**AIRPHOTO INTERPRETATION
OF SOILS OF
ST. JOSEPH CO., INDIANA**

**JULY, 1956
No. 30**

by
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**Joint
Highway
Research
Project**

**PURDUE UNIVERSITY
LAFAYETTE INDIANA**

AIRPHOTO INTERPRETATION OF SOILS OF

ST. JOSEPH COUNTY, INDIANA

TO: E. B. Woods, Director
Joint Highway Research Project

FROM: Harold L. Michael, Assistant Director

July 26, 1956

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The attached report, entitled "Airphoto Interpretation of Soils of St. Joseph County, Indiana," completes a portion of the work involving the state engineering soils mapping from aerial photographs. The report was prepared by P. T. Yeh, Research Engineer, Joint Highway Research Project.

An osalid print of the engineering soils map, as well as an osalid print of a chart of soil symbols are included in the back of the report.

Respectfully submitted,

Harold L. Michael

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OF
ST. JOSEPH COUNTY, INDIANA

by
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Project C-36-51B

Purdue University
Lafayette, Indiana
July 26, 1956

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OF

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by

P. T. Yeh

INTRODUCTION

The soils map of St. Joseph County, Indiana, which accompanies this report was compiled from 7" x 9" aerial photographs having an approximate scale of 1:20,000. These airphotos were taken in the summer and fall of 1938, with the exception of one strip which was taken in the Spring of 1939, in connection with the United States Department of Agriculture map program. The prints were purchased from the Agricultural Adjustment Administration (Now Commodity Stabilization Service, Performance and Aerial Photography Division, U. S. D. A.).

The sandy soil area of the county had been mapped by Dr. A. Morgan Johnson in his doctorate thesis entitled "Airphoto Interpretation and Engineering Evaluation of Northwest Indiana Sands" (1). This portion was revised and brought up-to-date. The old symbols were replaced by new ones, with textural symbols superimposed. The rest of the area was mapped recently to complete the soils map of the county.

After the airphoto mosaic of the county was assembled in the laboratory (Fig. 1) the major soil groups of different origins were sketched by visual examination of the photos. Detailed study were then followed with the aid of a pocket stereoscope. The major soil areas were broken down into sub-groups in accordance with the type of formation and were

FIG. 1 AIRPHOTO MOSAIC OF ST. JOSEPH CO. (*FROM 1951 INDEX SHEET*)

carefully delineated on the photos. Finally, the above subgroups were further broken down, where possible, into different textural areas. Special features, such as the definitely recognizable eskers, kames, sand dunes, and all significant man-made features such as gravel pits, were also marked on the air photographs.

Field trips were conducted at the completion of the laboratory work in order to spot-check the airphoto interpretation results. All modifications of soil borders and textural predictions were made during these field trips.

The data was then transferred, in the laboratory, from the airphotos onto a paper working map. By inserting the print into a reflectoscope, the scale of the photos which was approximately 3 inches to the mile, was reduced to 1 inch per mile on the base map. This paper map was in turn traced in ink and appropriate symbols were added to produce the final cloth map, a reproduction of which is enclosed in this report.

The techniques of airphoto interpretation outlined in reference number 2 were followed throughout this work. The agricultural soils report (3) and all pertinent geologic data, as well as the previous research on airphoto interpretation of northern Indiana soils (4) and drainage (5) were liberally consulted.

INTERPRETATION OF AREA

General

St. Joseph County is located in the northern tier of counties in Indiana as indicated in Figure 1. It is roughly rectangular in shape, with a width of about $19\frac{1}{2}$ miles (north-south) and a length up to about 24 miles (east - west). The total area of the county is about 464 square miles (3, p. 5). South Bend the county-seat with a population of 115,911 in 1950 (10 p. 273) is the fourth largest city in Indiana.

Originally most of the county was covered with a heavy growth of deciduous forest and the rest with prairie vegetation after the last glacial invasion. However, the ever increasing farming activities since the first settlement about 1829 (3, p. 3) have erased the natural vegetation almost completely from the county. Only a few swamps and a few scattered wooded lands are left untouched by the inhabitants. These areas can be located easily on the airphotos. Although St. Joseph County is located quite near to Lake Michigan and the marsh area near South Bend is about 140 feet above the surface of the Lake (6, p. 506), less than one quarter of the area is drained into the lake by the northerly flowing St. Joseph River. The rest of the county is drained westerly through the Kankakee River into the Illinois River which is one of the major tributaries of the Mississippi River. Besides, there are several small lakes throughout the center portion of the county which help to store surface run-off.

Climate

St. Joseph County has a humid, temperate, and continental climate. It is characterized by warm to hot summers and moderately cold winters tempered somewhat by Lake Michigan. The mean summer temperature is 71.1 degrees ranging from a maximum of 103 degrees to a minimum of 37 degrees. The mean winter temperature is 26.4 degrees with a minimum of -21 degrees to a maximum of 67 degrees. The

annual precipitation is 33.62 inches, about half of which falls between May and September. The average snowfall of the county is 39.5 inches per year.

The normal monthly and annual temperature and precipitation at Notre Dame (7) are given in the following table:

Month	Temperature			Precipitation		
	Mean of	Absolute Maximum of	Absolute Minimum of	Mean inches	Total Driest Year inches	Total Wettest Year inches
January	25.9	60	-21	2.06	1.55	4.68
February	27.7	67	-15	1.45	1.08	0.82
March	36.9	79	-3	2.63	2.10	4.39
April	48.0	88	13	3.00	2.24	7.20
May	59.3	92	27	3.77	2.52	3.84
June	69.0	100	37	3.57	3.10	3.28
July	74.2	105	43	2.87	2.38	1.51
August	71.7	102	41	3.18	3.22	2.64
September	65.0	98	33	3.20	1.90	2.65
October	53.8	88	20	2.93	1.06	5.23
November	40.8	74	-2	2.36	1.54	2.70
December	28.4	60	-17	2.13	1.60	2.72
Year	50.1	105 (in July '34 & '36)	-21 (in Jan. 1918)	33.15	24.29 (in 1953)	41.66 (in 1929)

Elevation 733 feet.

Physiography

St. Joseph County is situated in the Northern Moraine and Lake physiographic region of the state (8, p. 66). Three sub-divisions of the physiographic region occur in this county. The Valparaiso moraine section which occupies a very small area (about 6 square miles) is located in the northwestern corner of the county. The Steuben morainal lake section, occupying about 1/3 of the area, lies on the south central and southeastern portions of the county. The rest of the county belongs to the Kankakee lacustrine section (8, p. 66). With respect to its physiographic situation in the United States, St. Joseph County is part of the Eastern Lake Section of the Central Lowland province.

Topography

The topography of St. Joseph County varies closely with the physiographic classifications mentioned previously. The Valparaiso moraine section has a broad undulating ridge with numerous depressions or kettle holes. "The crest of the ridge rises to an average elevation of about 775 feet above sea level. A few knolls reach 800 feet. Local relief ranges from 20 to 40 feet." (3, p.7).

The Steuben morainal lake section can be sub-divided into two parts. The western portion lies in the Maxinkuckee moraine while the eastern part belongs to the till plain. The Maxinkuckee moraine in this county generally has an undulating to rolling topography, characterized in general by low ridges and swales. However, part of the moraine has a stronger rolling relief. This is mapped as the kettle-kame area in the attached soils map. The till plain area has a very gently undulating topography. "The average altitude is slightly above 800 feet, but local areas reach nearly 900 feet. The area south and west of South Bend has numerous basins with rather steep slopes, and is generally irregular in topography. Local relief ranges from 30 to 70 feet, but in other

places in this section it is generally less than 20 feet" (3, p. 8).

The Kankakee lacustrine section in the county consists of extensive sandy lacustrine plains, outwash plains and valley plains. "In general, there are two levels of the Kankakee plains. The main one at an average elevation of 750 feet borders the St. Joseph River and includes the extensive former marshland which comprises the headwater area of the Kankakee River. Local relief rarely exceeds 20 feet. In the vicinity of New Carlisle and northwest of Lydick remnants of outwash plains lie 50 to 75 feet higher than the main plain. Relief of 50 feet or more is not uncommon". (3,p.8).

"The maximum elevation, 891 feet above sea level, is about 3 miles southeast of South Bend", (3, p. 8). A radial drainage system around this area is shown on the county drainage map (fig. 2) (5). The lowest point in the county has an elevation at 654 feet; it is located at the point where St. Joseph River enters Michigan (3, p. 8). Maximum local relief in the county reaches 100 feet (8, p. 82). The elevation of railroad at the depots of some of the cities and towns are given as follows:

Crumstown	711 feet
Granger	806 feet
Lakeville	850 feet
Lydick	745 feet
Mishawaka	725 feet
New Carlisle	778 feet
North Liberty	740 feet
Osceola	722 feet
South Bend	722 feet
Walkerton	720 feet
Wyatt	848 feet

Geology

The surface and near surface materials of the county are of glacial origin transported by the Saginaw Lobe and the Lake Michigan lobe of the Late Wisconsin substage. "The bedrock formations were deeply eroded before the

Fig. 2 Drainage map of St. Joseph County.

deposition of the glacial drift which in places attains a thickness of more than 300 feet," (9, p. 687). The bedrock immediately beneath the glacial drift belongs to the Mississippian and Devonian periods of geologic time in the northeastern half and the southwestern half of the county respectively (9, Map p.2).

The following geological divisions have been recognized in the records of wells.

Quaternary	Clays and sands (recent) Clays, sands, gravel (Pleistocene)
Mississippian	Shale, silts (borden) Limestone (Rockford)
Devonian	Shale (New Albany) Limestone (Sellersburg, Jeffersonville) Sandstone (Pendleton)
Silurian	Shale (Mississinewa) Limestone (Osgood)

AIRPHOTO INTERPRETATION OF SOIL AREAS

ICE DEPOSITED MATERIALS

Since the entire county was covered by glaciers, the surface soils of St. Joseph County are chiefly ice deposited in origin. The various ice deposits are discussed as follows:

Moraines

(1) Valparaiso Moraine

The main body of this moraine traverses through Lake, Porter, and LaPorte counties paralleling the shore of Lake Michigan. Only a very small portion of it cuts across the northwestern corner of St. Joseph County. The moraine reaches an altitude of 800 feet in this county (1, p. 343). The outer border of the moraine is not distinctively higher than its adjacent outwash plain. However, the difference of airphoto pattern between these two land forms made possible their delineation. Although there is not much change in elevation within the morainic mass, the presence of numerous kettles or basins adds considerable to the local relief. The internal drainage in this area is moderate to slow. This can be seen from the drainage maps of LaPorte, Porter, and St. Joseph counties. The thick drainage net lying along the Valparaiso moraine indicates the soil is drained mostly externally. The locally rough topography is the best indication of the existence of the moraine.

The soils of the area have a moderately heavy to heavy texture. These sandy silty clay or silty clay soils are mixed with gravels of Devonian shale. The soils are identified as members of the Galena-Otis-Brookston catena. The typical soil profiles can be seen from references 3 and 12.

(2) Kalamazoo moraine:

(a) There are two small morainic ridges of the Kalamazoo moraine extending southwardly from Michigan into St. Joseph County (11, pp. 174-184).

The western branch is located in the vicinity of Mud Lake north of Lydick. This ridge is about one mile both in width and in length at the state border line. The characteristic kettle-kame morainic topography changes gradually into a pitted outwash plain to the south. It is quite difficult to delimit the boundary for these two materials. However, the plane surface and the pitted appearance south of the ridge indicate the granular deposit is likely to be an outwash. This fact is verified by Leverett who reported that the deposit is composed entirely of assorted materials capped with a boulder-strewn loamy deposit a few feet thick (11, p. 125). This morainic ridge and the pitted outwash area are surrounded by a vast outwash plain. The altitude of the outwash plain on the east has almost the same elevation as the moraine. However, there is quite a topographic break between the pitted outwash terrace and the flat outwash plain on the west. The morainic soil is well drained, sandy in texture, and a member of the Hilledale catena.

(b) The eastern leg of the moraine lies about $3\frac{1}{2}$ miles east of St. Joseph River. This mass is about 1 mile wide and 2 miles long extending southerly into the county from Michigan. The topographical relief is much more subdued than that of the western ridge mentioned previously. The surrounding outwash plains are also gently undulating. This could be attributed to the sandy nature of the material. Wind has reworked the deposit constantly. The weak morainic topography is likely to be modified to the extent that recognition of it is difficult. The soil of this area is very sandy in nature and is classified as Coloma soil.

(c) South of the Valparaiso moraine there is a mass of deposited material about 50 to 75 feet higher than the surrounding outwash plain (11, p. 175). Although part of the area has a pitted outwash appearance the altitude as well as the topography is too high and too rough to be outwash, especially in the area west of the county border. The mass is much higher

than the adjacent outwash apron which appears as a flat outwash terrace from the low outwash plain. Leverett believed that this mass belonged to the Kalamazoo moraine. Were it not for the large number of boulders this mass would be classified as outwash apron (11, p. 175). There are a number of short gullies developed around the kettles or sinks along the steep face of the morainic remnant. The gullies are generally steep and incised deeply into the sloping faces. Occasionally deltas and gullies of extremely white tonality are found in the photos. This is a good indication of the silty or sandy texture of the deposits.

Soil of this area contains more sand and in places are sandy in texture. Owing to the porous nature surface waters are removed essentially internally. The pitted surface accounts for the porous nature of the soils. The light colored soils are classified as Hilledale and Galena soils. Locally Tracy soils are found also.

(3) Maxinkuckee moraine

This is the massive moraine in St. Joseph County. It extends from South Bend southerly through the county border into Marshall County. The morainic belt is about 5 miles in width near South Bend and increases to about 8 miles on the south county line. The moraine is topographically conspicuous from the plain that borders it on the west, especially in the northern portion where the rugged kettle-kame morainic belt breaks abruptly from the smooth outwash plain. The plain adjacent to the moraine has an elevation of 720 to 750 feet while the moraine is generally above 800 feet and has points closely approaching 900 feet near South Bend (11, p. 131).

In the rugged morainic belt from South Bend to Potato Creek many knolls rise abruptly to heights of 50 to 60 feet. Among them are inclosed basins and sloughs. The local relief of the rest of the morainic belt is about 20 feet or less and slopes are gentle (11, p. 121).

The airphoto mosaic shows a very definite change of photo patterns

between the outwash plain and the morainic belt. However, the differentiation of the moraine and till plain is far more difficult from observing the photo pattern alone.

The moraine is composed largely of gravel and sand. Between South Bend and Potato Creek the composition of the drift is erratic; knolls chiefly composed of gravel stand next to knolls largely composed of silty clay. Some of the knolls show abrupt changes from gravel to silty clay. A road cut just west of the bend about 1 mile west of Rutwood shows that the knoll composed of compacted bluish gray silty clay is capped with a layer of loose clean sand and 10 feet of gravel.

South of Potato Creek the moraine becomes less conspicuous topographically and becomes more clayey in texture. The boundary between the moraine and the surrounding till plain is drawn solely on the slight topographic differentiation because the composition of both deposits is essentially the same.

East of U.S. 31 the moraine has a different photo pattern than that of the rest. (See Figure 3). The topography of the area is much more subdued or rounded. Surface drainage is well developed. These indicate the moraine in this area has a finer texture. Subsequently the internal drainage is retarded considerably. According to Montgomery (14, p. 231) the seal of Kankakee Valley at South Bend was made by the dumping of the sediment carried by what was known as Wenger's Creek from the morainic area. Tremendous amounts of material have been removed from this morainic area. The existing surface features of the moraine such as smooth rolling surfaces and well developed surface drainage can be accounted for in this manner.

A small area east of the area mentioned above has a smooth and nearly level surface (Fig. 4). This featureless surface is broken by a few low kames. Short gullies which develop along the slope of the domes disappear into this flat surface. This indicates the soil is well drained. From the airphoto pattern the soil seems to be fine grained. Therefore, a porous stratum must be underneath

Fig. 3 Different photo patterns of Maxinkuckee moraine due to the differences of composition of the deposits.
Note natural surface drainage is developed in the fine-textured morainic areas.

Fig. 4 Moraine with gently undulating surface.
 Note the gullies disappear near the foot of the kame.
 Surface drainage is absent in this area.
 Porous strata are found about 5 ft. below the fine-textured surface soil.

the fine material. This is confirmed by the agricultural soil survey stating that the heavy textured soil is underlain by strata of sand within 5 to 10 feet from the surface (3).

The soil texture in this moraine varies from place to place. In general light textural or sandy soils of the Hillsdale, Coloma and Galena Catena are found in the kettle-kame morainic belt and in the core at the moraine almost directly south from South Bend. These soils are well drained internally. The rest of the moraine is composed chiefly of Galena and Otis soils. These soils contain silty clay or sandy silty clay. Internal drainage is moderate to slow. Typical soil profiles are shown in references 3 and 12.

Surface boulders are numerous in the morainic regions. Leverett reported that the boulders are mostly granite of 2 to 3 feet in size and about 1000 to the square mile (11, p. 133).

(4) Bremen moraine:

Starting from the vicinity of Lakeville the Maxinkuckee moraine branches in a southeastern direction toward its eastern correlative, the Packerton moraine. This is one of the broken moraines across the inner space of the Saginaw ice lobe.

The western limb of the moraine is broken by a number of gaps. It is a low morainic mass with knolls rising 10 to 20 feet above their bases (6, p. 20). The easternmost portion of the moraine is defined by a prominent narrow ridge of one-eighth to one-quarter mile wide throughout the county. A county road is located directly on top of the ridge. The ridge is broad on the crest and rounded on the edges. The intermorainic space within this moraine is generally made up of ground moraine or till plain, usually of gently undulating nature.

The texture of this moraine is mostly sandy clay with a considerable amount of silt and occasional pebbles. The soils of the area are classified as members of the Hillsdale, Coloma and Galena Catena. By and large they belong to the Galena soil series.

Eskers and Kames

Not including the eskers and kames found in the kettle-kame morainic area, the county possesses only a few of them. The most prominent esker is located in Sec. 34, T 37N, R2E. Field inspection reveals that there is gravel all over the mass. Kames are not prominent in the morainic area. However, they stand up beautifully in the till plain or flat areas. A few small ones are located in Sec. 32, T 37N, R 3E.

Kettle-Kames

The northwestern portion of the Maxinkuckee moraine is extremely rugged in topography and, as the name implies, it consists of a number of depressions and kames. Generally the knolls are about 50 to 60 feet in height above the depressions. The knolls are usually capped with sands and gravels. Internal drainage is good. The kettles or basins are normally filled with water. Soils in the depressions, as a rule, are mucky or highly organic.

Till Plains

The largest till plain is located in the southeastern quarter of St. Joseph County. The other smaller till plains are located next to the moraine on the west and within the morainic mass. The till plains possess a nearly level to a gently undulating surface. Sometimes this is the only means to differentiate them from the subdued moraines. The photo tonality is more uniform in till plain areas than that of the moraine. Undefined swales with dark photo tones in contrast with the light tones on the slightly higher ground create the most spectacular drainage pattern of the till plains. A number of ditches are shown on the airphotos. These all indicate the poor internal drainage nature and the immature drainage development of the late Wisconsin drift.

Till plains are composed of a heterogeneous mixture of clay, silt, sand, gravel, and occasionally boulders. The composition, however, varies from one place to the other. The northern portion of the till plain in this county contains more silt and sand while the southern part has higher clay content.

Soils of the till plain areas are members of the Miami-Crosby-Brookston, Conover, and Galena-Otis-Brookston Catena. The typical soil profiles are shown in references 3 and 12.

WATER DEPOSITED MATERIALS

Owing to the enormous amounts of melt-water flowing over the county during the late glaciation, vast water-deposited materials were laid on the northern half of the county. The various water deposits are discussed as follows:

Outwash

Outwash deposits constitute one of the most extensive soil areas in the county. A broad outwash plain is located in the northern part of the county. It is about 8 miles wide from the eastern county line to South Bend and then widens southwesterly to the full width of the county. Characteristic airphoto patterns such as current markings, infiltration basins, the plane surface, and absence of surface drainage help to identify the well internally-drained outwash materials.

(1) Coarse-textured outwash:

The topography of the outwash plains is generally flat with only minor irregularities caused by the current action of the melt-waters and the infiltration of surface waters. However, in some areas where coarse granular deposits predominate, a pitted outwash plain may be found. The topography of the pitted outwash area sometimes may be as rugged as that of the kettle kame moraine. Figure 5 is a pitted outwash area located north of Lydick. The only topographic difference between the pitted outwash area and the moraine is a regional plane surface and an irregular surface respectively.

The outwash deposits vary considerably in texture throughout the county. In general sands are predominant in the outwash deposits. Stratified sands and gravels are found at various depths below the surface. The total thickness and the profile of the water deposited materials at South Bend can be found in the

Fig. 5 Pitted outwash area. Stereo-photo of the rugged stratified sands and gravels are exposed in the new pit along U.S. 20. The elevation of most peaks is the same.

bulletin entitled "Ground Water Resources of St. Joseph County, Indiana, Part 1 South Bend Area" (13, plate 1, 4 and 5). The gravel is well rounded and shale particles of the Devonian age predominate. They are blended with only a very small amount of limestone pebbles. The stratified deposits of the well rounded gravels and clean quartz sand are the best indication of their being water deposited.

Due to the different topography and the different situation, while the outwash materials were being sorted, variation of texture became inevitable. Comparatively coarse material can be found in the pitted outwash plain, high outwash terraces, and the south bank of Kankakee Valley. About 2 miles southwest of South Bend a giant gravel pit can be found. There are a few smaller pits west of South Bend. This indicates the deposit contains a profitable amount of good gravel which can be obtained economically.

Field inspection of the abandoned gravel pits near the northern border of the county in Sec. 10, T 38N, R1E and comparatively new pits along the county road (Fig. 6) show stratification of the deposits; the gravels are rounded and mixed with sand. The gravels are chiefly composed of Devonian shale.

The giant gravel pit located in the outwash plain south of the Kankakee River has well rounded gravels. The exposed surfaces show stratified layers of fine sand, silt, coarse sand, and loose conglomerate. The gravels in this area are more igneous in origin with but a smaller amount of shale.

The soils of the outwash plain or terraces are classified as members of the Tracy-Hanna-Willvale-Quinn, Door-Pinola, Lydick-Alida, Fox and Warsaw Catenas. Tracy soils are by far the most common soil series (about $\frac{1}{2}$ of the county area), in the outwash plain (3, Table 7).

(2) Fine - textured outwash

An area east of the Valparaiso moraine shows a uniform gray tone with feeble infiltration expression on the airphotos (Fig. 7). It has a low flat topography. Surface drainage is absent except for a few ditches that traverse the area.

Fig. 6 Abandoned gravel pits on the outwash plain are shown in this stereogram. Note the difference of elevation and topography between the outwash plains.

Fig. 7 Airphoto pattern of fine-textured outwash.
Note the level topography and the feeble expression of infiltration.

The abrupt topographic break between the coarse-textured outwash terrace on the east and the rugged moraine on the west helps in delimiting the area easily. This area is likely to be a filled glacial channel which might have served as the overflow channel for the glacial Lake Chicago (15, 16).

The above airphoto patterns and the topography suggest the area is likely to be covered by fine-textured material. Field examination shows that the surface soils of the area are silty clays mixed with some sand and gravel. Stratified sands and gravels are found about 6 or 7 feet from the surface (3). The soils are classified as members of the Uoor and Lydick Catenas.

In the northeastern quarter of the county the airphoto pattern also changes somewhat. The photo has an overall light tonality. It is only feeble infiltration expression. Surface drainage is absent in the nearly level area and no ditches can be seen on the airphotos in this region. This is an indication of an excessive internally drained area. The smooth surface appearance indicates the material is sandy in texture. Stratified sands and gravels are found under the fine sandy soils. Road cuts and borrow pits along the Indiana toll road in this region show that sand predominates in the area. However, cobbles are found within the sandy deposits. The soils in this area are exclusively members of the Tracy series.

Lakebeds

In the northeastern part of the county an area about 6 square miles in size has a nearly level surface. On the airphotos it has also a very uniform and darker gray tone than the surrounding outwash plain. No natural surface drainage is seen. However a few ditches have been dug to drain the area. The surface elevation is not much less than that of the surrounding outwash plain. In fact, it changes so gradually that it is difficult to realize the change on the ground. The area is a typical glacial lake bed. Fine materials

were deposited during the impounding period. Since it located inside a vast sandy outwash plain, the deposit is likely to be sand. The dark color is a good indication of high water table and organic material washed into the lakebed. A few mucky areas and islands of outwash deposits can be seen inside the lakebed. Field inspection shows that the lakebed is composed of organic sand deposits which are dark gray in color and quite uniform in size.

Transitional areas

Along the border of the outwash plains there are some small areas in this county which seem to have different airphoto patterns, (Fig. 8). The area mentioned has neither a morainic or till plain airphoto pattern nor an outwash appearance but one of combined features. The area has a lower topographic position than the moraine. The surface is rather smooth in this county. However, locally rough spots with the typically granular outwash pattern can be found in the area. The soil in this area is generally silty in texture.

Resorted Drift

Several areas, laid adjacent to large muck pockets, show different airphoto patterns (Fig. 9). The surface is smoother and topographically lower than the surrounding till plain. The typical till plain surface drainage patterns lose their identity in these areas. Sometimes faint current marks can be seen. The more uniform photo tonality and smooth appearance of the surface indicates the materials deposited over the area are fairly uniform in size. From the topography and the airphoto patterns, fluvial action can be visualized. Field inspection shows that a large quantity of pebbles are exposed on the field at the outer edge of the area and finer materials such as sand, silt, and clay are deposited at the border of the muck pocket. The assorted sand and silt deposits are from 4 to 5 feet thick and overlie the

Fig. 8 Airphoto pattern of transitional zone between moraine and outwash. Note the slight difference in topographic position and the gently sloping surface.

Fig. 9 Airphoto pattern of resorted drift.
 Note the sandy outwash-like airphoto pattern in this area.
 Finer materials are found on the borders of the muck pockets.

light to medium textural unsorted drift according to the agricultural soil survey report. Soils of the area belong to the Argos-Walkerton-Lapas catena. The profiles of the soils can be found in reference No. 3. This area can also be considered as shallow outwash on drift technically.

Terraces

Terraces are very limited in extent and in number in St. Joseph County. They are mainly located along the St. Joseph River. The terraces in the county occupy lower topographic positions than the adjacent outwash plains. The materials of the terraces are as a rule more gravelly than the adjacent outwash sediments. The soils of the terraces are classified as Fox and Warsaw. The soil profiles can be found in references Nos. 3 and 12.

Recent Alluvium

Practically all the rivers, streams, and creeks possess recent alluvial plains. However, only those areas of considerable size are shown on the soils map, because of the scale limitation. The long winding ones are found along Potato Creek and Pine Creek on the southwestern position of the county. The minor extent of the alluvial plains inside the meandering channel of Kankakee River can be identified by the infinite number of abandoned meanders. Most of the areas are subjected to seasonal flooding. However, several areas in the St. Joseph River Valley occurring on slightly elevated positions are not subjected to overflow. The organic content as well as the drainage characteristics of the alluvial soils vary from place to place. The land use therefore varies accordingly. The composition of the alluvial soil is generally silt and sand with a variable amount of clay.

WIND DEPOSITED MATERIALS

Wind deposited materials are limited to sand in St. Joseph County. Owing to the enormous sandy outwash plain in the county, it is likely that winds have picked up and redeposited the sand particles from time to time. The wind blown deposits on different materials are discussed as follows.

Sand on Moraine

There are no obvious sand dunes developed on the moraines in St. Joseph County. However along the western border of some morainic areas the modification of sand deposits can be detected. The topography is generally smooth or rounded. Because of these shallow wind deposits the characteristics of the underlying materials are more outstanding on the airphotos. These deposits can be seen on the airphotos in some areas along the western border of the Maxinkuckee Moraine and the southwestern tip of the Kalamazoo moraine located north of Lydick. Since the deposits are very limited in extent and are not significant, no attempt is made to show them on this small scale soil map.

Sand on till plain

The airphoto patterns of the till plain west from Maxinkuckee moraine are somewhat different than those of the east (Fig. 10). Especially in the northern portion of the area, the photo tonality is very uniform. The typical light and dark tone till plain drainage pattern is absent. Surface materials seem to be better drained. Although no dune formation is found in this region, it is logical to believe that a sand blanket covers this area. South of the area the till plain pattern becomes more typical. This may be due to the large mucky channel located west of the border which intercepted most of the windblown material from the outwash plain on the west.

Sand on outwash

Undoubtedly sand particles have been shifted from time to time on the vast sandy outwash plain. Even in the pitted outwash area several feet of sand are found on the knolls. However sand dune formations are very limited in St. Joseph County. The most prominent dune area is located at the southwestern corner of the county. Sand dunes are low and grouped together. In the other areas only isolated sand dunes are found. A very prominent dune is located east of Notre Dame in Sec. 31, T38N, R3E, and Sec. 6, T37N, R3E. Another

Fig. 10 Airphoto pattern of wind blown sand on till. Note the smooth surface appearance. The gully developed in the area indicates impervious material covered by a thin layer of sand.

sizable one is situated in Sec. 33, T 36N, R4E.

MISCELLANEOUS FORMATIONS

Muck and Peat

Areas containing muck and peat are widespread in St. Joseph County. The largest deposits are found in the Kankakee River Valley. Apparently this valley was a great glacial channel. With its flood plain the valley varies from 3 miles at the narrowest point which is one mile below South Bend to about 20 miles at its broadest part which is between Porter and Lake counties on the north and Newton and Jasper counties on the south (14, p. 279). The south wall of the valley is high (50 to 100 feet) while the northern side is low (15 to 20 feet) and shelving. After the glacier receded a system of stream capture occurred. The valley was sealed at South Bend by a sand bar (14, p. 281). "The Valley below South Bend, fed by the water escaping from beneath the Michigan moraine and foot of the Maumee, has been productive of a vast growth of peat or muck over the entire valley proper. Below this peat or muck bed which ranges from 6 to 10 feet in depth is found fine sand and gravel" (14, p. 282). The boundary of this muck area is very easy to delimit except in South Bend because the built up areas change the natural surface conditions considerably.

The other sizable peat and muck areas are located along or are associated with glacial channels as indicated on the map. Smaller peat or muck pockets are scattered in the till plain as well as the morainic areas.

Beds of marl are generally found under the peat and muck deposits. Field inspection on a basement excavation in Kankakee Valley shows interbedded peat, marl and sand deposits.

Highly Organic Topsoil Areas

Depressed areas where internal drainage is somewhat retarded by the high ground water table have given rise to the accumulation of considerable

amount of organic materials. These areas are most abundant in the outwash plains, but they are also found in the drift formations. The organic top soils sometimes are up to 18 inches in depth. They are associated quite frequently with the muck areas. The underlying material beneath the highly organic topsoil is assumed to be the same as the parent material of the surrounding areas.

Swamps

Some of the lakes and ponds which were left after the last glacier have not dried-up completely. As yet, they are covered with swampy vegetation around the remnants of water. Such fringe areas are marked with the symbol of marshes on the soil map of the county.

SOIL PROFILE DEVELOPMENT

A comprehensive discussion of Pedology, or the science of soil formation, can be found from pp. 45 to 60, reference 12. A guide chart to determine the types of soil profiles is found in pp. 152-53 in the same reference. This reference will serve to illustrate the depth and soil profile development in St. Joseph County. However the profile descriptions of the reworked drift classified as Argos-Walkerston-Laper soils are listed in the agricultural soil report (3). This is essentially Trety like outwash soil on unsorted glacial drift.

ENGINEERING SIGNIFICANCE OF THE AIRPHOTO INTERPRETATION

This soil map and its report have been prepared in about four months of time by one research engineer and one draftsman. The map shows the major soil areas, classified according to the mode of deposition of the materials. The subdivision of the major soil areas into groups of similar terrain characteristics and finally into groups of relatively similar textures are also shown in the map. In addition, the borrow pits of granular materials (existing at the time the county was photographed) are indicated on the map to give further clues of the nature of the deposits for those who use it. The map does not

include many local variations, because of the scale limitation and the limiting field inspection as well as the simple field exploratory equipment. However, adequate information regarding the terrain as well as the general textures and drainage characteristics of the soils are properly presented in the engineering soils map and its accompanying report. Highway engineers may find this is helpful in their planning of future projects.

SOIL SYMBOLS

A chart of symbols accompanies the map. The upper part of this chart shows the basic symbols of soil in conformity with a classification based on the origin and type of formation; the lower part shows the symbols for gravel, sand, silt, and clay arranged in four columns to indicate the relative proportions of each grain size groups in a soil mass, and thus suggest the relative textures of the soils. Since glacially deposited soils as well as the water worked outwash soils are not uniform throughout the county, the texture symbols used in this map are relatively general.

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All airphotos used in connection with the preparation of this report automatically carry the following credit line: "Photographed for Commodity Stabilization Service, Performance and Aerial Photography, U.S.D.A."

JHRP

1956/30

plate 2

JHRP

1956/30

plate 1

2 plates

T E O F M I C H I O A N

I E N C O

C A S S C O

ENGINEERING SOILS MAP
ST. JOSEPH COUNTY
INDIANA

PREPARED FROM
1938 A.A. AERIAL PHOTOGRAPHS

JOINT HIGHWAY RESEARCH PROJECT
BY
PURDUE UNIVERSITY

1956

UNIVERSITY OF MICHIGAN

MAPS BY M. C. REED

S T A T E D F M I C
B E R R I E N C O

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PART-B

BASIC SYMBOLS AND GROUPING OF PARENT MATERIALS ACCORDING TO ORIGIN

RESIDUAL		TRANSPORTED BY			
SEDIMENTARY	METAMORPHIC	IGNEOUS	ICE	WATER	WIND
10 SANDSTONE	13 GNEISS	16 GRANITE	20 OLD DRIFT, TILL PLAIN	28 VALLEY TRAIN, TRANSITION	39 SAND WITH INCIDENT DUNE DEVELOPMENT
11 LIMESTONE	14 SCHIST	17 BASALT	21 YOUNG DRIFT, TILL PLAIN	29 VALLEY TRAIN, TERRACE	40 DUNES
12 SHALE	15 SLATE	18 LAVA	22 MORAINE	30 RECENT ALLUVIUM	41 LOESS (SILT)
		19 VOLCANIC ASH	23 KETTLE-KAME	31 ALLUVIAL FAN	
MISCELLANEOUS					
42 PEAT & MUCK, SMALL AREAS	47 GRAVEL PITS		24 ESKER	32 OUTWASH PLAIN, TRANSITION	
43 PEAT & MUCK, LARGE AREAS	48 ROCK QUARRIES		25 KAME	33 OUTWASH PLAIN	
44 HIGHLY ORGANIC TOP SOIL	49 STRIP MINES		26 DRUMLIN	34 VALLEY FILL	
45 MARSH			27 WATER-MODIFIED YOUNG DRIFT	35 LAKEBED	
46 BOULDER BELT				36 BEACHES AND BEACH RIDGES	
				37 CORAL	
				38 DELTA	

TEXTURAL SYMBOLS

Figure 1 is a soil classification chart based on the relative proportions of sand, silt, and clay. The chart is divided into two main sections: GRAVEL (top) and SILT (bottom). The horizontal axis represents the percentage of sand (0% to 100%), and the vertical axis represents the percentage of clay (0% to 100%). The chart is further divided into various soil types based on the percentage of gravel, sand, silt, and clay. Key soil types include: (1) SAND, (2) SAND WITH SOME GRAVEL, (3) SANDY GRAVEL, (4) SAND - GRAVEL, (5) SANDY SILT, (6) SILT, (7) SILT WITH SOME SAND, (8) SILTY SAND, (9) SILTY CLAY, (10) CLAY WITH SOME SILT, and (11) CLAY. The chart is labeled "DECREASE IN PROPORTION" for sand and "DECREASE IN PROPORTION" for silt and clay.

MOLE: The texture window are to be superimposed on the basic window.

[illegible]

Chlorine 21.05