portions. In the vicinity of Sheridan it is the predominating type. The type occurs as irregular shaped bodies throughout the uplands.

The Clyde silty clay loam is especially well adapted to corn, and yields of 60 to 80 bushels per acre are not infrequent. Oats produce a heavy stand and lodge badly in rainy seasons. If the season is favorable, 50 to 60 bushels per acre are generally obtained. Clover produces a rank growth and with timothy produces from 1½ to 2 tons or more hay per acre. In the vicinity of the towns in which canning factories are located this type is used extensively for growing tomatoes, chiefly because of the heavier yields. For domestic use where a firmer tomato is desired they should be grown upon the lighter colored Miami soils. Tomatoes grown upon the Clyde soil decay more readily, and during wet seasons much of the crop may be lost in this way.

Where commercial fertilizers and barnyard manure are to be applied it is better to use the commercial fertilizers upon the Clyde silty clay loam and the barnyard manure on the lighter colored soils, which have a lower content of organic matter. For use upon this type a mixture having 8 to 10 per cent of phosphoric acid and 4 to 5 per cent of potash is recommended. Nitrogen is not generally needed, and where its use is advisable can best be supplied by growing legumes in the rotations.

The surface of this type is flat to depressed and artificial drainage is required to remove the surface waters. Open ditches were first employed, but these have generally been replaced in recent years by tile drains.

With proper drainage and liming alfalfa could be grown upon this type, but since it is used so extensively for corn and oats, legumes that occupy the land for shorter periods, such as clover, vetch, cow-peas, or soy beans, are probably more profitable.

The native forest growth consisted of swamp white oak, white elm, swamp pin oak, silver maple, bur oak, black ash, cottonwood, green ash, prickly ash, and willow. Spice bush, button bush, and wild rose are characteristic plants of smaller growth.

FOX GRAVELLY SANDY LOAM.

The surface soil of the Fox gravelly sandy loam, to a depth of 10 inches, is a brown gravelly sandy loam. The subsoil is a brown gravelly sandy clay.

This type is very open and porous and admits of a free circulation of air and moisture. The substratum below 3 to 4 feet is more often a coarse gravel, so that its natural drainage is adequate, if not excessive. In dry weather this soil suffers from drought, but by keeping it well stocked with organic matter this difficulty may be overcome to some extent.

The Fox gravelly sandy loam occurs upon the high terraces on the north side of West Fork White River in secs. 16, 19, 20, T. 19, R. 5. It occurs as narrow strips associated with the Fox loam and has a limited acreage in the county.

This type would be well suited to trucking, being especially well adapted to sweet potatoes, watermelons, cucumbers, cantaloupes, and other crops requiring a light-textured, friable soil.

Fox gravelly sandy loam, poorly drained phase.—The Fox gravelly sandy loam, poorly drained phase, occupies only a few acres of the SW. $\frac{1}{4}$ of section 23 and the NW. $\frac{1}{4}$ of sec. 26, T. 18, R. 4. The surface soil to a depth of 6 or 8 inches is a grayish-brown, coarse sandy loam or gravelly sandy loam, the percentage of sand and gravel being quite variable over small areas. The subsoil ranges in texture from a gravelly sandy loam to a light-gray, iron-stained sandy clay. The texture is heaviest at 20 to 24 inches. Below this the material becomes more sandy and in the lower depths very gravelly. In some places the subsoil is mottled with bluish and drab colors, but for the most part it is light gray. Where this soil is plowed a rather high percentage of fine to medium gravel accumulates on the surface.

The poorly drained phase of the Fox gravelly sandy loam requires drainage to improve its physical condition. Undrained areas are cold and soggy. The phase occurs on second terraces of West Fork White River and is made up of reworked sedimentary materials assorted and laid down by the river at the time when it flowed at a higher level than at present.

This type is at present valued chiefly for the production of hay, but is sometimes used for corn. It can not be rated as a strong soil and can probably be best reserved for pasture and hay production.

FOX LOAM.

The soil of the Fox loam, to an average depth of 12 inches, is a mellow, brown to yellowish-brown, light silty loam or loam, grading into a yellowish-brown silty clay loam. At 18 to 20 inches the subsoil is a brown, friable silty clay to gravelly sandy clay, similar to the boulder clay which underlies the flat phase of the Miami silt loam. Below 3 to 4 feet a coarse gravelly sandy loam is encountered, which in turn is underlain by coarse gravel.

The Fox loam occupies high terraces along the larger streams in the southern part of the county. A greater proportion of the type is found along West Fork White River.

The Fox loam is known locally as second-bottom land, although it occurs on both the second and third terraces above the river. It is also called "sugar-tree flats." The boundary between it and the Genesee loam is very distinct. In some places it rises to 30 feet or more above the first-bottom lands. The boundary between it and the upland types is not so marked, although in some places a fairly well-defined bluff or sharp slope, 10 or 20 feet high, was observed. The surface is generally level, except along Fall Creek, in the southeastern part of the county, where it is more undulating.

The Fox loam differs from the Miami silt loam, flat phase, in that the surface is coarser in texture and darker in color. The soil contains less silt and the subsoil a much larger percentage of gravel than either the Miami silt loam or its flat phase. The open, porous nature of the subsoil allows a freer internal movement of moisture, the type warms earlier, and crops make a more rapid growth. They are also somewhat more subject to injury by drought. This type reaches its maximum producing capacity in wet seasons, when the Clyde silty clay loam, Genesee loam, and other types are too wet to produce average yields. The Fox loam is very easy to cultivate and a mellow seed bed is readily obtained.

The Fox loam occurs on one or the other side of West Fork White River throughout its course. It is sometimes found upon opposite sides of the river, but in general it shifts back and forth from one side to the other. The town of Noblesville is located upon this type. The type is probably of alluvial origin, having been deposited when West Fork White River flowed at a higher level than at the present time.

The largest continuous body of this type occurs south of Noblesville, extending thence to the county line. Narrow strips of the type are found along Stony Creek, a considerable acreage of it along Fall Creek, and smaller areas along Mud and Cool Creeks, the former a tributary of Fall Creek.

The Fox loam is a good general farming soil. It is used for the production of corn, hay, oats, and wheat, being better adapted to the latter. Alfalfa does especially well upon this type, but for the best results it must be limed frequently. Alfalfa well tended should yield better returns from this soil than from any other type in the county. The soil is also well adapted to potatoes, tomatoes, peas, and beans, and other truck crops, and their culture should be extended. A large proportion of the type is conveniently located with respect to the Indianapolis markets.

The native timber growth was largely hard maple, from which fact it takes the local name "sugar-tree flats." The native forest included also white oak, beech, black walnut, and other hardwood species.

Land of the Fox loam type is valued at \$150 to \$175 an acre, although some of it is held as high as \$200 or more an acre.

WAUKESHA SILTY CLAY LOAM.

The surface soil of the Waukesha silty clay loam to an average depth of 9 inches is a dark-brown to black, heavy silt loam or silty clay loam. The subsoil is a bluish-black silty clay, grading into a drab-colored material. Below 30 inches it is of a lighter gray color and slightly sandy. The Waukesha silty clay loam is similar in general appearance and texture to the Clyde loam, except that in most areas it is not quite so dark in color.

This type occurs as low-lying or depressed areas along the outer margin of the higher terraces of West Fork White River. It is confined to the southern part of the county, where the second terraces have their greatest development, being found in secs. 27, 33, and 34, T. 18, R. 4, and in secs. 7, 8, and 9, T. 17, R. 4. To its depressed surface and the annual accumulation of decayed vegetable matter is due its dark color and loamy structure. A small area is also found along Stony Creek in secs. 13, 23, 24, and 26, T. 19, R. 5. Its position upon the terraces along West Fork White River, and particularly near the confluence of some of the smaller streams with the river, indicates that the material consists of old alluvium.

Most of this type has been reclaimed by artificial drainage and devoted to corn culture. Heavy yields are obtained. In small areas throughout the type the soil is inclined to be "chaffy." This unfavorable condition can be gradually remedied by deeper plowing and by liberal applications of barnyard manure, as was suggested for the Clyde loam, where similar chaffy conditions are found. The use of ground limestone and potash fertilizer, properly applied, would also increase the yields from this type.

Thus far the cultivation of this land has been confined largely to the growing of corn, though some oats and hay are produced. The yield of corn is heavy, averaging 50 to 60 bushels per acre. Oats make a luxuriant growth and lodge badly. Grasses also produce a rank growth, and the quality of hay is not generally as good as that grown upon the uplands or upon the Fox loam. Owing to the natural fertility of this land and the growing demand for corn, the tendency is to keep the fields in this crop almost continuously. In time the present high yields will be reduced unless crop rotation is practiced.

GENESEE GRAVELLY SANDY LOAM.

The surface soil of the Genesee gravelly sandy loam, to a depth of 15 to 18 inches, is a brown to dark-brown gravelly sandy loam, very similar in texture to the Fox gravelly sandy loam. The subsoil varies from a gravelly sandy clay to a gravelly loam. Below 24 to 30 inches it is more often a coarse gravel.

The Genesee gravelly sandy loam occurs in small bodies in the first bottoms along West Fork White River. It is subject to overflow, and additional deposits of the coarser materials borne by the river are constantly being laid down over the surface.

This type is open and porous, and air and moisture circulate freely through it, and drainage is adequate, if not excessive, owing to the underlying gravel. The water table is generally near enough to the surface, however, to be within capillary reach of the root zone, and the crops are able to withstand ordinary periods of droughts.

The Genesee gravelly sandy loam is used with the Genesee loam for growing corn and oats or for pasture. The land being subject to overflow, fertilization is not so necessary as on the upland soils.

Only a small acreage of this type is found in the county. It occurs as narrow strips along West Fork White River in sec. 2, T. 19, R. 5, northeast of Strawtown, and in sec. 30, T. 19, R. 5, and sec. 36, T. 19, R. 4, north of Noblesville, and secs. 1, 12, 23, 24, and 26, T. 18, R. 4, south of Noblesville.

GENESEE SILTY CLAY LOAM.

The Genesee silty clay loam occurs largely along the smaller streams and is the heaviest first-bottom land type in the county. The surface soil, to a depth of 10 or 12 inches, is a brown, heavy silt loam to silty clay loam. The subsoil is a brownish silty clay, grading into a drab or steel-blue, stiff, plastic clay, mottled with dark-brown or reddish-brown iron stains. The color of the subsoil becomes lighter with depth. Along Stony Creek the subsoil contains an appreciable amount of sand in the lower depths. The soil along this creek is also less uniform in texture than elsewhere. Where the areas lie above the level of usual overflow the soil is a light-brown, loose silty loam to 18 or 20 inches, below which it is a drab, mottled silty to sandy clay.

The Genesee silty clay loam forms the first-bottom land along Little Cicero, Taylor, Stony, Mud, and Dismal Creeks, Dry Branch, and other small streams. It occurs as narrow strips, the valleys being seldom more than one-eighth to one-fourth mile in width. The largest and most typically developed area occurs along Mud Creek above the mouth of Sand Creek.

The Genesee silty clay loam, like the other first-bottom soils, is of alluvial origin, the material being derived largely from reworked glacial till deposited by the streams along which it occurs. Only a small percentage is washed in from the adjacent uplands. Near the banks of the streams lighter textured materials generally occur, and where it was of sufficient extent to map separately it was included with the Genesee loam. The heavier materials were deposited in the outlying bends and wider portions of the valleys. Most of the streams along which this type occurs have been straightened and deepened by dredging, so that practically all of the land which was formerly poorly drained is now under cultivation.

This type is especially well adapted to corn, and some of the largest yields in the county have been obtained from it. Yields of 80 bushels per acre are not infrequent, though the average is probably close to 60 bushels per acre. Heavy yields of oats are sometimes obtained from this type, but the late springs and the wet condition of these bottom lands frequently prevent the planting of this crop. It is an excellent grass soil, and an average of 2 tons of hay per acre is obtained. As much of it is subject to overflow, it does not require as heavy fertilization as the upland soils.

If this type is cultivated under normal moisture conditions a good, loose tilth is obtained, but if plowed wet it forms large, compact clods, which can not be readily broken down by subsequent cultivation. Too often the farmers, in their haste to get in their crops, disregard this matter of moisture condition, and the physical condition of the soil is thus frequently impaired for more than one season.

The native vegetation upon this type consisted of swamp white oak, silver maple, bur oak, white elm, swamp or pin oak, black ash, cottonwood, and other hardwoods.

GENESEE LOAM.

The surface soil of the Genesee loam, to an average depth of 12 to 15 inches, is a medium-brown to dark-brown loam, underlain by a yellowish-brown silty clay to sandy clay or clay loam. Below 24 to 30 inches sand and gravel are frequently encountered. The type is subject to local variations over small areas, owing to the unevenness of distribution of the alluvial materials. Where the first-bottom lands are narrow and the currents at times of overflow are swift the alluvial materials thus deposited are coarser, the texture being more often a medium to fine sandy loam, but in the outlying bends where the waters are less turbulent the soil is heavier and is more nearly a light silt loam or heavy loam. The subsoil is also quite variable, the soil being underlain frequently by medium to fine sand at various depths. This phase of the type occurs mostly in proximity to the stream courses.

The Genesee loam includes the greater part of the first-bottom lands along the larger streams. It occurs chiefly along West Fork White River and Cicero and Fall Creeks. It also occurs as narrow strips along Little Cicero, Duck, Pipe, Mud, Cool, Williams, Little Eagle, and Hinkle Creeks. The widest area is found in the Strawtown bend of West Fork White River, northwest of the town, where there is an area nearly a mile in width. The soil in this body is a rich-brown loam, with a yellowish-brown subsoil. At other points along the river the areas are rarely more than one-fourth to one-half mile wide. Along Cicero and Fall Creeks they seldom exceed a quarter of a mile in width, and along the other creeks much narrower strips exist. The soil in the smaller bottoms is sometimes influenced by wash from the adjacent uplands.

The Genesee loam is an alluvial soil, being composed of materials washed from the upland glacial soils and reworked and redeposited by the streams along which it occurs. Except for a few small depressions or low sand ridges, the surface is generally level. This type was formerly poorly drained, but with the installation of tile drains, open ditches, etc., a greater part of the type is now under cultivation. The open structure of the soil and subsoil permits of the ready percolation of the surface waters, so that the soil dries out rapidly after floods.

The original timber growth was principally silver maple, white elm, sycamore, buckeye, red oak, and hickory.

The Genesee loam is an easy soil to cultivate and breaks up readily into a rich, mellow tilth. The additions of fresh alluvium from year to year tend to keep the soil in a productive condition. Large yields of corn are annually obtained from the same fields. Oats and grass also produce well, the yield of oats ranging from 50 to 60 bushels, and of hay from $1\frac{1}{2}$ to 2 or more tons per acre. Occasionally crop rotations are followed, but generally the fields are planted to corn year after year, or the land used for grass and pasture, being plowed only when the sod fails or the field is needed for corn. Wheat is sometimes grown upon this soil, but usually only on areas lying above overflow. The type is best adapted to the production of corn.

Near the larger towns or shipping points this type could be profitably used for trucking, being especially well adapted to watermelons, cantaloupes, potatoes, particularly sweet potatoes, peas, beans, tomatoes, etc. Alfalfa is being tried upon the higher portions of the type, which are above annual overflow, and it is reasonable to expect that the results will justify the extension of the crop to a larger acreage. Cowpeas, soy beans, vetch, and clover are all well adapted to the better drained areas and their inclusion in regular crop rotations should not be overlooked, especially where stock is to be fed upon ensilage.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of this type:

Mechanical analyses of Genesee loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>						
281421.....	Soil.....	0.3	2.4	5.7	16.8	17.0	45.6	12.1
281422.....	Subsoil.....	.8	3.2	8.5	26.5	14.0	33.9	12.9

MUCK.

Muck consists mainly of vegetable remains in various stages of decomposition. It is black or dark brown in color and varies in depth from a few inches at the margins of the areas to 3 feet or more at their center. There is but little change in color with depth, but the deeper material is usually in a less advanced stage of decomposition, resembling peat. The mass of organic remains is usually underlain by a bluish-black, stiff, plastic clay or silty clay, which grades into a heavy, drab-colored or gray mottled silty clay or clay. In some places an impure shell marl is found in the subsoil or substratum. Along the margins of the larger areas considerable mineral matter in the form of fine sand and silt has become incorporated with the Muck.

The areas mapped as Muck are referred to locally as "made land." They are of very small extent in Hamilton County. One of the largest areas occurs about 3 miles north of Noblesville and is called Fox Prairie. Another considerable body is found along the upper course of Stony Creek in the eastern part of the county. Smaller areas occur in sec. 33, T. 20, R. 4; secs. 10 and 15, T. 18, R. 4; secs. 14 and 23, T. 18, R. 4; sec. 5, T. 20, R. 3.

Peat is occasionally found with the Muck, but in areas too small to be mapped separately. It represents a more fibrous and less decomposed mass of vegetable matter than Muck. It usually occurs near the center of the bodies of Muck, where the accumulation of organic matter has been more recent and has not undergone as thorough decay, though it sometimes occurs in spots throughout a given area.

The areas occupied by these organic soils were at one time shallow lakes or ponds, which have been gradually filled with the accumulated remains of different forms of aquatic vegetation.

The native sedges and grasses flourishing on the areas of Muck were the chief sources of hay for the early settlers. The water table was near the surface and the drainage was originally poor, but this has been remedied to a great extent by the construction of

large open ditches, which form outlets for many small tile drains. Further improvement may be brought about by the construction of open ditches along the margin of the swampy areas to intercept the drainage from the adjacent uplands and prevent the temporary flooding of the fields during heavy rains.

The greater part of the Muck has been brought under cultivation, though a few areas are still suitable only for pasture. Corn, oats, and timothy are at present the chief crops. Corn will yield from 50 to 60 bushels and oats from 40 to 60 bushels per acre. The latter crop is not very successful, however, as the straw makes a rank growth and lodges badly. Timothy is easily seeded and does well, making a very rank growth, but it usually "burns" the ground and does not yield as much hay as on other soils. Alsike clover is well adapted to this soil and should be grown in combination with timothy.

Early and late frosts are very injurious to crops grown on soils of this type. It is often necessary to replant corn two or three times, and early fall frosts sometimes prevent the corn from maturing.

This soil is especially adapted to onions, cabbage, celery, Irish potatoes, beets, turnips, cauliflower, and other garden products and has been successfully handled in the production of such crops in northern Indiana and adjoining States, but transportation facilities in most cases hardly warrant the growing of such special crops for commercial purposes in the area.

Applications of potash salts and phosphatic fertilizers are very advantageous to these soils. Coarse barnyard manure and lime are also beneficial.

MEADOW.

Where the bottom lands are subject to frequent overflow the alluvium deposited is usually of a miscellaneous character and can not be correlated with any established soil type. The term Meadow has been used to cover these conditions and as here employed denotes a generalized type embracing the low-lying, flat, poorly drained areas along certain minor stream courses. If shown in detail the included types would be classed with the Genesee soils. The predominating material is a heavy silt loam, dark brown in color. Because of its constant change from year to year, as the result of fresh deposits from overflows, there is a wide variation in the color, composition, and texture of the soil, as also in local drainage and surface conditions, and boundaries between Meadow and the other alluvial types of similar origin and topographic position must necessarily be arbitrary ones and subject to future modification.

The subsoil is prevailingly a mottled drab or grayish silty clay, somewhat heavier in texture than the soil. Near the stream channel

it may be lighter in texture, but throughout most of the area subject to annual overflow the sediments are fine, so that the soils are rather heavy.

Meadow areas in their natural condition are ordinarily too wet for cultivation, yet they are not permanently swampy. Most of this poorly drained land in Hamilton County has been reclaimed by dredging and straightening the stream channels. Corn is the chief cultivated crop upon such areas and where they are properly drained excellent yields are obtained. Where the valleys are deep and narrow and the surface is frequently broken in shallow depressions or marshy places, the chief value of the land is for pastures. Complete drainage of Meadow is not essential for this use, and the greater part of the Meadow in the county is being utilized in this way. The native forest growth, consisting of silver maple, white, elm, sycamore, and red oak, is usually allowed to remain.

The acreage of this type is small. It is confined to a few narrow strips along Sand, Tharp, Hinkle, Mud, Prairie, and Bear Creeks, Long Branch, and the other small streams of the county.

SUMMARY.

Hamilton County is situated slightly north of the geographical center of the State of Indiana. It has an area of 399 square miles, or 255,360 acres.

The surface varies from level to undulating, becoming broken near some of the streams, particularly along Hinkle and Fall Creeks and West Fork White River. The elevation above sea level ranges from 800 to 950 feet.

West Fork White River and its tributaries control the drainage of the entire area. The river has a general southern course through the county.

The first settlement in the area was made in 1818. The county was organized in 1823. The greatest activity in settlement came in the fifties.

Noblesville, the county seat and chief business center, with a population of 5,073, is located near the center of the county. There are 20 other towns and villages in the area.

The population of the county is 27,026, of which about 15,000 is rural.

The county possesses an excellent system of free pikes and sectionized gravel roads, and there are only a few miles of unimproved roads within its borders. All toll roads have been abolished.

Transportation facilities are afforded by three railroads and one electric line.

There are a number of manufacturing industries in the county, but it owes its prosperity chiefly to its productive soils.

The area is highly developed and prosperous. Good homes, towns, schools, churches, excellent roads, telephone lines, electric railways, and rural mail delivery are among the advantages enjoyed.

The mean temperature for the winter months is 31° F., for the summer 74° F. The average rainfall is about 41 inches, and the precipitation is evenly distributed throughout the year. The period between killing frosts is about 5½ months.

Corn is the principal crop, the average yield for the county being 45 to 50 bushels. Wheat is next in acreage, and oats third. The acreage in corn is considerably more than that of oats and wheat combined. Hay is also an important crop. Corn is being cut and stored extensively for ensilage. Cowpeas are also being grown and used for this purpose.

Much of the farm produce is fed to stock, which has proved to be the most profitable method of disposing of it. The surplus corn, oats, and hay find a ready sale in the local markets. Wheat is sold or exchanged for flour and feed at the elevators.

Very little truck is grown in the area except for canning purposes. The excellent market afforded by Indianapolis would seem to warrant the extension of this branch of agriculture. The growing of potatoes, beans, and peas should prove profitable, particularly to those having small holdings of land.

Dairying is an important industry, especially in the vicinity of Sheridan, at which point a condensery is located. Much milk is separated on the farm and the cream shipped to Indianapolis or manufactured into butter at the local creameries. Dairying can be profitably extended, as the demand for these products in the larger cities is rapidly increasing.

In 1910 the average size farm was 81 acres. The tendency is to increase farm holdings, with a proportionate increase in the number of tenants.

Five series of soils were recognized and mapped in the county—the Miami and Clyde, which occur on the uplands, and the Fox, Waukesha, and Genesee, which are found upon the bottoms and terraces. The Miami series represents the areas locally called “clay lands,” and the Clyde series includes the greater part of the areas known locally as “black lands.” The silty clay loam, which is the only type of the Waukesha series found in the county, is also generally classed with the “black lands.”

The upland soils are derived directly from glacial till of the late Wisconsin stage. They have undergone local changes which give rise to the various types. The bottom lands are also derived largely from the same parent materials, but have been reworked and redeposited by the streams along which they occur.

The Miami silt loam occupies the more rolling areas along the stream valleys and the morainic hills. The Miami silt loam, flat phase, is the most extensive and widely distributed soil in the county. They are best adapted to wheat and fruit growing.

The Clyde silty clay loam is the predominating type of that series. Only a small acreage of the Clyde loam, the only other type of this series developed in the county, exists. The Clyde soils are especially well adapted to corn. Oats and hay also yield well.

The Fox loam and gravelly sandy loam occupy the greater proportion of the higher terraces. Only a small acreage of the Fox gravelly sandy loam is developed. These soils are well adapted to alfalfa. The Fox gravelly sandy loam, poorly drained phase, is a level type of limited acreage.

Of the Genesee series, which occupies the first bottom lands, three types were mapped, the silty clay loam, loam, and gravelly sandy loam. The loam is the predominating type of the series and occurs principally along West Fork White River and Cicero and Fall Creeks. The Genesee soils are best suited to corn, though oats and hay produce good yields.

Muck and Meadow are undifferentiated soils and are of limited extent in the county.

The agriculture of the county is in a prosperous and highly developed condition. Practically all of the land is in cultivation or used for pasture. Scientific farming is being practiced to some extent, but its possibilities are not fully appreciated. Much can be done to increase the crop yields by a more thorough study of the individual soil types and the adjustment of crops and cropping systems on the basis of soil adaptation.



[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.]

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