

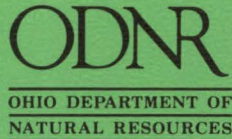
STATE OF OHIO  
Richard F. Celeste, Governor  
DEPARTMENT OF NATURAL RESOURCES  
Joseph J. Sommer, Director  
DIVISION OF GEOLOGICAL SURVEY

Report of Investigations No. 141

**GLACIAL GEOLOGY  
OF  
MEDINA COUNTY, OHIO**

by  
Stanley M. Totten

Columbus  
1988



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# GLACIAL GEOLOGY OF MEDINA COUNTY, OHIO

by  
Stanley M. Totten

## ABSTRACT

Medina County lies about 15 miles south of Lake Erie in northern Ohio and is within the glaciated portion of the Allegheny Plateau. The Plateau in western Medina County is a slight to moderately dissected shale and sandstone upland that ranges in elevation from about 850 feet to 1,100 feet and has slight relief. In eastern Medina County the Plateau is a maturely dissected resistant sandstone upland that ranges in elevation from about 950 feet to 1,200 feet. In this eastern region the relief between upland and lowland commonly is greater than 150 feet. Major streams in Medina County include East Branch Black River, and West Branch, North Branch, and East Branch Rocky River, which flow northward into Lake Erie, and River Styx, Chippewa Creek, and Camel Creek, which flow southward toward the Ohio River.

Glaciation in Medina County resulted from the generally southward expansion of ice in the Killbuck sublobe of the Erie lobe. Glacial ice advanced into Medina County at least three times during the Wisconsin Stage and an unknown number of times during the Illinoian and earlier Pleistocene stages.

A complex sequence of end moraines having a general south-west-northeast trend is the most prominent glacial landform in Medina County. Of the 27 morainic elements recognized in north-central Ohio, at least 14 are present in the county. These elements form the Mississinewa, St. Johns, Wabash, Fort Wayne, New Washington, and Defiance Moraines. These moraines, which have 10 to 40 feet of relief, have plugged the major valleys of East Branch Black River, Chippewa Creek, West Branch Rocky River, and East Branch Rocky River, thereby causing derangement and reversal of drainage.

Two large and two small kame complexes are present in Medina County. The largest tract of kames is in an east-west-trending buried valley traversed by Camel Creek and Little Killbuck Creek in Harrisville and Westfield Townships southeast of Lodi. The other large tract is in a complex buried-valley system in the Coddington-Granger Lake area in Granger Township. Small groups of kames are present in the valley of Wolf Creek at the Medina-Summit County line in Sharon Township and in the valley of West Branch Rocky River near Hardscrabble in Liverpool Township. Most kames in Medina County are less than 30 feet high; the largest has a height of 80 feet and a width of 0.25 mile. Kame terraces are present along one or both sides of the valleys of Hubbard Creek, Granger Ditch, and River Styx. Valley-train remnants are preserved as outwash terraces along the valley sides of River Styx, Wolf Creek, and Silver Creek (Wadsworth Township). Remnants of alluvial terraces are preserved along the valley sides of East Branch Black River, East Branch Rocky River, and West Branch Rocky River.

Three relatively large late-glacial and postglacial lakes formed in Medina County following the retreat of Hiram ice; a remnant of one of these, Chippewa Lake, still survives. Chippewa Lake occupies a portion of a valley that in late-glacial time was a 7-mile-long lake in eastern Lafayette and Westfield Townships. Garden Isle Lake occupied a large, nearly circular depression at the confluence of the buried valleys of East Fork of East Branch Black River and Little Killbuck Creek south of Lodi. In its last stages the lake stagnated and became a peat bog. Lake Spencer was a short-lived late-glacial lake in the valley of East Branch Black River northwest of Lodi. Lake Spencer ranged from 1 to 1.5 miles wide and was at least 7 miles long.

## INTRODUCTION

Medina County is located in northern Ohio (fig. 1) about 15 miles south of Cleveland and Lake Erie, and about midway between Pennsylvania and Indiana. The county is bounded on the north by Cuyahoga and Lorain Counties,

The Millbrook Till is the oldest till identified in Medina County. It is typically very firm, compact, silty, relatively sandy, and contains abundant pebbles, cobbles, and boulders. Many of the coarse fragments are igneous or metamorphic, indicating an origin in Canada. Unoxidized Millbrook Till is dark gray or olive gray, whereas the oxidized till is dark yellowish brown to olive brown. The Millbrook Till has prominent vertical joints, and the oxidized till is characterized by large angular blocks which are stained reddish brown to black by iron and manganese. Millbrook Till is more than 40 feet thick in places and makes up the bulk and framework of the end moraines. It tends to be thin (less than 10 feet) in places on uplands. Millbrook Till is a complex stratigraphic unit consisting of two or more subunits and considerable amounts of closely related sand and gravel. Its age is a matter of conjecture; it may be either Illinoian or early Wisconsinan.

Navarre Till, the oldest of three Woodfordian (late Wisconsinan) tills deposited in Medina County, overlies the Millbrook Till and forms a nearly continuous but thin subsurface blanket averaging 29 inches in thickness. Navarre Till is silty, relatively sandy, moderately pebbly, loose, and crumbly. It contains numerous sand lenses that tend to slump when wet; the till commonly appears as a wet zone where it is exposed. Oxidized Navarre Till is dark yellowish brown, in contrast to the overlying chocolate-brown tills.

Hayesville Till, of Woodfordian age, overlies the Navarre Till and is present throughout Medina County; it is the surface till in the southeastern quarter of the county. Hayesville Till is silty, clayey, sparingly pebbly, and blocky; it oxidizes to a dark brown, in contrast to the underlying yellow-brown and olive-brown tills. The Hayesville Till generally is less than 6 feet thick.

Hiram Till, also of Woodfordian age, overlies the Hayesville Till and is the youngest till in Medina County. Hiram Till, the surface till over all of the county except the southeastern part, is silty and clayey and contains so few pebbles and granules that it may be mistaken for lacustrine silt or clay. Hiram Till can be distinguished from the underlying Hayesville Till by its higher clay content and particularly by its very sparse pebble content and its almost total lack of granule-size material. In most places in Medina County the Hiram Till is 2 to 4 feet thick; its average thickness is 2.5 feet.

A subsurface concentration of boulders is common in many parts of the county at an average depth of 68 inches. The boulders, which are predominantly igneous or metamorphic, are most common at the stratigraphic position of the Navarre Till.

Medina County contains large commercial resources of sand and gravel. The major sand and gravel deposits are in the east-west-trending buried valley between Lodi and Seville in Harrisville and Westfield Townships near the southern margin of the county. At least 20 pits, past and present, have been operated in an area about 4 miles long and 1 mile wide. Sand and gravel also have been extracted from several small pits in the Coddington-Granger Lake area. Most of the sand and gravel deposits are of Millbrook age and generally have a covering of till as much as 40 feet thick.

Glacial sands and gravels are important aquifers in several buried valleys in the county. Yields of as much as 1,000 gallons per minute are possible from wells in permeable sand and gravel in small parts of two buried valleys, and yields of 100 to 500 gallons per minute are possible from wells in four relatively extensive buried valleys.

on the east by Summit County, on the south by Wayne County, and on the west by Ashland and Lorain Counties. Medina County lies between 81°41'6" and 82°10'24" west longitude, and between 40°59'19" and 41°16'36" north latitude. The entire county lies within the Connecticut Western Reserve. The county is of moderate size, with an



FIGURE 1.—Location of Medina County, Ohio.

area of 425 square miles and a population, according to the 1980 Federal Census, of 113,150. The largest city is Brunswick, followed by Medina, which is the county seat, and Wadsworth. Villages include Lodi, Seville, Spencer, Westfield Center (formerly Leroy), Briarwood Beach, Gloria Glens Park, and Chippewa-on-the-Lake. Much of the county, particularly the northern and eastern sectors, is experiencing rapid urban growth due to the interstate highway system and proximity to the large urban centers of Cleveland and Akron.

#### PURPOSE AND SCOPE

This report describes the glacial drift—the surface material overlying the bedrock—in Medina County (pl. 1). Morphology of the landforms and stratigraphy of the deposits are described and correlated with surface features and deposits in adjacent counties. Economic resources of the glacial drift are considered, and suggestions are made for their utilization and conservation.

This report will be of interest to various groups and individuals: geologists, highway engineers, construction firms, sand and gravel pit operators, architects, city planners, soil scientists, and landowners. Citizens who are or will be responsible for planning and shaping the future of Medina County for agriculture, urbanization, recreation, and industrialization will find this report useful in making their decisions.

#### ACKNOWLEDGMENTS

This report is based on a detailed field study, aided by air photos and water-well records, by the author in the summer of 1975. The Medina County Engineer's office and the Ohio Department of Transportation made available the

records of borings made for highway construction. The late Dr. George W. White accompanied the author in the field and made available his field notes of earlier years. Mr. Horace R. Collins, former State Geologist of Ohio, provided valuable support and encouragement in the development of this report. Dr. Linda Shane collected samples of peat and wood from the Quillin bog (see discussion on p. 27) and provided valuable information about plant identifications and carbon-14 dates.

#### PREVIOUS INVESTIGATIONS

Some of the earliest investigations of the geology of northern Ohio, including Medina County, were made by Charles Whittlesey (1838, 1848, 1850, 1866, 1869). Newberry (1874) gave a brief description of the surface features of the county and made particular mention of three large glacial boulders in Harrisville Township.

The earliest report specifically on the geology of Medina County was that of Wheat (1878), who described the bedrock and economic products in detail, but virtually ignored the glacial drift, except for mentioning the previously reported boulders in Harrisville Township. Leverett (1902) described the topographic features and the materials of the county in his Erie Basin monograph. White (1960, 1982) described the glacial deposits of northeastern Ohio and included Medina County on his maps.

Economic products in the rocks of Medina County have been reported in various publications. Orton (1888) reported on natural gas production; Bownocker (1903) reported on both natural gas and oil production. Wheat (1878) described the building stones of the county, as did Bownocker (1915). Smith (1949) mentioned several gravel pits in Medina County, and Risser (1981) mapped the sand and gravel resources of the county. Stout (1940) described deposits of marl and bog ore, and Dachnowski (1912) described peat deposits. The Ohio Division of Geological Survey annually publishes a *Report on Ohio mineral industries*, which lists production by county.

The principal source of information regarding water supply is the report by Stout, Ver Steeg, and Lamb (1943, p. 445-452). Schmidt (1978) prepared a generalized map of the ground-water resources of Medina County. The detailed soil survey of Medina County (Hayhurst, Milliron, and Steiger, 1977) is a useful reference in the study of the surficial materials, including their engineering properties.

Reports on adjacent counties provide information on glacial deposits at or near the margin of Medina County. Published reports include those for Cuyahoga County (White, 1953a; Ford, 1987) to the north, Summit County (White, 1953b, 1984) to the east, Wayne County (White, 1967) to the south, and Ashland County (White, 1977) and Lorain County (Totten, in preparation) to the west.

#### PHYSIOGRAPHY AND DRAINAGE

##### TOPOGRAPHY

Medina County has a rolling topography that is both scenic and adaptable to a wide variety of uses. The glacial topography ranges from gently undulating ground moraine to hummocky and moderately sloping end moraines (pl. 1).

The flattest topography in Medina County is in valley bottoms, which make up a small but significant part of the county. Several deeply cut valleys form an intertwined network surrounding bedrock knobs primarily in the eastern half of the county. These valleys have been partially

filled with drift, producing wide valley flats. Hummocky drift in the form of kames and end moraines is common in the valleys, and in places extends completely across the valley, forming a dam or plug. Portions of several valleys were the sites of lakes at various times during the Pleistocene; Chippewa Lake is a vestigial remnant of an earlier, more extensive lake. The widest valley flat is a nearly circular area 2.7 miles in diameter south of Lodi known as Garden Isle Bog. This flat area is at the intersection of two or three buried valleys. Other valley flats more than 1 mile wide include the valleys of River Styx southwest of Wadsworth, Chippewa Creek in Westfield and Lafayette Townships, and Camel Creek-Killbuck Creek near the Medina-Wayne County line. Several valley flats at least 0.4 mile wide are present throughout the county.

The eastern part of the county is maturely dissected and is characterized by steep-sided valleys cut deeply into the resistant sandstone-capped uplands. In this region the thickness of glacial drift is generally insufficient to fill the valleys, and much of the early Pleistocene relief is preserved.

The steepest slopes are in Hinckley Township in Hinckley Reservation, a park noted for its scenic lake, sandstone ledges, and buzzard roost. The highest elevation in Medina County is between 1,320 and 1,330 feet and is 1 mile northeast of Hinckley Lake near the northeastern corner of the county. The relief in this area is 360 feet in 0.6 mile, and 410 feet in 1 mile. The southeastern corner of the county in and near Wadsworth is nearly as high, with elevations of 1,300 feet and higher. Elevations in most of the county are between 900 and 1,200 feet, and minimum relief is 50 feet in 1 mile, an indication of the rolling nature of the topography. The lowest elevation in the county is about 765 feet and is in the north-central part where West Branch Rocky River flows northward into Lorain County.

PHYSIOGRAPHIC DIVISIONS

Medina County lies within the glaciated Allegheny Plateau section of the Appalachian Plateaus physiographic province of Fenneman (1928, 1938). In this part of Ohio no sharp

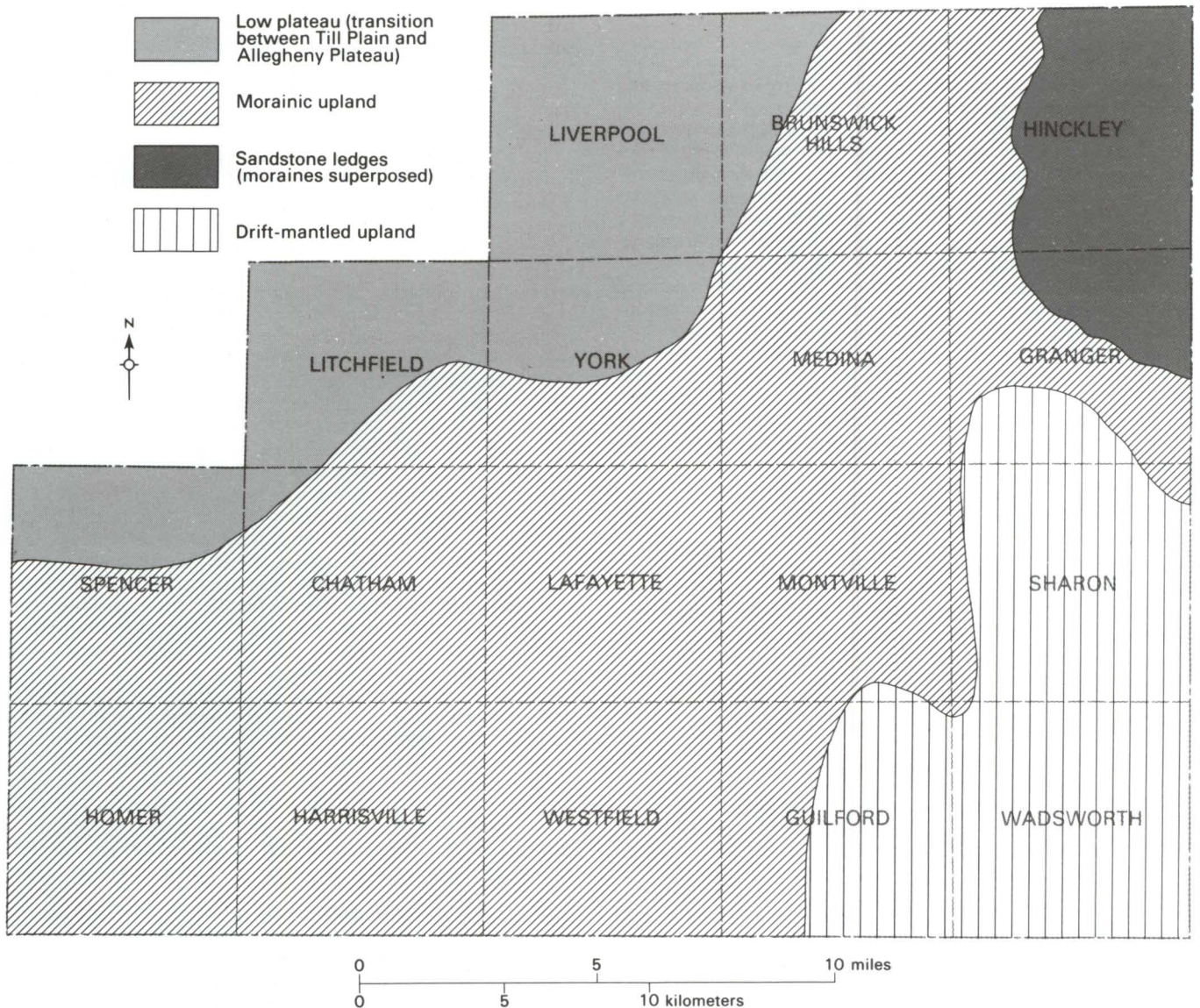


FIGURE 2.—Generalized physiographic divisions of Medina County.

break occurs between the Allegheny Plateau and the Till Plains Section of the Central Lowlands province to the west; the northwestern border of Medina County may be considered a transition zone between these two major provinces. For the purpose of this report, four divisions of the Allegheny Plateau may be recognized: low plateau, morainic upland, sandstone ledges, and drift-mantled upland (fig. 2).

#### Low plateau

White (1934) first proposed "Low Plateau" as a separate physiographic unit for the transition zone between the Allegheny Plateau and the Till Plains. Southwest of Medina County, the low plateau has an elevation of 1,100 to 1,200 feet and a width of 5 to 16 miles (White, 1934). In northwestern Medina County, the low plateau has an elevation of between 850 and 1,000 feet and a maximum width of 7 miles. The low plateau has a gently rolling or undulating topography formed by the deposition of ground moraine over a bedrock surface of low relief.

#### Morainic upland

A distinct belt of end moraines, 6 to 15 miles wide, trends northeastward across the heart of Medina County (figs. 2, 7). These moraines, consisting of multiple elements or ridges, are closely bunched and well developed, producing a hummocky topography. The drainage in Medina County is strongly influenced by the end moraines, which serve as drainage divides. The end moraines crossed the major valleys, thereby ponding and deranging earlier drainage. Chippewa Lake and Garden Isle Bog occupy two major depressions formed in this manner. The morainic upland may be described as a moderately dissected upland containing numerous hummocks that generally form linear ridges. Elevations on the morainic upland are commonly between 1,000 and 1,200 feet, and the relief between moraine crest and valley bottom typically is 100 to 150 feet in a distance of 1 mile or less. The slopes are pleasing aesthetically yet are not so steep as to provide serious limitations on land use.

#### Drift-mantled upland

The southeastern corner of the county, including most of Guilford, Sharon, and Wadsworth Townships (fig. 2), is characterized by thin drift which covers but does not obscure the underlying bedrock topography. Numerous youthful valleys have dissected the region, which consists of moderate slopes typical of an early mature region. Bedrock crops out on the steeper slopes and in the smaller tributary valleys. Drift is thicker in the valley bottoms. The relief is moderate, commonly no more than 100 to 150 feet in a mile.

#### Sandstone ledges

The sandstone ledges in Hinckley and Granger Townships in the northeastern corner of the county provide the steepest slopes and most spectacular scenery in Medina County (fig. 2). The ledges, with a nearly vertical rise in elevation of 100 feet or more, border both sides of the valley of East Branch Rocky River. The modern relief of 350 to 400 feet from upland to valley bottom is only about half the maximum relief of approximately 750 feet on the bedrock surface. Prior to valley filling (pre-Wisconsinan), the scenery in this area must have been even more spectacular! The several narrow morainic ridges in this area have modified only slightly the ledge topography.

### THICKNESS OF GLACIAL DRIFT

The thickness of glacial deposits overlying the bedrock in Medina County (fig. 3) is highly variable, ranging from near zero on the uplands in Hinckley Township to over 400 feet in the buried valley of East Branch Rocky River in a geographic distance of less than a mile. Areas of thin drift may be determined from field observations along streams, valley walls, and road cuts. Where the drift thickness is greater than a few feet, water-well drilling records, called well logs, represent the major source of subsurface information. Most of the water wells in Medina County have been drilled to bedrock, so the thickness of glacial drift is known in many places. In addition, most of the well logs contain information about the type of glacial drift recorded by the driller, so that the composition of the drift is known in a general way.

The thickness of drift in Medina County is controlled by: (1) the depth of early Pleistocene valleys, which have been filled or partially filled, (2) the formation of a belt of end moraines, and (3) postglacial erosion. The influence of the topographic and geomorphic landforms is demonstrated by the cross section (fig. 4) across Medina County.

The drift-thickness map (fig. 3) is dominated by a system of four major buried valleys that trend northwest-southeast. Each of these valleys is characterized by drift thickness in excess of 200 feet.

Drift greater than 150 feet thick is limited to the central portions of the large, deeply buried valleys and the downstream portions of a few of their tributaries (fig. 3). Although of limited extent, these areas are of great importance as locations of sand and gravel aquifers. Most water wells in the buried valleys do not go all the way to bedrock but are completed in glacial sand and gravel aquifers, and thus do not reveal the true drift thickness. The greatest drift thickness penetrated by a well in Medina County is 430 feet in the valley occupied by East Branch Rocky River that bisects Hinckley Township. The slope of the buried valleys is toward the south-southeast, and the drift thickness in these valleys also tends to increase in a southeast direction.

Areas of 51-150 feet of drift are extensive in Medina County (fig. 3). These areas of moderately thick drift represent primarily the wide morainic belt that trends generally southwest-northeast across the county. These areas also include the smaller buried valleys and the middle and upper slopes of the deeply buried valleys.

Areas of 10-50 feet of drift also are extensive and widely distributed across the county (fig. 3). These areas of relatively thin drift are located primarily on the broad uplands where several till sheets are present and where end moraines are not well developed.

Drift is very thin—less than 10 feet thick—and bedrock is close to the surface at relatively few places in Medina County. The largest area of thin drift is in Liverpool and northern York Townships north of Mallet Creek (fig. 3). The most extensive bedrock outcrops in the county are in the eastern part where sandstone ledges are common, especially in Hinckley and Sharon Townships. Bedrock exposures are rare in the western part of the county; perhaps the best known of these is the rock outcrop at the north end of Lodi.

### MODERN DRAINAGE

The major divide separating Ohio River drainage from Lake Erie drainage follows the end-moraine belt in southern Medina County (fig. 5). The divide follows no single end-moraine ridge, but skips from one ridge to another. The divide follows the Fort Wayne Moraine in Homer Township,

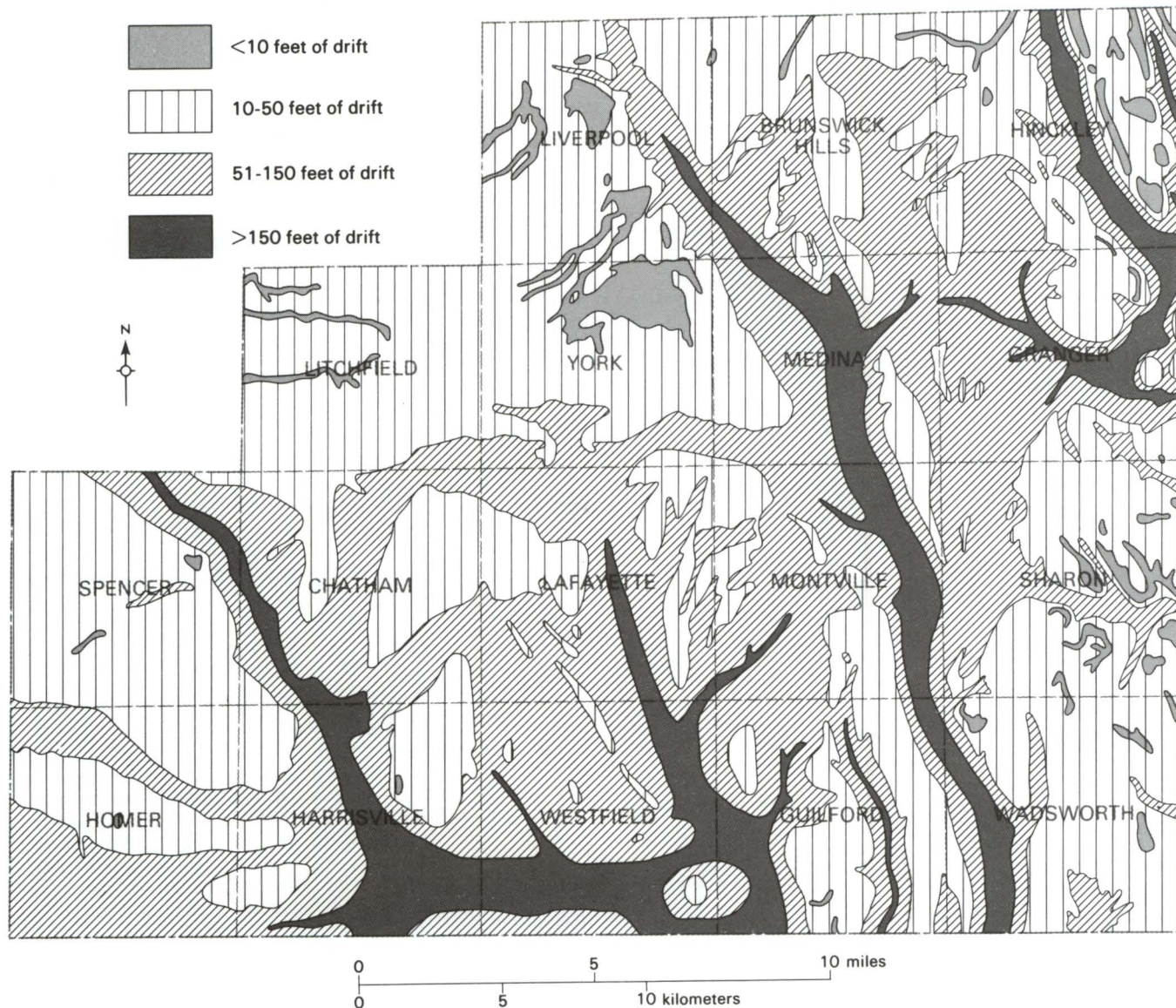


FIGURE 3.—Generalized thickness of drift in Medina County.

the New Washington Moraine in Chatham and Lafayette Townships, and the St. Johns Moraine in Sharon Township.

The modern drainage in the county is controlled primarily by two features: (1) the major stream courses occupy large Pleistocene valleys that are partially filled with glacial deposits, and (2) the courses of many tributaries follow depressions between end moraines. The moraines bend southward where they cross major valleys, so that tributaries north of the divide appear barbed.

Medina County is the headwaters region for several large streams including East Branch Black River and East and West Branches Rocky River, which all flow northward, and River Styx, Chippewa Creek, and Killbuck Creek, which all flow southward. The drainage basins in Medina County are described below.

**Black River basin**

East Branch Black River drains all or the major part of Spencer, Homer, Litchfield, Chatham, and Harrisville Town-

ships in the western part of the county. Its major tributaries are East Fork, West Fork, Clear Creek, and Coon Creek. These tributaries occupy positions along the south margins of morainic ridges and make sharp bends where they enter the main stream. East Fork, for example, flows southward for 7 miles to Lodi, makes a 180° bend, and then flows north-northwestward to join with West Fork to form East Branch. Several intermediate-size tributaries and many small, short tributaries enter East Branch mostly at right angles. East Branch and several of its tributaries meander erratically on narrow floodplains bordered by terraces representing an earlier drainage episode.

**Rocky River basin**

West Branch Rocky River and its tributaries, including Mallet Creek and North Branch and its tributaries Plum Creek and Granger Ditch, drain nearly 1/3 of the county, which makes the Rocky River drainage basin the largest in Medina County. West Branch heads in the end moraines in

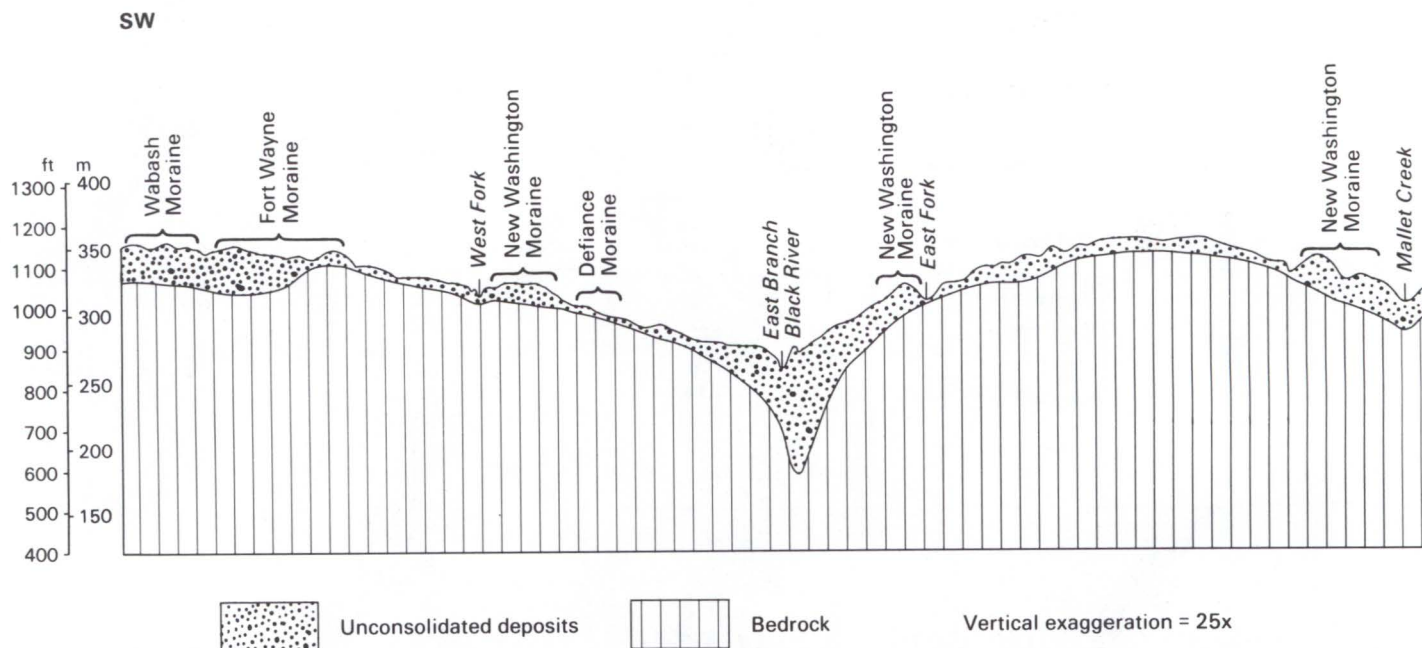


FIGURE 4.—SW-NE cross section across Medina County

Montville Township southeast of Medina and flows north-northwestward for 15 miles past Abbeyville, Valley City, and Hardscrabble into Lorain County. Although the valley reaches a width of 0.8 mile in the vicinity of Valley City, the modern floodplain is very narrow in most places and large alluvial-terrace remnants are present. The river course twists and turns in irregular fashion within the confines of the valley walls.

West Branch Rocky River is unique in that its headwaters collect drainage diverted from two large adjacent basins. One diversion is from Chippewa Creek in the Tuscarawas River basin to the south by way of Mallet Creek. The other is from the Cuyahoga River basin to the east by way of Granger Ditch and Plum Creek. Both diversions cross bedrock divides and probably occurred when end moraines ponded southward drainage in the major southwest-trending valleys.

Mallet Creek, a major tributary to West Branch Rocky River, drains parts of Lafayette, York, and Liverpool Townships in north-central Medina County. Mallet Creek originates in the wide morainic complex that plugs the southward-trending Chippewa Creek valley, yet Mallet Creek flows northward across the low divide in northern York Township into the Rocky River basin. The creek flows in a narrow valley excavated partially through the end moraines and partially in bedrock northeast of the moraines.

Plum Creek drains the upland in eastern Brunswick Hills Township and flows southward for about 4 miles across several morainic elements to Weymouth. At Weymouth, Plum Creek joins Granger Ditch to form North Branch of West Branch Rocky River. North Branch is a 3-mile-long meandering tributary that flows across the narrow end-moraine and bedrock divide in northeastern Medina County to enter West Branch Rocky River near Medina.

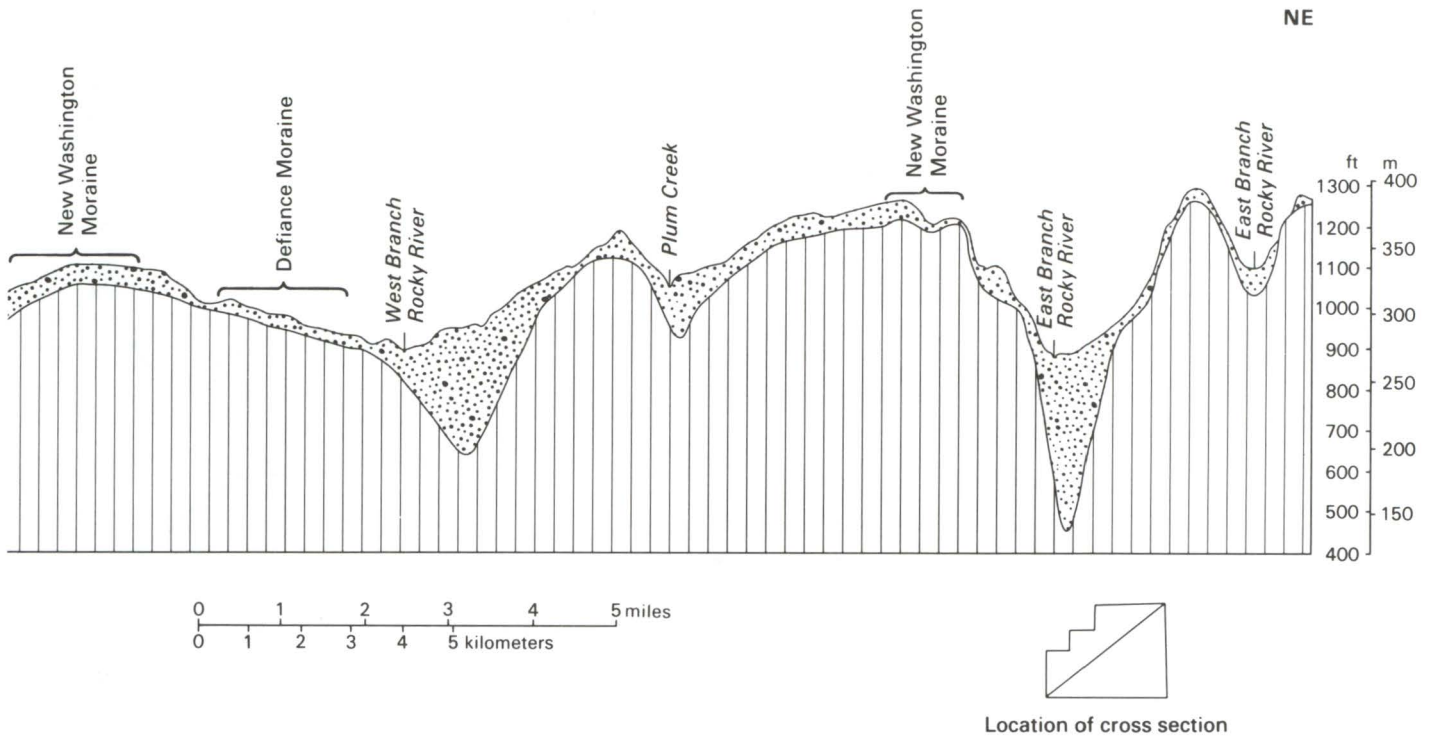
East Branch Rocky River is the principal stream draining

the sandstone upland in Hinckley Township in northeastern Medina County. The headwaters of East Branch are in southwestern Cuyahoga County. The stream follows a U-shaped course around a large sandstone ridge in eastern Hinckley Township. East Branch flows southward from Cuyahoga County across northeastern Hinckley Township and a corner of Summit County then bends westward back into Hinckley Township, where the stream intersects a deep, partially buried, early Pleistocene valley. East Branch then flows northwestward through Hinckley Reservation in a meandering valley flanked by hills, ridges, and ledges of resistant sandstone and conglomerate. Hinckley Lake is an artificial lake made by damming East Branch southeast of the community of Hinckley.

#### Tuscarawas River basin

The headwaters of Wolf Creek lie along the flank of the St. Johns Moraine in southwestern Granger Township. The stream flows eastward for 4 miles into Summit County and thence to the Tuscarawas River. A tract of kames along the north side of the valley near the Medina-Summit County line plugged the valley, and a lake, now filled with sediment, was formed.

River Styx is a relatively small stream that occupies a broad flat valley nearly 1.5 miles wide west of Wadsworth. The St. Johns Moraine partially plugs the valley in southeastern Montville Township and serves as the drainage divide between West Branch Rocky River, which flows north, and River Styx, which flows south. River Styx has only small, short tributaries with the exception of Holmes Brook, and its drainage area is little wider than the valley itself. The river flows southward for about 7 miles into Chippewa Creek in Wayne County. Near the Wayne-Medina County line the valley is partially blocked by drift (end



showing end moraines and buried valleys.

moraine or kame moraine). A small lake, now filled with sediment, existed north of this plug west of Wadsworth.

Drainage into the Chippewa Creek valley north of Chippewa Lake is largely by means of a channelized ditch known as The Inlet. This drainage heads in the morainic upland a few miles west of Medina and flows through the broad, flat, swampy lacustrine plain north of Chippewa Lake. A spillway constructed at the south end of Chippewa Lake controls the outlet and maintains a pool stage of 986 feet. From Chippewa Lake, Chippewa Creek follows a mostly channelized course for 5.5 miles southeastward through Seville and into Wayne County. In its modern form, Chippewa Creek is grossly underfit for its valley, which reaches a width of 1.7 miles. Its drainage basin is small for such a wide valley, and its only tributary of any consequence is Hubbard Creek, which joins Chippewa Creek at Seville.

Cuyahoga River basin

Only a small portion of Medina County drains into the Cuyahoga River basin, via Yellow Creek. Yellow Creek has its origin in several small streams that head in the kames and end moraines in southeastern Granger and northeastern Sharon Townships. Part of the headwaters area formerly was part of the large valley now occupied by Granger Ditch and plugged by end moraines. Yellow Creek flows eastward into Summit County, where it joins the Cuyahoga River.

Killbuck Creek and Mohican River basins

South-central Medina County is drained by Camel Creek, Little Killbuck Creek, and Killbuck Creek. The southwestern corner of Homer Township is drained by Muddy Fork, which flows southward from Medina County through Ashland

and Wayne Counties and eventually into the Mohican River via Lake Fork in Holmes County.

PLEISTOCENE DRAINAGE SYSTEMS

The Pleistocene and pre-Pleistocene drainage history of Medina County is very complicated and many details are still imperfectly understood. Several reversals of drainage are known in the county. These reversals are associated with advance and retreat of ice coupled with the formation of a series of end moraines that served as earthen dams which blocked streamflow, in places temporarily, in places permanently. The surface features and present drainage systems reflect only the Wisconsin glacialiation. Earlier glacialiations and their effect on the drainage of Medina County are known primarily from water-well records, which provide data on buried stream and lake deposits as well as the topography of the buried bedrock surface.

Stout and others (1943, map 4) show two northward-flowing preglacial (Teays-Stage) streams draining Medina County; they named these two streams Olmstead [Olmsted] Falls Creek and Oberlin Creek (fig. 6). Stout and others (1943) considered Medina County to be unaffected by the Deep-Stage drainage associated with the earliest Pleistocene (Kansan) glacialiation and to have had only minor diversion of streams to the post-Illinoian Massillon River, which they believed drained northward through Summit County. White (1934) presented evidence that the preglacial divide in Ohio was located 30 miles south of Medina County in Holmes County, but he was of the opinion that the preglacial valleys were at higher elevations than at present. White's (1934) interpretation suggests that the system of buried valleys in Medina County (see fig. 3) originated in the early and middle Pleistocene, and is not a preglacial system.

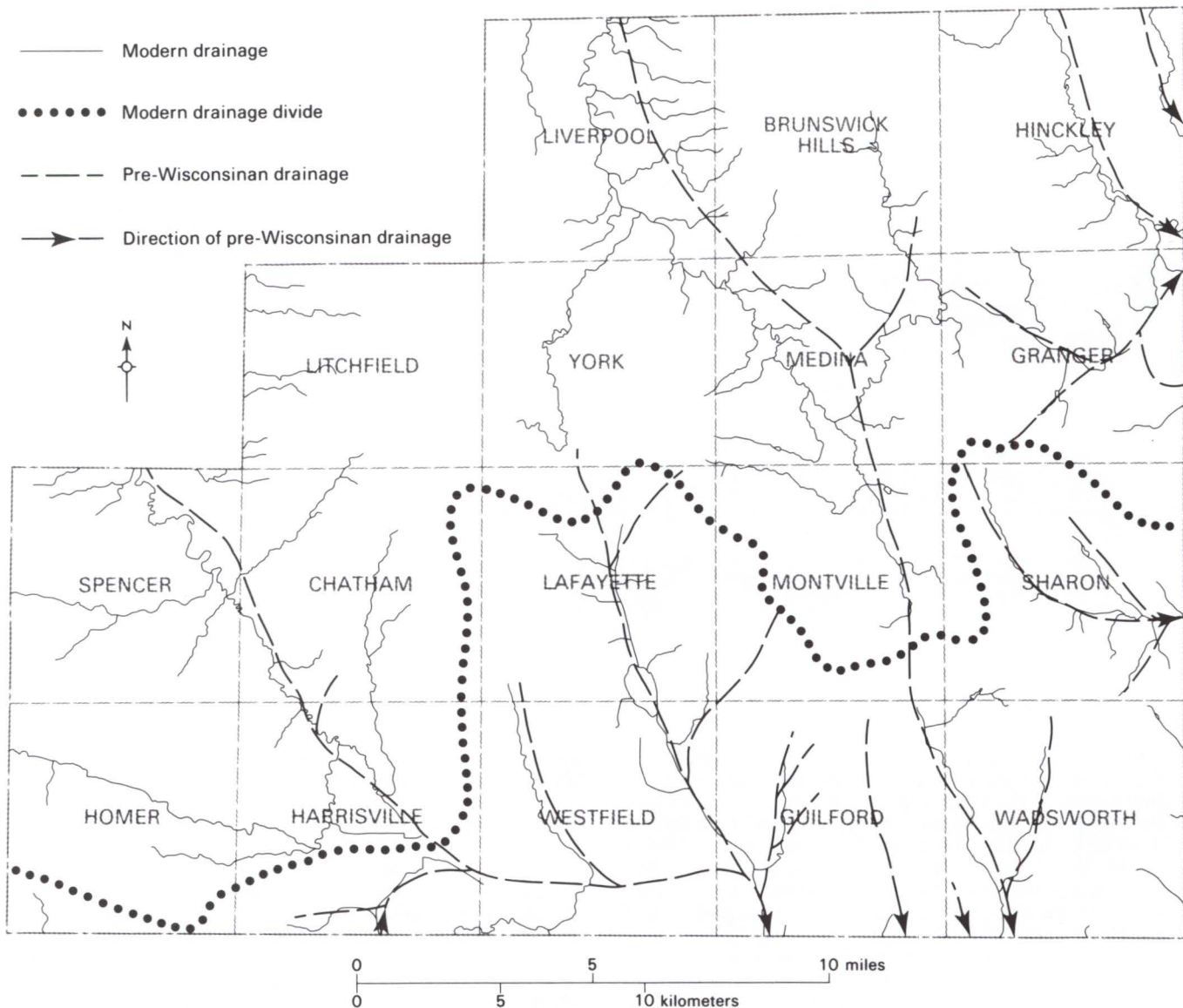


FIGURE 5.—Principal modern streams and pre-Wisconsinan drainage in Medina County.

The earliest (Nebraskan?) glacier to reach the Great Lakes area blocked the northward-flowing streams and diverted them southward. Many of these new southward-flowing streams may have occupied the headwaters of preglacial valleys, but the new streams incised numerous divides to maintain the drainage southward. The valley walls and bottoms were incised deep into bedrock, in places to depths of 300 feet or more. The elevation of the valley bottom (now partially filled) in northeastern Hinckley Township is below 550 feet, or at least 750 feet below the nearby ridge tops. This great amount of incision was made possible by a combination of large volumes of glacial melt-water and a lower base level due to a lowering of sea level during continental glaciation.

The drift-thickness map (see fig. 3) indicates a system of four major buried valleys trending southeastward in Medina County. These valleys and their tributaries now are filled or partially filled with a complex assortment of sediment, some of which is water bearing. In most cases these ancient

valleys contain modern streams which are grossly underfit for the valleys they occupy.

#### GLACIAL EROSION

Most, if not all, ice advances into Medina County were in a south-southeast direction and followed the trend of the major preglacial or early glacial valleys. The ice was thicker in the valleys than on the adjacent uplands, and the greatest erosion potential was in the valleys aligned parallel to ice movement. It is probable that some valleys were deepened and widened, but it is not possible to determine the amount of erosion. The bedrock surfaces exposed beneath till have been scoured by ice, and any paleosol that may have been developed in rock was removed. However, there is little if any evidence to indicate that the first glacier to cover Ohio was responsible for eroding more than the thin layer of weathered bedrock or regolith.

Unknown amounts of older till may have been eroded

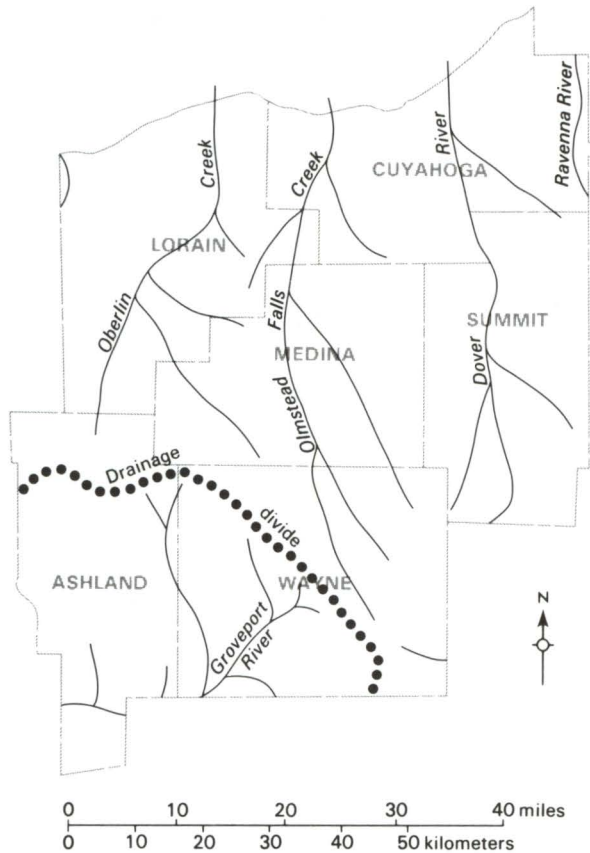


FIGURE 6.—Preglacial (Teays-Stage) drainage in north-central Ohio as interpreted by Stout and others (1943).

during later ice advances, principally the Altonian, as pre-Millbrook till has not been identified in Medina County. Erosion of the Millbrook Till by the thinner ice associated with the Woodfordian glaciation apparently was negligible.

**GEOMORPHOLOGY OF THE GLACIAL DRIFT**

The surface expression of the glacial drift in Medina County has been produced by several ice advances, which deposited till in the form of ground moraine and end moraine. During ice retreats, meltwaters deposited sand and gravel upon, within, or beyond the melting ice as kames and outwash. In addition to ice-related deposits, several large lakes existed for considerable lengths of time after disappearance of the ice, and lake deposits form distinctive features. These constructional geomorphic features are discussed separately from the stratigraphy of the deposits (discussed on p. 17-26) because many landforms did not result from deposition by the last glacier to cover the region, but are the result of deposition and modification by multiple glaciations.

**END MORAINES**

A complex sequence of end moraines is the most prominent glacial landform in Medina County (pl. 1, fig. 7). End moraines are hummocky ridges of till with some gravel that were deposited at or near the ice margin whenever it halted or fluctuated over a narrow area for a period of time. The

end moraines in Medina County represent a significant portion of the large end-moraine sequence that trends generally southwest-northeast across the glaciated portion of Ohio (Goldthwait and others, 1961). Most moraines in Medina County consist of two or more separate ridges termed elements. Of the 27 morainic elements recognized in north-central Ohio (Totten, 1969), at least 14 are present in Medina County. These elements are part of the Mississinewa, St. Johns, Wabash, Fort Wayne, New Washington, and Defiance Moraines (fig. 7). The general trend of the moraines in Medina County is southwest-northeast, transverse to the direction of major drainage lines. The morainic elements in many places are separated from one another by shallow troughs occupied by streams tributary to the major southeast-flowing streams. The end moraines exhibit a pronounced southeastward loop where they cross the major valleys of East Branch Black River, Chippewa Creek, West Branch Rocky River, and East Branch Rocky River. The moraines have plugged many of these valleys, thereby causing derangement and reversal of drainage.

The morainic elements tend to diverge on the uplands and converge in the valleys. Several elements may combine to form a single morainic ridge then diverge by a mile or more in a short distance.

The end moraines do not project so high above their surroundings as to represent topographic barriers in the county. The major valleys and sandstone bedrock knobs are more imposing features. However, the moraines do represent a distinctly contrasting topography, a topography that is pleasantly rolling and not too steep to prohibit most agricultural uses.

Materials exposed in stream cuts and excavations in Medina County end moraines indicate the moraines are composed of Millbrook Till veneered with as much as 8 to 10 feet of younger Navarre, Hayesville, and Hiram Tills. The surface till of the end moraines over all but the southeastern quarter of the county is the Hiram Till; Hayesville Till is the surface till of the end moraines over most or all of Guilford, Wadsworth, Montville, and Sharon Townships. The Millbrook Till in Medina County consists of two or more till subunits, and it is probable that the end moraines were formed during at least two Millbrook ice advances or retreats. Subsequent overriding of the end moraines by two or more ice sheets probably caused the present morainic topography to be smoother and less steep than the original Millbrook topography.

**Mississinewa Moraine**

The Mississinewa Moraine is the southernmost and presumably the oldest moraine in Medina County. The moraine is represented by two or more elements in the southeastern part of the county (fig. 7). A few small isolated morainic segments are oriented north-south on the upland in central Guilford Township; a much larger and continuous segment 0.5 mile wide and 4.5 miles long occurs in western Wadsworth and Sharon Townships. One or in places two distinct crests are apparent in the long irregular ridge that rises about 30 feet above its surroundings. A short distance north-northeast of Boneta the moraine is superimposed on a bedrock ridge which rises nearly 60 feet above its surroundings. Two or more prominent elements south and west of Granger Lake are intimately associated with the irregular masses of gravel and kames in the Coddington-Granger Lake area.

**St. Johns Moraine**

The St. Johns Moraine is situated approximately midway between the Mississinewa and Wabash Moraines in eastern

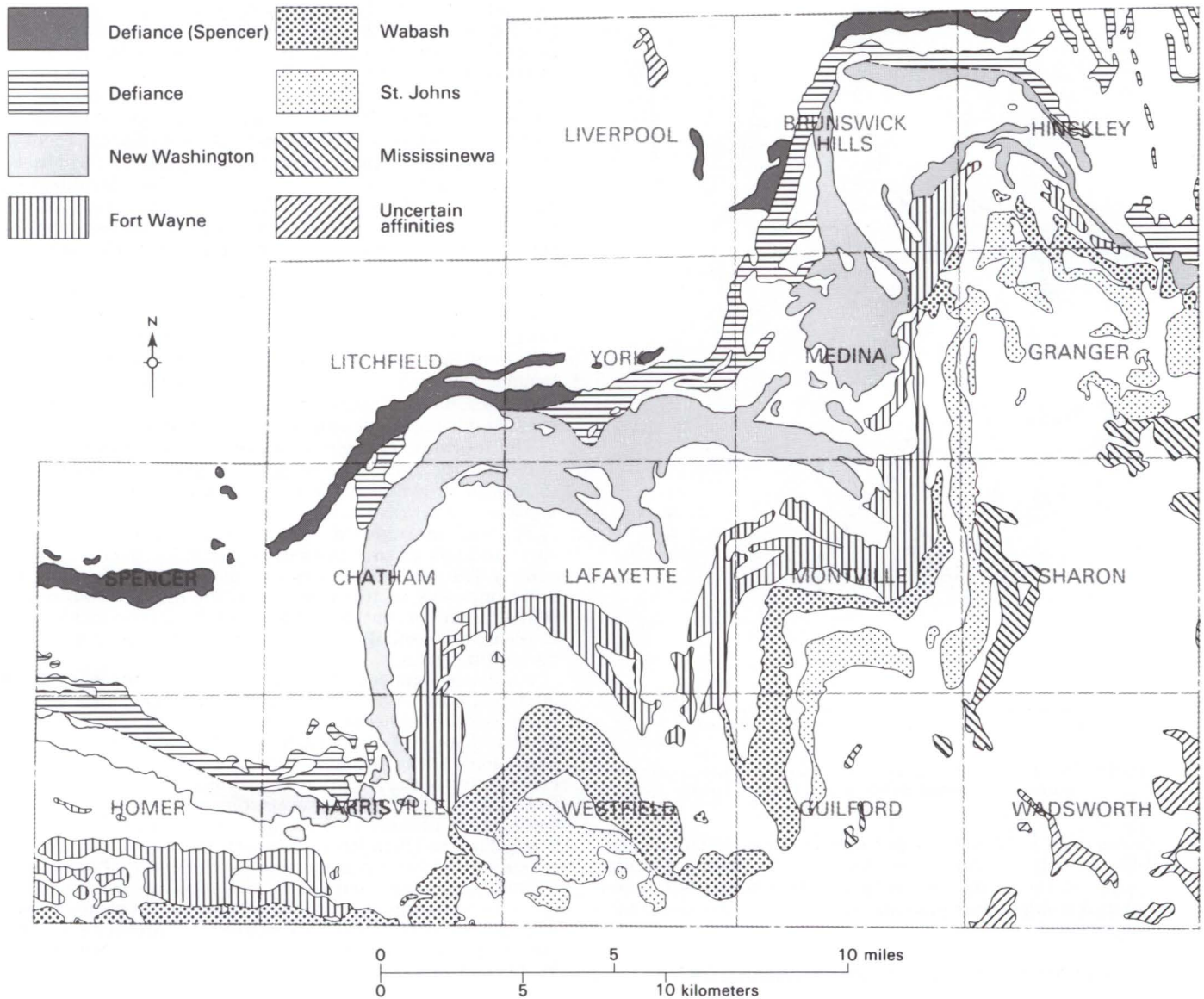


FIGURE 7.—Identification of end moraines in Medina County.

and southeastern Medina County (fig. 7). The St. Johns Moraine extends northward from Wayne County into Westfield and Guilford Townships. It can be traced from Seville northward for about 4 miles, where Hubbard Creek flows along its west flank. In southern Montville Township the moraine bends eastward and then dips southward for 1 mile into the valley of River Styx, where the moraine serves as the divide between West Branch Rocky River and River Styx. East of the valley, the moraine trends northward for 8 miles to the valley now occupied by Granger Ditch. Northeast of Granger Ditch the moraine bends southeastward and becomes a part of the large morainic complex that plugs the valley system near Granger Lake at the Medina-Summit County line.

The St. Johns Moraine ranges from 0.25 to 1.0 mile wide and is from 20 to 40 feet high. The moraine consists of two distinct elements that are so close to one another that in some places they form a single prominent ridge. These two elements are best seen along Interstate 71 for a distance of

1.5 miles between the Ohio Route 18 interchange and the Interstate 271 interchange.

#### Wabash Moraine

The Wabash Moraine is the southernmost moraine that can be traced more or less continuously across southern and eastern Medina County (fig. 7). Along the Wayne-Medina County line in Homer and Harrisville Townships this moraine consists of a single eastward-trending ridge about 0.5 mile wide and 30 to 40 feet high. The general east-northeastward trend of the moraine in southwestern Medina County is influenced greatly by the irregular valley-and-ridge topography; consequently, the moraine exhibits a series of southward loops in the valleys.

The Wabash is one of the more prominent valley-plugging moraines. It plugs the Killbuck Creek valley 3 miles south of Lodi near Burbank in northern Wayne County. The Wabash Moraine also plugs the major east-west-trending valley

occupied by segments of Camel, Killbuck, and Little Killbuck Creeks southeast of Lodi, in the process burying rich gravel deposits, and blocks the valley of Chippewa Creek at Seville. The moraine "dam" at Seville resulted in the formation of a 7-mile-long glacial lake, of which only a much smaller Chippewa Lake remains. The Wabash Moraine also contributes a large share of the morainic plug in the valley occupied by West Branch Rocky River and in the valley occupied by East Branch Rocky River near the Medina-Summit County line.

For the most part, the Wabash Moraine is separated from the adjacent St. Johns and Fort Wayne Moraines by low areas of ground moraine occupied by small tributary streams. Hubbard Creek north of Seville is the largest tributary to follow a depression bordering the moraine.

The Wabash ridge ranges in width from 0.25 to 1 mile and reaches heights generally 30 to 35 feet above its surroundings. For a single ridge, the Wabash dimensions are the most imposing of any morainic ridge in Medina County.

#### Fort Wayne Moraine

The Fort Wayne Moraine consists of three closely related elements in the wide space between the Wabash and New Washington Moraines (fig. 7). The Fort Wayne Moraine can be traced from northeastern Ashland County into southwestern Medina County, where the three elements are distinct though somewhat discontinuous in southern Homer Township. All three elements are buried beneath sediment filling the large buried valley south of Lodi, now the site of Garden Isle Bog. The moraine extends northward and eastward from Lodi for 4 miles before bending southward into the valley of Chippewa Creek. Chippewa Lake occupies a large depression in the valley bounded by two elements of the moraine. The village of Chippewa-on-the-Lake is located on a Fort Wayne morainic element which forms the eastern boundary of the lake. From Chippewa Lake the Fort Wayne Moraine trends northward 4 miles nearly to Medina before bending eastward toward the valley of West Branch Rocky River. The valley of West Branch is plugged with the drift of several moraines, yet the river has managed to establish a channel northward through the moraines. The continuity of the Fort Wayne morainic elements is lost in the northeastern part of the county, where the ridges are narrow and dissected.

The three elements of the Fort Wayne Moraine range in width from 0.5 to 1.5 miles. The moraine exhibits a rolling topography with hummocks rising 20 to 30 feet above the bordering ground-moraine till plain. The hummocks are fairly continuous, and in places distinct ridge crests are continuous for a mile or more.

#### New Washington Moraine

The New Washington Moraine lies between the Fort Wayne Moraine to the south and the Defiance Moraine to the north (fig. 7). Three New Washington morainic elements are well defined to the west in Ashland County (Totten, 1969; White, 1977) and trend eastward into Homer Township in southwestern Medina County. The southernmost element is poorly developed in western Medina County, whereas the other two elements join to form a prominent ridge 0.7 mile wide and nearly 40 feet high in northern Homer Township. The southern margin of this ridge is marked by the valley of West Fork of East Branch Black River. The moraine is nearly buried beneath outwash in the East Branch Black River valley at Lodi, and only the tops of

a few knolls are visible. The New Washington Moraine trends due north from Lodi, and Ohio Route 83 follows its crest for 6 miles. The village of Chatham, located on the crest of the moraine, stands 45 feet above the valley of East Fork of East Branch Black River to the west.

All three elements of the New Washington Moraine are well developed in the Chippewa Creek valley near the center of the county. The southern element is the drainage divide between Mallet Creek, which flows northward, and Chippewa Creek, which flows southward. Between Chippewa Creek and West Branch Rocky River the moraine consists of broad ridges and rolling hills on which most of the city of Medina has been built. The moraine nearly plugs the valley of West Branch east of Medina and then trends northward for about 5 miles to Brunswick. The belt of hummocky topography 2 miles wide northeast of Medina and west of Weymouth is assigned to the New Washington Moraine (fig. 7) because of its geographic position, but could be another system. This belt consists of 12 or more small arcuate ridges that collectively resemble a giant washboard. Near Brunswick the morainic elements become discontinuous and bend eastward into Hinckley Township, where the moraine consists of narrow ridges that border the valley of East Branch Rocky River.

The overall dimensions of the New Washington Moraine—width 1 to 2 miles and height 20 to 30 feet—coupled with its continuity make it one of the major end-moraine systems in Medina County.

#### Defiance Moraine

The Defiance Moraine, the northernmost end moraine in Medina County, may be subdivided into northern and southern subbelts, each of which consists of two or more elements. The southern subbelt in southwestern Medina County is composed of two elements and is separated from the northern subbelt by a till plain 2 to 4 miles wide. The distance of separation generally is less than a mile in other parts of the county. North of Homerville in southwestern Medina County the southern Defiance subbelt joins with the New Washington Moraine to form a single ridge 1.2 miles wide. This belt trends east-southeastward and plugs the large valley of East Branch Black River west of Lodi. From Lodi the combined Defiance-New Washington morainic belt trends northward past Chatham and bifurcates in northern Chatham Township. The southern Defiance subbelt is discontinuous where it bends eastward in Litchfield Township and is combined with the northern Defiance subbelt in York Township. The combined width is greater than a mile where the moraine crosses the Mallet Creek valley. North of Medina the southern Defiance subbelt bifurcates as it crosses West Branch Rocky River; the two elements rejoin north of the river. North of Brunswick, both Defiance subbelts join with elements of the New Washington Moraine to form a single belt. Near the Medina-Cuyahoga County line the subbelts assume an eastward trend and are separated once again by a tract of ground moraine. The southern subbelt bifurcates west of the valley of East Branch Rocky River; one element trends northeastward directly across the valley and the other makes a sharp southeastward bend to cross the valley at the south end of Hinckley Lake. East of the valley of East Branch Rocky River the element trends northward into Cuyahoga County as a chain of short, narrow ridge segments.

The northern Defiance subbelt in western Medina County trends eastward from Lorain County into central Spencer Township, where Coon Creek follows the depression along its southern margin. This subbelt, also known as the Spencer

Moraine (Goldthwait and others, 1961), named for the town located on its crest, is 0.8 mile wide and 30 to 35 feet high in Spencer Township. Where it crosses the valley of East Branch Black River east of Spencer the northern subbelt is discontinuous but can be traced from the east side of the valley northeastward into Litchfield Township. Southeast of Litchfield the subbelt bends eastward and bifurcates. The northern element of the subbelt is discontinuous east of Mallet Creek, whereas the southern element becomes stronger and joins with the southern Defiance subbelt and the New Washington Moraine to plug the Chippewa Creek valley. The plugged portion of the valley is now occupied by the headwaters of northward-flowing Mallet Creek, which is fed by barbed tributaries. East of the Mallet Creek valley the northern Defiance subbelt trends north-northeast into Brunswick Hills Township, where it is draped over a resistant sandstone ridge. North of Brunswick the northern subbelt trends eastward just south of the Medina-Cuyahoga County line, crosses East Branch Rocky River at the county line, and bends northward into Cuyahoga County (Ford, 1987, pl. 1).

#### GROUND MORAINE

Slightly more than half of the surface of Medina County consists of ground moraine. The ground-moraine surface changes dramatically from west to east across the county. In the western part of the county, the underlying bedrock topography is obscured beneath drift and the ground-moraine surface is a gently undulating till plain which has undergone slight to moderate dissection by streams. In the eastern part of the county, the bedrock surface has significantly greater relief and the thickness of glacial drift is insufficient to obscure the bedrock topography. Consequently, the ground-moraine surface in eastern Medina County is controlled by the underlying bedrock surface, which is quite steep or hilly in places. The surface till of the ground moraine over all but the southeastern part of the county is the Hiram Till, in which somewhat poorly drained soils are developed. The slightly older Hayesville Till is at the surface in the southeastern part of the county, and the soils are better drained.

#### LATE-GLACIAL AND POSTGLACIAL LAKES

##### Chippewa Lake

One of the largest natural lakes in northern Ohio is Chippewa Lake, long a popular resort. The lake presently is

1.2 miles long and 0.6 mile wide. Its surface elevation is maintained at 986 feet by a small spillway constructed at its southern end. Chippewa Lake is the only survivor of a larger lake or series of lakes that occupied a 7-mile-long valley in eastern Lafayette and Westfield Townships. Several prominent end moraines bend sharply southward where they cross the valley, which was dammed in three places to create the lakes. Chippewa Lake is situated between two elements of the Fort Wayne Moraine, which nearly encircle the lake and provide the higher ground on the east side on which several villages are located. A large bog of about 200 acres at the south end of the lake was a part of the lake until recent times.

The Chippewa Lake basin probably was occupied by an ice block during the Woodfordian glaciation and thereby escaped being filled by outwash during glacial retreat. The resulting kettle hole must have been fairly deep for Chippewa Lake to remain a lake, unlike most other kettles in northeastern Ohio, which are now completely filled.

##### Garden Isle Lake

Garden Isle Lake (now a bog) occupied a large, nearly circular depression at the confluence of the buried valleys of East Fork Black River and Killbuck Creek south of Lodi. The valleys were blocked and encircled by the Wabash, Fort Wayne, and New Washington Moraines to form a large lake, which is now filled with sediment to a level that drains southward in Little Killbuck Creek. Garden Isle Lake received some sandy outwash from melting ice, but in its last stages the lake stagnated and filled with peat. Inasmuch as the total sediment thickness in the valley is more than 200 feet, only the latest stages of bog history are known from the shallow drainage-ditch exposures. A drainage ditch 0.8 mile south of Lodi exposed peat 6 feet thick partially filling a shallow depression (kettle?) in gravel (fig. 8). A pitted outwash plain is evident as a gravel terrace at elevations between 910 and 920 feet. Below 910 feet the terrace is covered with peat of variable thickness. The gravel exposed probably dates from the Woodfordian glaciation and the peat is either late glacial or postglacial.

##### Lake Spencer

Lake Spencer is the name given to the short-lived late-glacial lake in the valley of East Branch Black River. This valley is blocked by the New Washington and Defiance Moraines at Lodi, and drainage in the valley has been diverted northward. Highway bridge borings indicate that

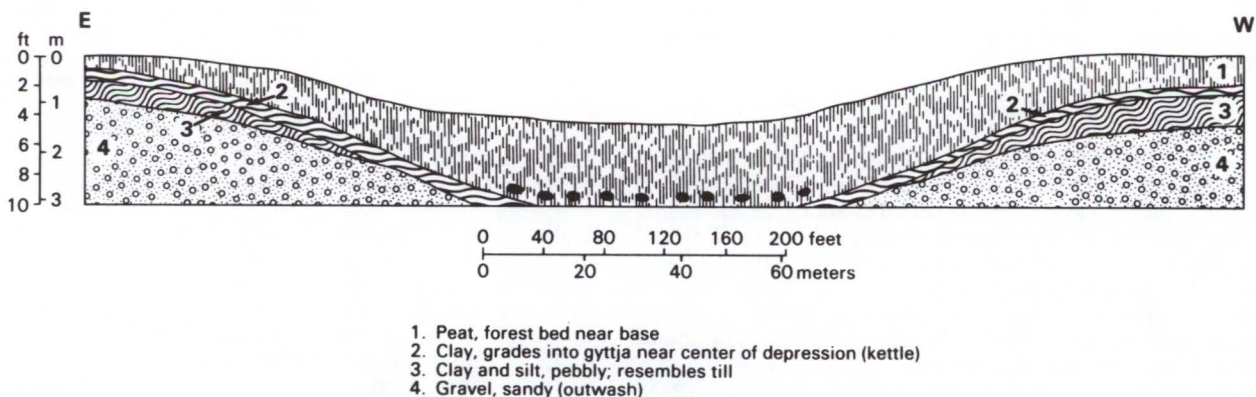


FIGURE 8.—Sketch of glacial deposits exposed in drainage ditch west of Garden Isle Road in Garden Isle Bog, 1 mile south of Lodi, in Harrisville Township.

the silt, sand, and gravel are more than 75 feet thick in this valley; thus the surface materials represent only the latest episode of glaciation.

Woodfordian ice dammed the reversed northward flow of East Branch to form Lake Spencer, which in its early stages had a surface elevation of about 900 feet. The lake was controlled by a natural spillway over the moraines near Lodi, and water must have drained periodically into Garden Isle Lake. Lake Spencer, as evidenced by the distribution of lake deposits (pl. 1), ranged in width from 1 to 1.5 miles and was at least 7 miles long. The lake sediments consist mainly of clay and silty clay as much as 6 feet thick overlying sand and gravel. The Caneadea, Fitchville, and Glenford soils have been derived from these clayey sediments, and Haskins and Rawson soils are derived from silty materials near the lake margin (Hayhurst and others, 1977). The lake deposits reach a maximum elevation of 905 feet in the south in Chatham Township, 880 feet in the River Corners area, and 860 feet in the north near the Medina-Lorain County line. Evidently the elevation of the lake was lowered by down-cutting of the outlet near Lodi during ice retreat, and by the time Medina County was ice free very little water was left in Lake Spencer.

#### GLACIOFLUVIAL DEPOSITS

A considerable amount of sorted and stratified sand and gravel was deposited by glacial meltwater streams in Medina County. These sand and gravel deposits occur in several distinct landforms including kames, kame terraces, eskers, and outwash valley trains. Kames are conical hills formed when sand and gravel are washed from glacially entrained debris (till) into cavities in the ice or into reentrants along the edge of the melting glacier. Subsequent melting of the ice resulted in collapse and slumping of the bedded material to form kames. In places, masses of unsorted debris (till) were deposited along with the sand and gravel to form a kame moraine. Kame terraces consist of sand and gravel deposited along valley margins by meltwater streams flowing between the valley walls and stagnating ice remaining in the center of the valley. When the ice in the valley melted, hummocky deposits resembling kames remained along the valley sides. Kame terraces may exhibit diverse topographical forms including chains of kames, kame deltas, valley-train segments, and kettles. Kettles, also termed kettle holes, are depressions which formed when buried ice blocks melted; they are typically associated with glaciofluvial deposits. Eskers are sinuous (meandering) ridges of sand and gravel deposited by streams flowing on top of or beneath the ice at or near the ice margin. The sand and gravel represent material deposited along the bed of a stream which was confined by ice walls. Subsequent melting of the ice exposed a ridge of sand and gravel in the configuration of the former stream channel. Eskers may also form as "elongated kames" when supraglacial streams near a stagnating ice margin deposit sand and gravel in a reentrant which is retreating. This type of esker resembles a string of connected kames.

Valley-train outwash consists of silt, sand, and gravel deposited in valley bottoms by meltwater streams flowing away from the ice margin. The end moraines and kames in Medina County, deposited primarily by Millbrook ice, effectively blocked large segments of the major valleys and ponded much of the drainage. Consequently, much outwash from the melting of Woodfordian ice was deposited in the broad valley depressions, and finer grained silts and clays were deposited as lacustrine sediments in the ponded valleys. The stratigraphy in these buried valleys, as deter-

mined from water-well records, is varied and complex; the surface material may be thin and quite different from the material below (see figs. 17, 18). Postglacial stream erosion has removed much of the valley-train material; the remnants of valley-train surfaces are terraces along valley sides. Valley-train terraces may be distinguished from kame terraces by their flat surfaces and by their position farther down the valley sides.

Distinctive soils are derived from the various types of glaciofluvial deposits, provided the deposit is not covered with more than a couple of feet of till. Chili, Fitchville, and Bogart soils are derived from sandy, gravelly parent material associated with eskers, kames, and kame terraces; Haskins, Jimtown, Glenford, and Fitchville soils are derived from sandy, silty valley-train material (Hayhurst and others, 1977). Carlisle, Luray, and Lorain soils are derived from silty, clayey, and organic-rich lacustrine sediments. Figure 9 shows the general distribution of soil associations in Medina County.

#### Kames and kame terraces

*Coddingville-Granger Lake kames and kame terraces.*—A complex series of kames and kame terraces occurs in and near an intricate buried-valley system in Granger Township. The southernmost kame, 1 mile south of Coddingville, is the site of a gravel pit in which coarse cobbly gravel 20 feet or more thick is overlain by 6 feet of Millbrook Till. Most of the other gravelly deposits are arranged in a sinuous, hummocky ridge, which may be an esker, about 1.8 miles long. This eskerlike feature trends north-south through Coddingville on either side of Ohio Route 18. A few kames are associated with the central segment of the esker at Coddingville, and three gravel pits, now abandoned, have been located in the esker.

The kames around Granger Lake contributed significantly to the plugging of the valley system. The largest kame in the county, 0.25 mile in diameter and 80 feet high, is located north of the junction of Allard Road and State Road. A small pit in the kame exposed coarse rubbly gravel 10 feet thick covered with thin silt and till. Other nearby kames containing gravel occur over an area of about 2 square miles, and several kettles as much as 0.25 mile in diameter are intermixed with the kames. At least three pits in the smaller kames exposed rubbly gravel overlain by Hayesville Till. The till covering is of variable thickness and the actual distribution of gravel may be more extensive than shown on plate 1. The gravel is of probable Navarre age and is not of good quality owing to a high concentration of sedimentary-rock fragments such as clay-ironstone concretions.

Just northwest of the Granger Lake kames are masses of mostly small kames on both sides of the arcuate valley occupied by Granger Ditch. The kames and kame terrace along the north side of the valley can be traced from near the Interstate 71-Ohio Route 606 interchange southeastward for 6 miles. The terrace is as much as 0.4 mile wide, and its southeastward slope is opposite the present direction of drainage. Poorly sorted gravel is exposed in a small pit in the terrace along the east side of Stony Hill Road and south of Granger Ditch. The terrace is covered with till in places as evidenced by patches of somewhat poorly drained Ellsworth soil mapped on the terraces (Hayhurst and others, 1977).

*Wolf Creek kames.*—A mass of low, subdued kames nearly plugs the Wolf Creek valley in Sharon Township at the Medina-Summit County line. Several gravel pits, most of them located in Summit County, have been operated in this

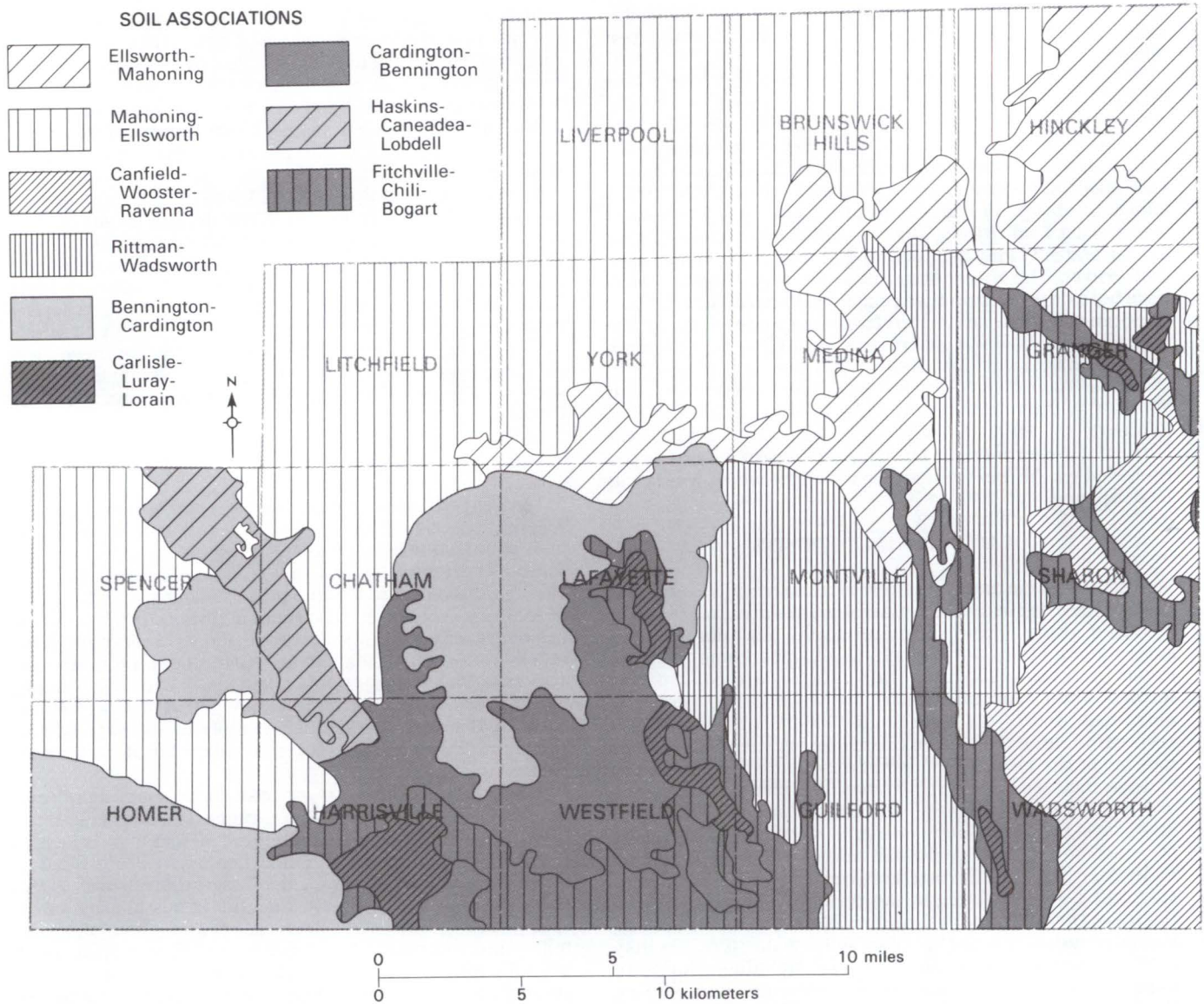


FIGURE 9.—Generalized distribution of soil associations in Medina County (from Hayhurst, Milliron, and Steiger, 1977). Soil associations may include many individual soils.

kame complex. In a gravel pit 300 yards east of the Medina-Summit County line, coarse stony gravel 15 feet thick overlies stony gray Millbrook Till, which in turn overlies gravel known from drilling records to be at least 30 feet thick. The upper gravel probably is of Navarre age, whereas the lower gravel likely is of Millbrook age.

*River Styx kame terrace.*—The wide valley of River Styx in the southeastern part of the county has been plugged by moraines in Montville Township, thereby burying kames that might have existed in the northern part of the valley. A kame terrace is located against the steep, rocky west valley wall. The narrow terrace averages about 300 yards in width and can be traced continuously from just north of Fixler Road for 6 miles to the Medina-Wayne County line. The terrace is covered with thin till in many places. Borings along I-76 indicate the gravel beneath the till may attain a thickness of 20 feet. The gravel is coarse, poorly sorted, and contains large slabs of local sandstone bedrock. In a gravel pit west of Mennonite Road 1.2 miles south of I-76, the

gravel is 12 to 16 feet thick and is overlain by as much as 4 feet of Hayesville Till. Two or three terrace remnants are present along the east side of the valley; these terraces also are till covered except near the county line. The gravels are at least as old as the Navarre ice advance and may be older than Navarre.

*Hubbard Creek kame terrace.*—A kame terrace extends 4 miles along the east side of Hubbard Creek in western Guilford Township. The terrace ranges in width from 100 yards to 0.4 mile and slopes southward from an elevation of 1,090 feet in the north to 1,000 feet at the Medina-Wayne County line. The terrace surface is gently hummocky with a few kamelike knolls evident. A boring where I-76 crosses Hubbard Creek indicates a minimum gravel thickness of 12 feet, and exposures along Hubbard Valley Road indicate gravel at the surface. This terrace is likely of Navarre age, although Millbrook gravel may occur at depth.

*Lodi kames.*—The largest kame complex in Medina County is in an east-west buried valley traversed by Camel

Creek and Little Killbuck Creek in Harrisville and Westfield Townships southeast of Lodi. This tract of kames is about 4 miles long and 1 mile wide and has been extensively mined for sand and gravel for over 80 years. Prior to the era of mining, numerous well-formed kames as much as 40 feet high covered an area about 3 miles by  $\frac{1}{2}$  mile, as indicated on the 1906 Medina 15-minute U.S. Geological Survey topographic map. The edges of some kames still remain and have a covering of Hiram and Hayesville Till as much as 12 feet thick. Numerous pits in recent years have exposed as much as 40 feet of sand and gravel of kame origin beneath the aforementioned excavated kames (see figs. 17, 18). Millbrook Till occurs as lenses within the sand and gravel and as much as 40 feet of Millbrook Till is found on the lower flanks of the older kames. Much of the thick till covering is part of the St. Johns Moraine, which was deposited during and after deposition of the older kames. At least two generations of kames and probably three (two Millbrook episodes and one Navarre) are indicated by the stratigraphic evidence in this area. Tracing the lateral extent of the kames is difficult because of the till cover of the St. Johns Moraine in the central and eastern part of the kame complex, and of the Wabash Moraine in the western and northwestern part. Numerous kettles, some of which contain postglacial peat and muck, occur within the kame complex.

*Other kames.*—A few small kames are present in the valley of West Branch Rocky River near Hardscrabble, in Liverpool Township. Poorly sorted gravel overlain by Hayesville and Hiram Tills has been excavated in small amounts in several places. Several small kames are covered by till in the valley of East Branch Rocky River in Hinckley Township. Poorly sorted gravel at least 10 feet thick is exposed in these kames. Sandy kames are present in the valley of East Branch Black River in Spencer Township. A few other kames, some of them too small to show on plate 1, occur in Medina County, mostly within the major valleys. It is probable that kames buried beneath thick till were not detected in this study. Likely areas of undetected kames are in areas mapped as gravelly moraine (pl. 1).

#### Valley-train outwash

*River Styx valley train.*—A valley train as much as 1.5 miles wide extends for about 8 miles in the valley of River Styx from eastern Montville Township southward to the Medina-Wayne County line. The elevation of the terrace ranges from about 1,030 feet at its head to 960 feet at the county line, a gradient of 9 feet per mile. The valley-train surface is relatively featureless except for several morainic knolls and till-covered kames that project above its surface. Shallow depressions or kettles, which mark the position of Woodfordian ice blocks buried in outwash, are common in the valley. These kettles have been filled or are nearly filled with silt, clay, and peat of lacustrine and swamp origin. Several of these areas currently are swampy. Exposures of sediment in the valley are almost nonexistent, and borings have revealed a complex mixture of clay, silt, sand, and gravel in the upper 50 feet of valley fill. The predominant soil developed in the terrace materials is Fitchville silt loam; Chili, Bogart, and Jimtown soils also are widespread (fig. 9). The outwash at and near the surface is of Woodfordian age and relatively little is likely to be of commercial quality or quantity. Pre-Woodfordian outwash most likely occurs at depth in the valley and may have economic potential, particularly as a source of ground water.

*Chippewa Creek valley train.*—A narrow outwash terrace bordering both sides of the valley of Chippewa Creek

can be traced for about 10 miles from central Lafayette Township south-southeastward to the Medina-Wayne County line. Most of the valley bottom consists of lacustrine deposits of an ancestral Chippewa Lake; only in the vicinity of Seville near the county line does the outwash extend across the present valley floor, which exceeds 1 mile in width. A large ice block about 7 miles long and possibly covered with outwash is thought to have existed in the valley during Woodfordian time; the lake basin was formed by melting of the ice following glacial retreat. The deepest part of this basin is occupied by present-day Chippewa Lake. Outwash probably was deposited on and adjacent to the ice block, and some of the outwash which formed on the ice now is at a lower elevation than when it was deposited. Terrace elevations range from 1,020 feet at the head to 980 feet at the county line, a gradient of 4 feet per mile. The terrace remnants on the west side and in the center of the valley are at lower elevations than those on the east side of the valley, probably because of lowering during melting of valley ice. Silty sand, silt, and silty clay are exposed in shallow cuts in the terrace. The predominant soils developed in the silty materials are Jimtown, Bogart, and Glenford.

Hubbard Creek, a small tributary of Chippewa Creek at Seville, has a narrow terrace about 2 miles in length.

*Killbuck Creek/Camel Creek valley train.*—The very wide buried valley south of Lodi (fig. 3) was occupied by a large ice block during Woodfordian time. This block subsequently melted to form the depression known as Garden Isle Bog. Surrounding this bog are outwash deposits of Woodfordian age. These outwash deposits are most extensive in the valley now occupied by Killbuck Creek and its tributary, Camel Creek, east of the bog. Only small, narrow terrace segments are present in the upper reaches of Camel Creek, and much of the valley occupied by the lower reaches of Camel Creek and by Killbuck Creek is a complicated array of kames, kettles, and morainic knolls. Terrace elevations range from 1,080 feet along Camel Creek in northwestern Westfield Township to 950 feet at the Medina-Wayne County line. The terrace remnants fringing the bog are lower, ranging in elevation from 900 to 940 feet. The outwash west of the bog apparently is a delta built by Clear Creek and West Fork prior to their diversion northward to East Branch Black River.

*Wolf Creek valley train.*—An outwash terrace as much as 0.8 mile wide borders both sides of Wolf Creek in Sharon Township for 4.5 miles from Beach Road southeast and east to the Medina-Summit County line. The elevation of the terrace ranges from about 1,070 feet at its head to 1,020 feet at the county line, a gradient of 11 feet per mile. Silty gravel is exposed in shallow cuts in the terrace, and the predominant soils developed in the silty materials are Jimtown and Bogart. A few areas of Chili soils mapped on the terrace may represent coarser gravels; however, these gravels probably are thin and likely do not represent commercial quantities. A tributary of Wolf Creek north of Sharon Center also exhibits terrace development.

*Silver Creek valley train.*—A small area of outwash about 1 mile long and as much as 0.4 mile wide is present at the head of Silver Creek just southeast of Wadsworth. The elevation of this valley train is 1,050 to 1,065 feet.

#### Alluvial terraces

The modern drainage in northern Medina County is northward (fig. 5) to Lake Erie, principally by means of East Branch Black River and East Branch and West Branch Rocky River. The present drainage was established primarily

following the Illinoian?-early Wisconsinan Millbrook glaciation as a result of two conditions: (1) blocking of major southeast-trending valleys by prominent end moraines trending southwest-northeast across the central part of the county, and (2) crustal depression in the Erie Basin by Millbrook ice for a considerable period and creation of a northward tilt, thereby allowing streams to flow northward. Northward drainage in northern Medina and Lorain Counties became so well established following the Millbrook glaciation that streams were able to keep pace with glacio-isostatic rebound and the lowering of lake levels in the Erie Basin.

Northward-sloping terraces in two levels are present in the valleys of major northward-flowing streams. These terraces are not truly outwash terraces typical of the southeastward-flowing meltwater streams of southern Medina County. Instead, these terraces represent floodplains cut by streams that had base levels higher than present and determined by levels of ancestral Lake Erie during the Plum Point Interstade (see table 1). The streams responsible for the terraces had gradients of about 10 feet per mile and remained at stable base levels for sufficiently long intervals for extensive lateral cutting to occur.

These terraces formerly were veneered with thin deposits of sand and gravel. However, the present terrace surface is the result of modification of the original surface by both ice and water. In places the terraces have a hummocky appearance, which is the result of the deposition of thin till on the terraces during the Woodfordian glaciation. Proglacial lakes occupied the valleys during retreat of the Woodfordian glaciers and lacustrine silt and clay were deposited on the terraces. Postglacial streams occupied the lower terrace for a few hundred years during the high lake stages in the Erie Basin immediately following deglaciation. Lake levels in the Erie Basin dropped below the present average lake elevation of 571 feet about 12,500 years ago, resulting in a new cycle of stream erosion. The modern streams flow in narrow valleys entrenched into the former floodplain, portions of which still remain as terraces.

*East Branch Black River alluvial terraces.*—Alluvial terraces in the valley of East Branch Black River extend from just northwest of Lodi to the Medina-Lorain County line, a distance of 9 miles. The valley of East Branch is poorly defined, and numerous short tributaries have dissected the terraces. In addition, the clayey deposits of Lake Spencer (pl. 1) occupy much of the valley bottom, which was originally a terrace surface.

The higher terrace is best developed about 3.5 miles north-northwest of Lodi, where it is about 0.5 mile wide and 2 miles long with an elevation of 900 to 920 feet. Farther north, the position of the upper terrace is occupied by the lacustrine deposits of Lake Spencer, which mantle the valley surface at elevations below 900 feet. The higher terrace surface is mantled in places by Navarre and younger tills, but much of the surface material is gravelly and gives rise to Chili, Bogart, Jimtown, and Fitchville soils. The higher terrace surface correlates with the higher terrace in the same valley 9 miles northwest in Lorain County (Totten, in preparation) at an elevation of 815 feet, for a gradient of 10 feet per mile.

The lower terrace consists of numerous small segments on either side of East Branch and can be traced from Lodi northwestward to the Medina-Lorain County line. Individual terrace segments range in width from a few feet to 0.4 mile or more northwest of Spencer Lake and are as much as 0.75 mile long, although most are considerably shorter. Terrace elevations range from 900 feet at Lodi to 850 feet near River Corners and 825 feet at the Medina-Lorain

County line, for a gradient of 8 feet per mile. The lower terrace shares the valley bottom with lacustrine deposits of Lake Spencer. However, drainage was reestablished while ice still remained a short distance north in the Erie Basin, and additional alluvium was deposited on the terrace surface. Silty and sandy alluvium, from which Fitchville, Lobdell, and Rawson soils are derived, is at the surface over most of the lower terrace. The alluvial sediments underlying the terrace generally are only a few feet thick, and older materials such as till may be encountered in shallow excavations.

*West Branch Rocky River alluvial terraces.*—Alluvial terraces in the valley of West Branch Rocky River extend from southeast of Medina for about 14 miles to the Medina-Lorain County line. Alluvial terraces also are present in several tributaries of West Branch, including North Branch, Plum Creek, and Granger Ditch. Very few remnants of the older and higher of the two terraces still remain. At Weymouth, in the North Branch valley, a small terrace remnant has an elevation of between 1,010 and 1,020 feet; Chili soils are developed in the gravelly materials that underlie the terrace. Chili soils also are mapped where the higher terrace is preserved northwest of Abbeyville in the West Branch valley. Two high terrace remnants, the larger covering about 100 acres, are present 1 mile north of Hardscrabble near the Medina-Lorain County line at an elevation of 820-830 feet. Like the other high terrace remnants, gravelly Chili soils are developed in these terrace remnants.

The lower terrace is much better preserved and can be traced almost continuously for about 10 miles in the valley of West Branch Rocky River. The earlier stream which shaped the valley and formed the terraces had a complex meandering pattern resulting in scalloped valley walls. The modern stream, with its narrow floodplain, meanders across the lower terrace but has not removed much of it. The valley, and thus the lower terrace, widens northward, reaching widths of 0.8 mile at Valley City and 1 mile at Hardscrabble. The lower terrace elevation is between 1,040 and 1,050 feet at Weymouth, 900 feet northeast of Medina, 815 feet at Valley City, and 800 feet at Hardscrabble, for an average gradient of 18 feet per mile. The sediment underlying the lower terrace generally is fine-grained gravel, sand, silt, and clay in which Jimtown and Fitchville soils are developed. The lower terrace surface is nearly flat and numerous structures, including the villages of Valley City and Hardscrabble, have been built on it.

The alluvial terrace in the Plum Creek valley is 0.8 mile wide at its upper end and 3 miles long. The terrace is hemmed in at its southern end by an end moraine. Gravel and silty sand are exposed in shallow cuts in the terrace.

Alluvial terraces about 1.5 miles long are present on both sides of the Granger Ditch valley in northwestern Granger Township. The terraces attain an elevation of 1,050 feet along the valley wall and merge with the modern alluvium near the center of the valley at elevations below 1,040 feet.

The alluvial sediments underlying the terraces in West Branch and its tributaries generally are only a few feet thick, and bedrock or till may be encountered in shallow excavations. Both terrace levels, which differ in elevation by about 20 feet, are thought to be cut terraces graded to earlier Lake Erie levels of between 775 and 800 feet.

*East Branch Rocky River alluvial terraces.*—East Branch Rocky River in Hinckley Township occupies an old valley that is deeply incised into bedrock. The valley now is partially filled with over 400 feet of drift, but the steep upper valley walls remain as ledges that enclose the present valley floor, which exceeds 1 mile in width. A series of end

moraines plugs the valley southeast of Hinckley Lake, and drainage has been diverted northward.

Two levels of alluvial terraces may be traced from the vicinity of Hinckley Lake north-northwestward for about 4½ miles to the Medina-Cuyahoga County line, where they continue northward into Cuyahoga County. Both levels of terrace are covered with thin Hayesville and Hiram Till in many places, and alluvial sediment is at the surface primarily on the lower terrace.

The higher terrace is as much as 0.5 mile wide on either side of Hinckley Lake and narrows northward as the valley itself narrows. The terrace has been dissected by many steep, short tributaries of East Branch. Ellsworth and Mahoning soils developed in clayey Hiram Till predominate on the high terrace (Hayhurst and others, 1977); a few scattered patches of Rawson and Chili alluvial soils also are present. The elevation of the higher terrace is about 990 to 1,020 feet near Hinckley Lake and decreases northward to about 900 feet at the Medina-Cuyahoga County line, for a steep gradient of about 24 feet per mile.

The lower terrace is narrower than the upper terrace and is best preserved along the eastern side of East Branch. The terrace is relatively flat, ranges in width from 1,000 to 2,000 feet, and is covered by thin clayey till in many places. Fitchville and Sebring silty loam soils, which generally develop in lacustrine deposits, predominate on the lower terrace (Hayhurst and others, 1977), an indication that a small shallow lake may have existed for a short time in the valley during the last ice retreat. The elevation of the lower terrace ranges from 910 feet at the north end of Hinckley Lake to 855 feet at the Medina-Cuyahoga County line, for an average gradient of 14 feet per mile.

## PLEISTOCENE STRATIGRAPHY

The glacial deposits of Ohio are the result of several ice advances during the Pleistocene or Glacial Epoch. Ice accumulated far to the northeast in eastern Canada in the general area of Labrador and spread out laterally in all directions. A portion of this ice advanced southwestward into the Lake Erie basin as a major tongue known as the Erie lobe. As the Erie lobe advanced into northern Ohio and northwestern Pennsylvania, it spread southward into lowlands and subdivided, from east to west, into the Grand River, Cuyahoga, Killbuck, Scioto, and Miami sublobes (fig. 10), hereafter referred to as lobes.

Glaciation in Medina County resulted from southward expansion of the Killbuck lobe. At least three ice sheets invaded the county in later Pleistocene time and an unknown number of advances occurred in earlier Pleistocene time. All of the glacial deposits at the surface and in most shallow cuts in Medina County are of the Wisconsin Stage, the latest stage in glacial history (table 1). Much of the glacial materials in the subsurface exposed in deep cuts are of uncertain age; the materials may be of the Illinoian Stage or possibly early Wisconsin. It is probable that even older Pleistocene deposits are deeply buried beneath Wisconsin and Illinoian deposits, primarily in buried valleys. These older deposits are known only from drilling records.

Till deposits of the several ice advances are sufficiently distinctive to be distinguished where they are exposed (see fig. 17). It is to be expected that, in any very large exposure showing considerable thickness of glacial material, the material will have been deposited by more than one ice advance, and the layers will differ more or less in character. The till deposited by an individual ice advance commonly is very thin; the Hiram, the last ice sheet to invade all except

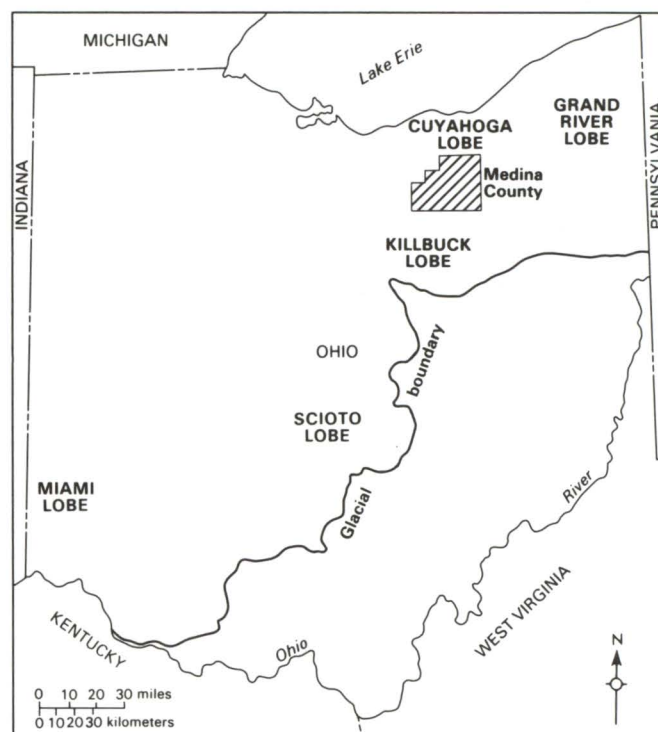


FIGURE 10.—Glacial boundary and glacial lobes in Ohio and position of Medina County.

the southeastern corner of the county, may have deposited little or no till in some places, so that the surface till is not Hiram, but the earlier Hayesville Till. If the Hayesville Till is very thin, even earlier till may be evident at or very close to the surface.

## CRITERIA FOR IDENTIFICATION AND CORRELATION OF TILLS

The various tills in northern Ohio may be distinguished from one another by several criteria, including texture, mineral composition, color, and weathering characteristics. Till character is dealt with in more or less detail in several publications describing the glacial geology of northeastern Ohio counties, such as Wayne County (White, 1967), Richland County (Totten, 1973), and Ashland County (White, 1977), to cite a few. In Medina County, tills of the two latest ice advances form the surface drift, but at some places the younger tills are thin or missing and older tills are exposed at the surface. Older tills may be exposed in a few ravines and river valleys where postglacial erosion has removed the younger tills. Till is thickest in the belts of end moraine (pl. 1) and thinnest on the uplands adjacent to the morainic belts.

### Texture

Tills in northern Ohio range from quite sandy tills with relatively low clay content to clayey tills with a low sand content. The texture (grain size) of each till is reasonably constant over a large area. The tills at the surface in Medina County are clayey or silty, but some sandy till is found below these fine-grained tills. In the southeastern corner of the county, particularly Wadsworth Township and portions

TABLE 1.—*Glacial stages and deposits in Medina County*

Epoch	Stage	Substage	Unit or interval	Deposit in Medina County	Approximate dates (years B.P.)		
Pleistocene	Wisconsinan	Late	Woodfordian	late-glacial and postglacial	alluvium, peat, loess, lacustrine silt and clay	15,000	
				Hiram Till	dark-brown clayey silty till		16,000
				Hayesville Till	dark-brown silty clayey till		
				Navarre Till	dark-yellow-brown silty pebbly till		17,500
	Wisconsinan	Middle	Farmdalian	ice retreat (Plum Point Interstade)	stony paleosol, alluvial terraces	24,000	
				ice retreat	stony paleosol		32,000
	Wisconsinan	Early	Altonian	ice retreat	stony paleosol	60,000	
				Millbrook Till <sup>1</sup>	olive-brown silty stony till (several units)		
	Pleistocene	Sangamonian		ice retreat	unknown	80,000	
				ice retreat	unknown		130,000
Millbrook Till <sup>1</sup>				olive-brown silty stony till (several units)			
Pleistocene	Illinoian		ice retreat	unknown	350,000		
			Millbrook Till <sup>1</sup>	olive-brown silty stony till (several units)			
Pleistocene	Pre-Illinoian		ice retreat	unknown	350,000		
			not exposed	probable till, outwash, and alluvium in buried valleys			

<sup>1</sup>Age of Millbrook Till is uncertain. All units may be Wisconsinan, all may be Illinoian, or some may be Wisconsinan and some may be Illinoian.

of Sharon and Guilford Townships, the silty till at the surface is generally thin, and coarser till may be at the surface in some places.

#### Mineral composition

Tills differ in content of quartz, feldspar, and carbonate minerals. The mineral composition of tills in northeastern Ohio, including Medina County, has been the subject of earlier studies by Totten (1960) and Heath (1963). These studies indicate that the quartz content of tills ranges from 65 to 89 percent, being highest in the oldest tills; the feldspar content ranges from 11 to 35 percent, being highest in the youngest tills; and carbonate content (calcite and dolomite) ranges from 5 to 21 percent.

#### Color

The color of till is a subtle but very useful physical characteristic in till identification. At almost every thick till section, two dominant colors may be seen: brown where the till is oxidized and gray where the till is unaltered; the boundary is commonly 8 to 12 feet below the surface. The

original gray color is due primarily to ferrous iron; oxidation to ferric iron gives the till a brown color, the shade of which is characteristic and consistent for each till. The oxidized tills (Hiram, Hayesville) at the surface of Medina County are generally dark brown, tending toward chocolate brown, whereas the older, subsurface tills (Navarre, Millbrook) are yellow brown to olive brown.

#### Weathering characteristics

In the weathering of till, the first minerals to be altered are the iron-bearing minerals, especially pyrite. These minerals are oxidized, furnishing the brown color to the weathered till. The carbonate minerals (calcite and dolomite) are leached, and the most resistant minerals, the silicates, are degraded. Where the upper part of a till has not been removed by erosion or the work of man, the till can be divided vertically into five distinct horizons, based on degree of weathering.

Horizon 5 is the unaltered till; the iron-bearing minerals have not been oxidized. On drillers' and engineers' records, this horizon is sometimes called "blue clay with stones," but the color is a shade of gray rather than blue. The top of

horizon 5 is generally 8 to 12 feet below the surface. In Medina County gray till may be seen in the deeper highway cuts, in gravel-pit excavations, and in the cliff sections along major streams.

Horizon 4 is calcareous till similar to that of horizon 5, except it has been oxidized to a brown color. The top of horizon 4 is also the depth of leaching, which ranges from about 2 feet below the surface in the Hiram Till to as much as 6 feet in the Navarre Till.

Horizon 3 is similar to horizon 4, except that in horizon 3 the carbonates have been leached. Iron and manganese oxide stains may be present along joints.

Horizon 2 (essentially the B<sub>3</sub> horizon of soil scientists) is the zone of decomposed till underlying the main part of the true soil. This horizon is not only oxidized and leached, but is also considerably weathered, and some of the pebbles and cobbles may have decomposed. Some clay material has accumulated in the joints, and soil-forming processes are advanced. The material is not so completely weathered, however, that it cannot be identified as once having been till. The color of the upper part generally is a mixture of buff, gray, and brown. The lower part may have dark stains along the joints.

Horizon 1 is the soil of soil scientists and is divided into the A and upper B soil horizons. The characteristics of the soil differ with drainage and slope, as well as with parent material. The soils of Medina County are described in great detail in the report and very detailed maps by Hayhurst and others (1977). Figure 9 of this report shows the general distribution of soil associations in Medina County. Figure 11 shows the weathering horizons and their idealized relationship to the till stratigraphy and landscape development in Medina County.

MILLBROOK TILL

The Millbrook Till is the oldest till—early Wisconsinan or Illinoian—in stratigraphic sections over a wide geographic area. The till was named for a village in Wayne County by White (1961, p. 71-72), who traced the deposit across

Wayne County into Medina County, mainly as a subsurface unit. The Millbrook Till does not occur at the surface in Medina County but extends over all of the county in the subsurface. In those rare places where the base of the Millbrook Till is exposed, the till rests either on bedrock or on relatively unweathered gravel. Any tills older than Millbrook in the county probably are in the deeper parts of buried valleys, where they are unlikely to be exposed.

The Millbrook Till is very firm, compact, silty, relatively sandy, and commonly stony. Unaltered Millbrook Till (horizon 5) is dark gray (2.5Y 4/1) to olive gray (5Y 5/2), whereas the oxidized till is dark yellowish brown (10YR 4/4) to olive brown (2.5Y 4/4). The depth of oxidation is relatively shallow compared with younger tills. Unaltered Millbrook Till is 3 to 14 feet below the surface depending on the geomorphic and stratigraphic conditions (fig. 11). Millbrook Till has prominent vertical joints along which oxidation extends downward for several inches into the unoxidized till. These joints commonly are coated with clay and secondary calcium carbonate. Oxidized Millbrook Till is characterized by large angular blocks which are stained reddish brown to black by iron and manganese. Rusty stains also coat most pebbles, and, as pebbles are loosened from till, rusty molds remain where pebbles formerly were located.

Analyses of Millbrook Till samples average 25 percent sand, 44 percent silt, and 30 percent clay; the liquid limit averages 23.9 and the plastic limit averages 16.8 (table 2; figs. 12, 13).

Millbrook Till is the product of more than one ice advance (White and others, 1969; White, 1982) and is closely associated with thick, high-quality gravel deposits, most notably in the Lodi area. Totten and Szabo (1985, 1987) have subdivided the Millbrook Till in north-central Ohio into six units based on mineral composition, texture, stratigraphic position, and the presence of lenses or layers of cobbles, gravel, sand, and silt between subunits. Multiple units of Millbrook Till are exposed in relatively few places in Medina County. One of the thickest exposures of Millbrook till is along I-271, 0.75 mile southwest of the Ohio Route 94

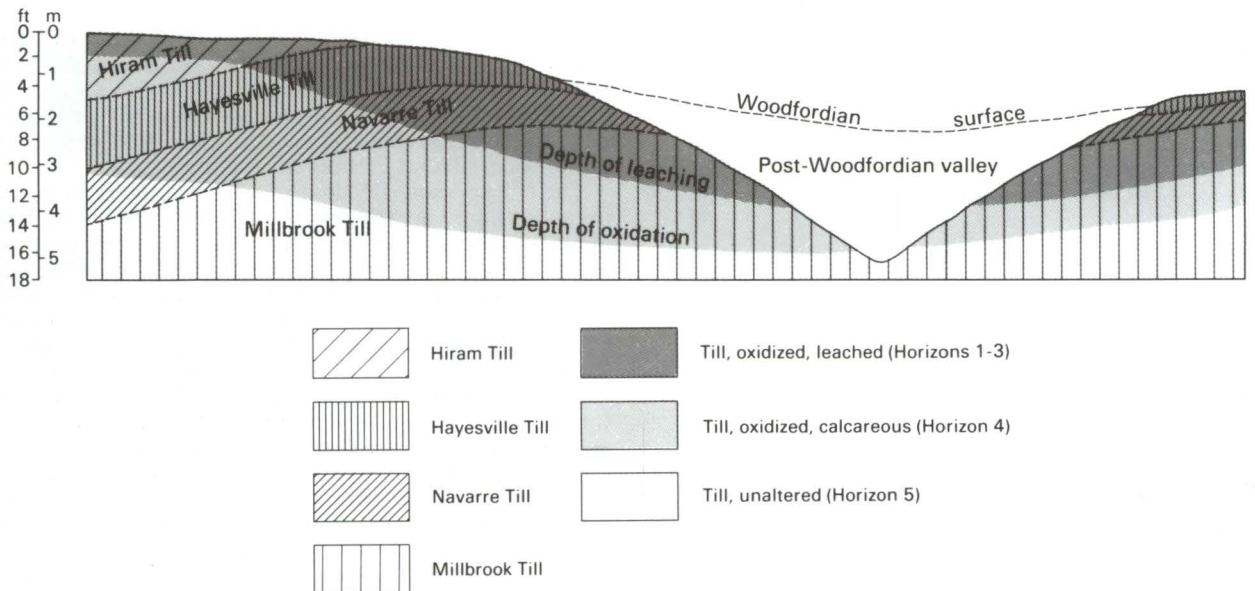


FIGURE 11.—Diagrammatic cross section showing the relationship of depth of oxidation and depth of leaching to till stratigraphy and topography in Medina County. Erosion of stream valley is postglacial.

TABLE 2.—Statistical summary of till analyses for Medina County<sup>1</sup>

Till	No. of samples	% Sand			% Silt			% Clay			Atterberg limits								
		Median	Mean	SD <sup>2</sup>	Median	Mean	SD <sup>2</sup>	Median	Mean	SD <sup>2</sup>	Liquid limit			Plastic limit			Plasticity index		
											Median	Mean	SD <sup>2</sup>	Median	Mean	SD <sup>2</sup>	Median	Mean	SD <sup>2</sup>
Hiram	45	16.0	15.9	4.0	41.3	41.3	3.6	41.9	42.7	6.2	31.0	31.3	2.8	20.0	19.7	1.2	11.0	11.6	2.0
Hayesville	105	17.3	17.7	4.4	43.1	43.1	3.7	39.1	39.2	6.0	29.0	29.1	3.1	19.0	19.1	1.6	10.0	10.0	2.0
Navarre	33	24.6	25.2	7.3	44.5	44.2	3.3	31.2	30.6	6.3	26.0	25.7	3.1	18.0	18.9	5.5	8.0	7.8	1.8
Millbrook	38	24.0	25.2	9.0	45.0	44.3	4.7	30.6	30.4	6.5	24.5	23.9	3.2	17.0	16.8	2.0	7.0	7.0	2.8

<sup>1</sup>See Appendix for sample analyses.  
<sup>2</sup>SD, standard deviation.

interchange, where 14 feet of stony, sandy Millbrook Till overlies 16 feet of relatively silty, clayey Millbrook Till. Two thin units of Millbrook Till separated by 15 to 20 feet of sand and gravel occur in the Quillin pit (see fig. 18).

Multiple Millbrook ice advances are indicated in the Baker pit (see fig. 17) by the presence of very thick Millbrook Till and related gravel which overlie an earlier gravel. This general stratigraphic pattern of Millbrook Till over gravel is

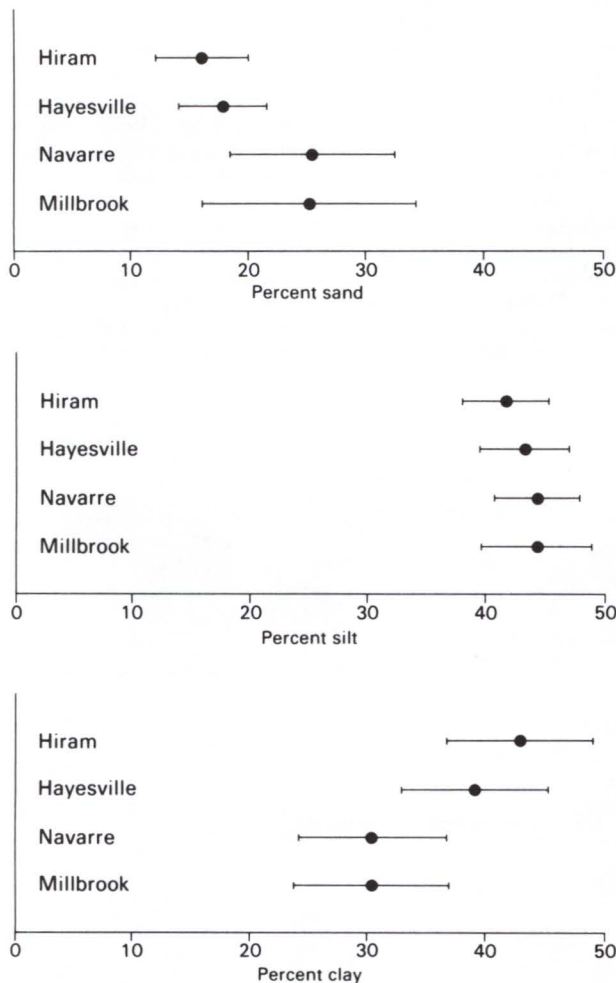


FIGURE 12.—Mean and standard deviation of sand, silt, and clay percentages for Medina County till samples. Circles represent mean, width of bar represents standard deviation.

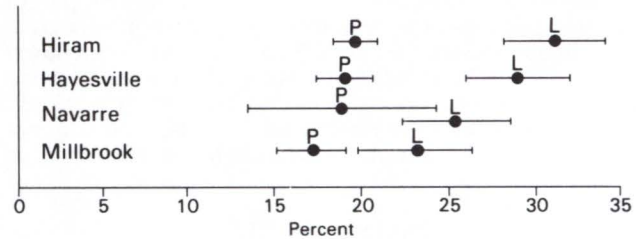


FIGURE 13.—Mean and standard deviation of plastic limit (P) and liquid limit (L) for Medina County till samples. Circles represent mean, width of bar represents standard deviation.

repeated throughout the Lodi sand and gravel district. It seems likely that the thick sand and gravel deposits which underlie the Millbrook Till, particularly in valleys, represent outwash and kames or kame terraces of an earlier Millbrook advance, and the thick till overlying the sand and gravel is the product of a later Millbrook advance.

The thickness of the Millbrook Till is difficult to measure because its base is rarely exposed. Most thickness determinations of complete sections of Millbrook Till are in areas of shallow depth to bedrock; consequently, any statistical study of Millbrook Till thickness will yield a figure considerably less than the true thickness. Thickest sections of Millbrook Till are located in interstate highway cuts through morainic knolls, where Millbrook thickness may exceed 30 feet. The Millbrook Till makes up the bulk and framework of the moraines where the stratigraphy is exposed and probably forms the bulk of all major moraines in the county.

Cobbles and boulders commonly are concentrated at the interface between the Millbrook Till and the overlying Navarre Till. Boulder pavements in Medina County are discussed on p. 25. One possible Millbrook paleosol was noted in Medina County in this study. Near Acme, west of Wadsworth, rusty weathered Millbrook Till containing thick clay flows underlies gravel and Navarre Till.

The Millbrook Till is correlative with the Mogadore Till of the Cuyahoga lobe (White, 1982) and the Titusville Till of

the Grand River lobe (White and others, 1969; White, 1982). The frequently cited radiocarbon age assignment of approximately 40,000 years before present (B.P.) (White and others, 1969) for the Titusville Till may be incorrect. Two thermoluminescence dates of about 145,000 and 125,000 years B.P. on loess overlying Millbrook Till in Morrow County (Totten, 1987) suggest that at least the older Millbrook unit(s) is Illinoian. With or without incorporation of these loess dates in the Millbrook Till chronology, a wide range of age assignments is possible. All Millbrook units may be Illinoian, all Millbrook units may be Wisconsinan, or older Millbrook units may be Illinoian and younger Millbrook units may be Wisconsinan. More data are needed before a definitive Millbrook chronology can be determined.

NAVARRE TILL

The Navarre Till, the oldest of three Late Wisconsinan (Woodfordian) tills deposited in Medina County, was named by White (1961, p. 72) for the village of Navarre in south-

western Stark County. The till can be traced at the surface and in the subsurface across western Stark County (White, 1963), Wayne County (White, 1967), and into Medina County. The Navarre Till forms a nearly continuous but thin subsurface blanket over most of Medina County.

The Navarre Till is silty, relatively sandy, moderately pebbly, loose, crumbly, and mealy. It contains numerous sand lenses that tend to slump when wet; the till commonly appears as a wet zone in road cuts. Unaltered Navarre Till is dark gray, although the till is rarely thick enough or exposed at sufficient depth to exhibit a gray color. Oxidized Navarre Till is dark yellow brown (10YR 4/4 to 4/3) in contrast to the olive-brown Millbrook Till and the chocolate-brown younger tills. Unoxidized Navarre Till may be encountered at depths of 10 to 15 feet, but the Navarre is so thin and/or so close to the surface in most places that it has been completely oxidized. A fresh exposure of oxidized Navarre Till, when struck with a pick or mattock, exhibits numerous orange spots, which are the cross sections of broken, strongly oxidized sandstone pebbles.

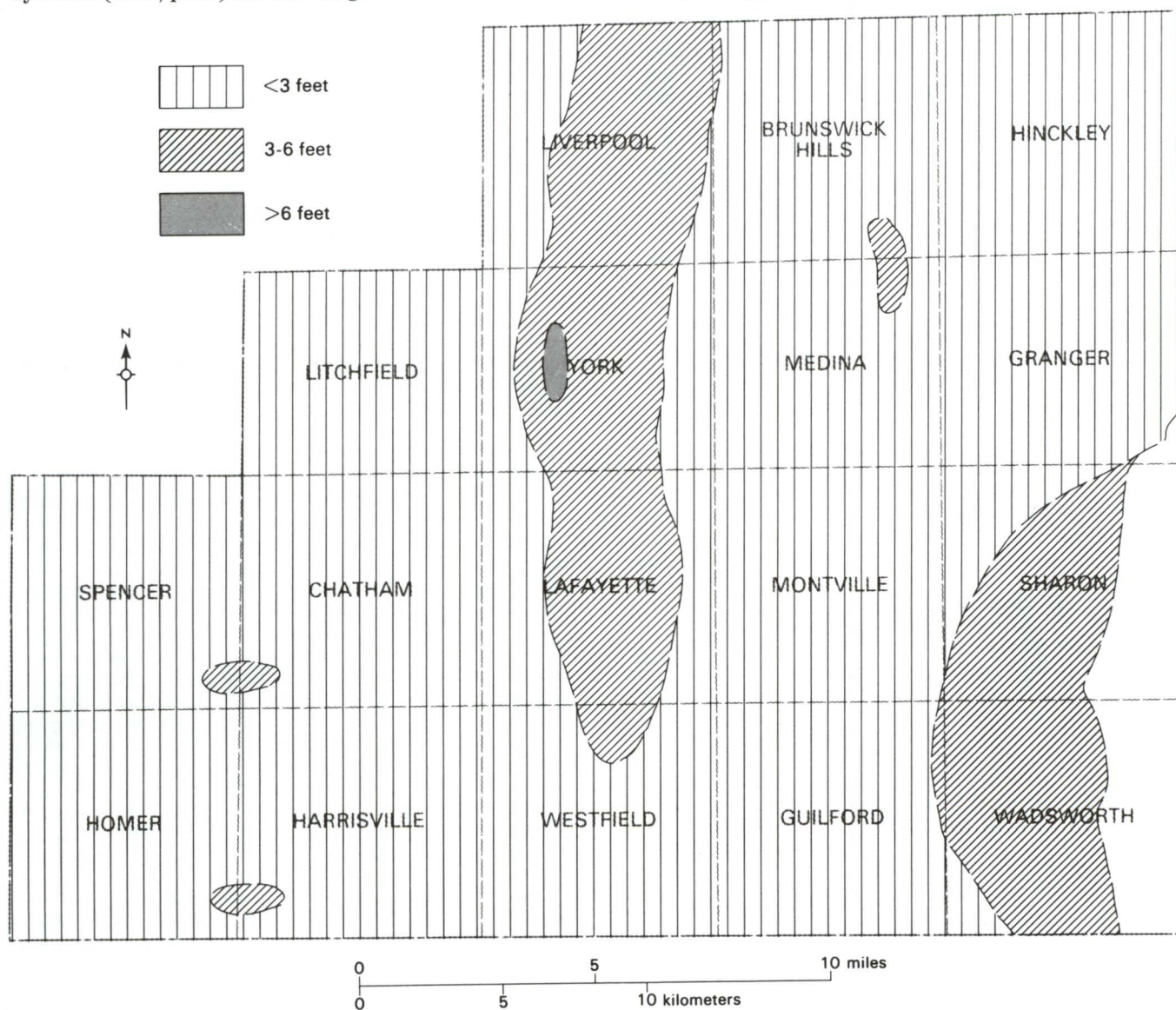


FIGURE 14.—Thickness of Navarre Till in Medina County.

The depth of leaching in Navarre Till is difficult to measure in Medina County because the till is not the surface material. In a few places where leaching has occurred primarily in thick Navarre Till overlain by a negligible amount of Hayesville Till, the depth of leaching ranges from 62 to 78 inches and averages 71 inches.

The presence of numerous sand lenses in the till coupled with the crumbly nature of the till gives the impression that the till is quite sandy. Analyses of Navarre Till samples average 25 percent sand, 44 percent silt, and 31 percent clay, the same as for the Millbrook Till; the liquid limit averages 25.7 and the plastic limit averages 18.9 (table 2; figs. 12, 13).

Navarre ice did not advance as far into Medina County as the younger Hayesville ice did; thus the outer margin of the Navarre Till in Wadsworth and Sharon Townships is buried beneath Hayesville Till. The Navarre Till generally is very thin, typically less than 3 feet thick (fig. 14; table 3). The thickest measured exposure of Navarre Till is in western York Township west of Mallet Creek, where the till is 7 feet thick. Navarre Till is 3 to 6 feet thick in two large areas of the county. One area extends as a broad north-south-trending belt in the center of the county. The other area is near the Navarre Till margin in Wadsworth and Sharon Townships. This latter area of moderately thick Navarre Till partially overlaps an area of thin (0-3 feet thick) Hayesville Till. Thus the moderately to well drained Canfield-Wooster-Ravenna soils are developed in Navarre and Millbrook Tills over much of Wadsworth and Sharon Townships even though they aren't the surface tills.

TABLE 3.—Mean thickness of tills  
in Medina County

Till	No. of measurements	Mean thickness (inches)
Hiram	81	30
Hayesville	65	60
Navarre	28	29

Considerable amounts of outwash sands and gravels are associated with Navarre Till in the major valleys in southern and eastern Medina County. These glaciofluvial deposits are discussed on p. 13-17.

The Navarre Till is correlative with the Kent Till of the Cuyahoga and Grand River lobes in eastern Ohio and northwestern Pennsylvania (White, 1961, 1963, 1967; White and others, 1969). Driftwood in lacustrine material from Cleveland, Ohio, an area that was overridden by Kent ice, has a radiocarbon age of 24,000 years B.P. (White, 1968); the Kent-Navarre ice probably reached Medina County about 23,000 years B.P.

The contact between the Navarre Till and the underlying Millbrook Till commonly is marked by a line of cobbles and boulders or by a wet gravelly zone. In places where cobbles and boulders or other coarse materials are lacking, the contact is marked by a distinct increase in the compactness or hardness of the underlying Millbrook Till.

#### HAYESVILLE TILL

The Hayesville Till was named for the village of Hayesville in southern Ashland County by White (1961, p. 73), who traced the till across parts of Ashland and Wayne Counties into Medina County. The Hayesville Till, second youngest in

Medina County, occurs throughout the county, but is at the surface only in the southeastern quarter of the county east of the Chippewa Creek valley and generally south of Ohio Route 18. The outcrop area includes most or all of Guilford, Wadsworth, Montville, and Sharon Townships.

The Hayesville Till generally is 6 feet or less thick. In a few places, such as the knolls west of Lodi in Harrisville Township, the valley of East Branch Rocky River, and northeastern Granger Township, the till attains a thickness approaching 20 feet (fig. 15). North of Medina over parts of Brunswick Hills, Liverpool, Medina, Montville, and York Townships, the thickness of Hayesville Till exceeds 6 feet. Elsewhere the till is considerably thinner; it is less than 3 feet thick in the western, northern, and southeastern parts of the county.

The Hayesville ice advanced from the north-northwest and deposited a generally continuous layer of till over all but the southeastern fringe of the county. The Hayesville Till boundary is southeast of Medina County in Wayne (White, 1967) and Summit (White, 1984) Counties. However, the Hayesville Till typically is thin and discontinuous near its outer margin; in these areas of thin Hayesville Till the soils and other characteristics of the surficial material resemble the underlying Navarre and Millbrook Tills. The boundary between continuous and discontinuous Hayesville is shown on plate 1.

The Hayesville Till is silty, clayey, sparingly pebbly, and has a blocky structure where fresh. The till is more compact or harder than the overlying Hiram Till, which it closely resembles. The Hayesville Till in places has a "cruddy" appearance, as if significant amounts of older, more weathered material had been incorporated in the till.

Unaltered Hayesville Till is dark gray and at depths of 10 to 12 feet below the ground surface. Oxidized Hayesville Till is dark chocolate brown (10YR 4/3) to ginger brown in contrast to the older yellow- and olive-brown tills below the Hayesville. The depth of leaching ranges from 27 to 60 inches, averages 41 inches, and is a useful field criterion for distinguishing Hayesville Till from the similar Hiram Till. The majority of depth-of-leaching measurements in the Hayesville Till falls into the range of 40 to 50 inches. Hayesville Till generally is massive and compact where fresh and relatively unweathered, but horizontal partings develop where the till has been exposed to weathering. These partings are commonly ½ to 1 inch apart, and the till breaks into ½- to 1-inch cubes and prisms. Secondary calcium carbonate may be concentrated along the partings and joints or fractures just below the zone of leaching.

Analyses of Hayesville Till samples average 18 percent sand, 43 percent silt, and 39 percent clay; the liquid limit averages 29.1 and the plastic limit averages 19.1 (table 2; figs. 12, 13). Rittman-Wadsworth soils, ranging from moderately well drained to somewhat poorly drained, develop in Hayesville Till where the till is more than 3 feet thick. Rittman-Wadsworth soils cover a large irregular area in southeastern Medina County (fig. 9) from Seville to Medina to Granger Lake, including much of Guilford, Montville, and Granger Townships. Cardington and Bennington soils, which are similar to Rittman-Wadsworth soils, develop in Hayesville Till which is overlain by a thin (0-2 feet) covering of Hiram Till. Cardington and Bennington soils are distributed over a fairly wide area from Medina southwestward to the county line (fig. 9). For the most part, soils developed in Hayesville Till are moderately well drained and moderately productive.

Very little sand and gravel are associated with the Hayesville Till, a situation that is likely due to relatively clean ice and an insufficient quantity of coarse material in

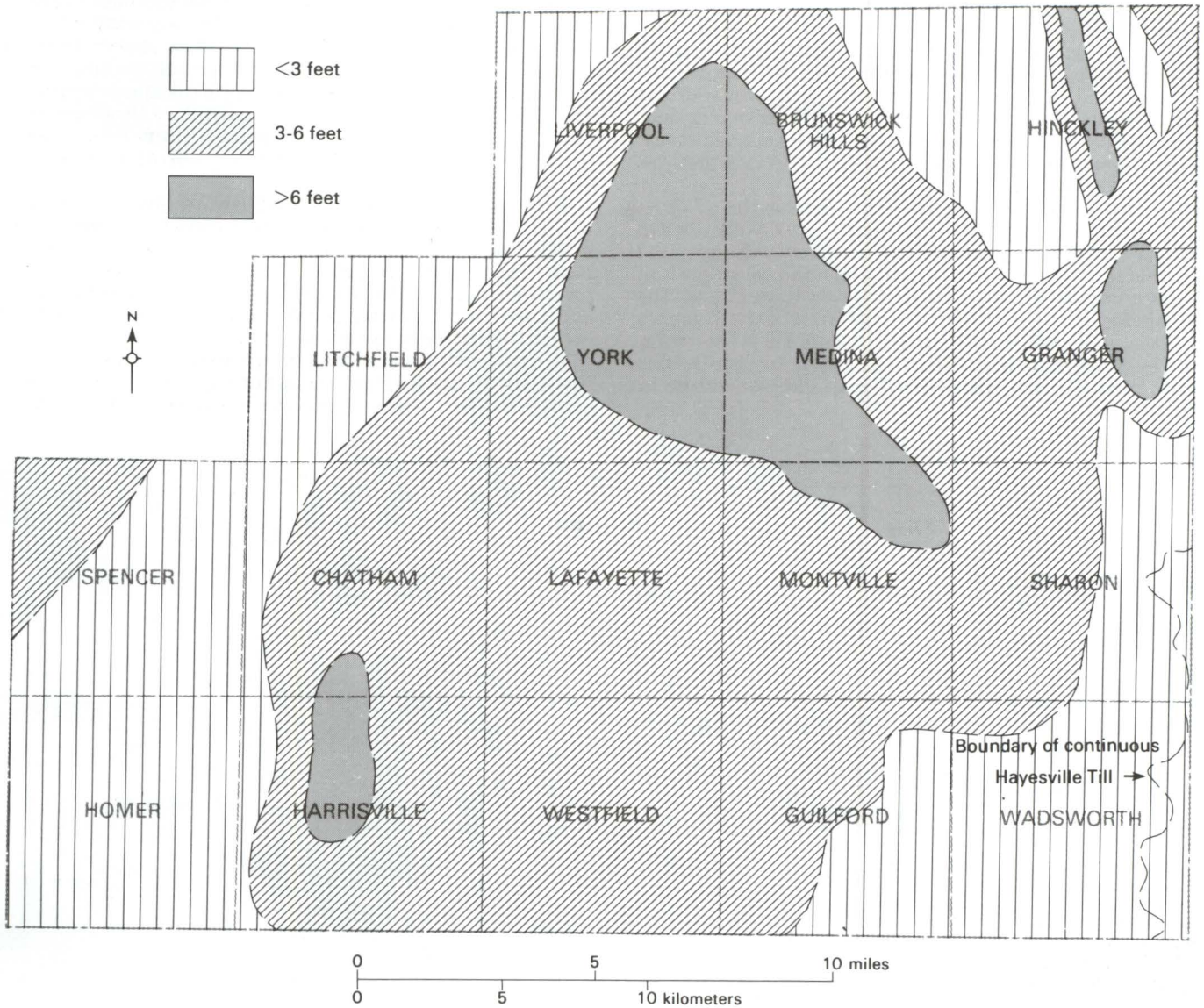


FIGURE 15.—Thickness of Hayesville Till in Medina County.

the till.

The Hayesville Till is correlative with the Lavery Till of the Cuyahoga and Grand River lobes (White, 1967, 1982). The contact of the Hayesville Till with the underlying Navarre and Millbrook Tills typically is marked by the presence of boulders, cobbles, gravel, or sand. The sand and gravel are in thin lenses 1 to several inches thick, and the zone may be marked by small springs.

The time of advance of Hayesville ice into Medina County has not been dated with certainty. Estimates of the age of the Hayesville Till have differed by several thousand years; approximate dates of 17,500 to 16,000 years B.P. (table 1) are used for Medina County in this report. Unlike the Navarre ice, which apparently advanced slowly, Hayesville ice is thought to have advanced rapidly as a surge, and thus a relatively short time may be represented by the Hayesville Till.

#### HIRAM TILL

The Hiram Till, the youngest till in Medina County, was named for the village of Hiram in northeastern Portage County by White (1960), who traced it from its type locality in the Grand River lobe south and west across Summit County into Medina County. Hiram Till is the surface material over all except the southeastern part of Medina County; the boundary extends along an irregular line from Granger Lake to Seville (pl. 1). Hiram ice likely was extremely thin, possibly less than 300 feet thick, near its outer margin and was highly sensitive to topographic irregularities. The till boundary loops southward for about 3 miles in the valleys of Granger Ditch, River Styx, and Chippewa Creek in much the same fashion as the moraines, although the till boundary does not coincide with any specific morainic element.

Hiram Till is silty, clayey, and contains very few pebbles. Analyses of Hiram Till samples average 16 percent sand, 41 percent silt, and 43 percent clay; the liquid limit averages 31.3 and the plastic limit averages 19.7 (table 2; figs. 12, 13). In places the till resembles lacustrine clay, with which it might be confused. Hiram Till is very calcareous, and secondary calcite concretions commonly form a short distance below the leached zone. The till is sticky when wet and very hard when dry.

Unaltered Hiram Till is dark gray, whereas the oxidized till is dark brown (10YR 4/3). Hiram Till sufficiently thick to preserve unaltered gray till was observed only near the intersection of I-71 and Ridgeville Road southeast of Medina; here the depth of oxidation was 10 to 12 feet. The depth of leaching in Hiram Till ranges from 20 to 35 inches and averages 26 inches. Weathered Hiram Till is characterized by uneven horizontal partings generally  $\frac{1}{8}$  to  $\frac{1}{2}$  inch apart, and the till breaks into small chunks, cubes, or prisms.

The thickness of Hiram Till ranges from 0 to more than 20 feet and averages 2.5 feet (table 3). In the northwestern half of the county the Hiram Till is 2 to 4 feet thick; however, in the low-lying areas of central Medina and northern Montville Townships, Hiram Till thickness exceeds 4 feet (fig. 16). Three other small areas of thick Hiram are in Chatham, Granger, and York Townships. Hiram Till is quite thin (<2 feet) in the southwestern and northeastern portions of the county.

The somewhat poorly drained Ellsworth and Mahoning soils are developed in Hiram Till that exceeds a thickness of 2 feet. These soils cover a large area in the northwestern part of the county, including significant portions of nine townships (fig. 9). The slightly better drained Cardington and Bennington soils are developed in a composite of thin Hiram Till underlain by Hayesville Till.

The contact between the Hiram Till and the underlying Hayesville Till is the least evident of any till contact in the county. Foreign material may be lacking at the contact,

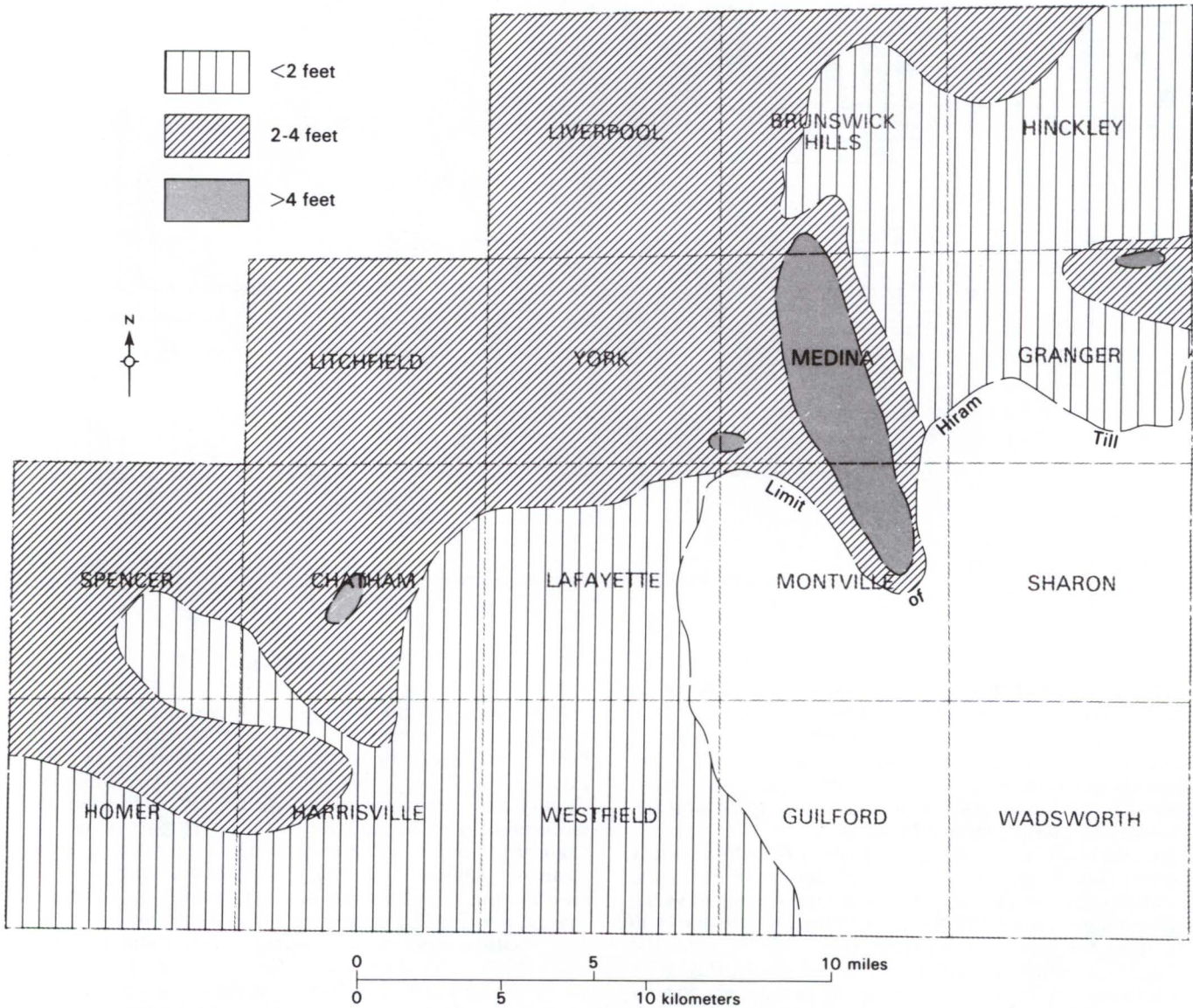


FIGURE 16.—Thickness of Hiram Till in Medina County.

although at a majority of exposures small amounts of silt, sand, gravel, or cobbles are present. The only differences noted across the contact are subtle changes in color, texture, structure, and pebble content. Near Medina, a consolidated pavement is developed on the underlying Hayesville Till, and in a road cut along Shaw Road in Chatham Township, sand-filled wedges are developed in Hayesville Till below the contact. At least four wedges about 19 inches deep and 4 inches wide at the top are present over a distance of 12 feet. These sand wedges, which are thought to be fillings of ice wedges, are truncated by Hiram Till.

The time of advance of Hiram ice into Medina County has not been determined with certainty. A minimum radiocarbon date for the Hiram ice retreat is  $14,500 \pm 150$  years B.P. (ISGS 402), determined from organic matter which accumulated in a kettle hole southeast of Lodi (see fig. 20). The apparent continuous deposition of nonglacial sediment in the kettle as well as the succession of radiocarbon dates indicates Hiram ice had retreated from southern Medina County prior to 14,500 years B.P., although how much earlier is a matter of conjecture. Ice that deposited the Hiram Till probably advanced rapidly as a surge, requiring perhaps only several hundred years to advance and retreat across northern Ohio. Approximate dates of 16,000 to 15,000 years B.P. are used for Medina County in this report (table 1).

#### BOULDER PAVEMENTS

A zone or layer of large boulders is encountered several feet below the surface in numerous excavations for basements, sewers, and highways in Medina County. There is also evidence of large concentrations of boulders in drilling records and in several housing subdivisions, where boulders excavated during construction are prized landscape materials. The first report of boulders in Medina County was by Newberry (1874, p. 38), who was particularly impressed by three large blocks of granite north of Lodi. Newberry (1874, p. 39-40) erroneously concluded that the absence of striations on most boulders was proof they were deposited by ice rafting and not by glaciers. Concentrations of boulders are especially visible on moraines in western Ohio (see the *Glacial map of Ohio* by Goldthwait and others, 1961). Subsurface concentrations of boulders have received less publicity but actually are quite common and are environmentally significant. Subsurface boulder pavements are known from many localities in northeastern Ohio and are particularly prominent in portions of Lorain County (Toten, in preparation).

The subsurface boulder pavement is composed of well-rounded boulders of all sizes, many of which are several feet in diameter. Newberry (1874, p. 38) estimated the exposed part of one boulder to weigh 150 tons. The boulders are of sufficient size and concentration to attract attention in most moderately deep excavations. A large percentage (generally greater than 50 percent) of the boulders are Precambrian igneous and metamorphic rocks that are native to Canada and have been transported by the glaciers.

The subsurface boulder belt is widely distributed across Medina County. The boulders commonly are encountered at a depth ranging from 18 to 132 inches, averaging 68 inches. Although boulder concentrations may occur in Millbrook, Navarre, or Hayesville Till, the major concentration is at the stratigraphic position of the Navarre Till, typically along the contact or interface between either the Millbrook and the Navarre or the Navarre and the Hayesville. Igneous and metamorphic cobbles and boulders are

common in the Millbrook Till, and a variety of processes may have contributed to their concentration in younger deposits. Frost action, stream and wave erosion, sheetwash, mass movement, and wind deflation of fines all may have contributed to a concentration of boulders during the interglacial or interstadial period following Millbrook Till deposition. The well-rounded nature of most boulders indicates that water—either streams or waves or both—played a role because boulders are not appreciably rounded during transport by glacial ice. It is proposed that large numbers of rounded boulders littered the Millbrook Till surface in Medina County and the surrounding area just prior to the Navarre ice advance about 24,000 years B.P. Many of these boulders may have been incorporated into Navarre ice to eventually become part of the Navarre Till. Overriding of the thin, discontinuous Navarre Till by Hayesville ice likewise may have resulted in the incorporation of exposed boulders into the Hayesville Till.

#### LATE-GLACIAL AND POSTGLACIAL DEPOSITS

##### Silt cap

Wind-blown silt, known as loess, was recognized at eight localities in the southern half of the county. This loess is the surface deposit and is slightly younger than the youngest till on which it rests. The loess was derived from valley-train deposits of the southeastward-trending valleys in southern Medina County, and possibly from nearby Wayne and Ashland Counties. The loess, where recorded, is about 1 foot thick, although slightly thicker accumulations are known. The loess in places likely has been washed from hillslopes into depressions, and in other places has been so disturbed that the contact between silt and till has been obliterated. Loess is not mapped on plate 1.

##### Made land

Made land consists of active and inactive mining areas, reclaimed land, graded areas, and areas of fill where the land surface has been modified by man. In Medina County only two areas have been mapped as made land (pl. 1); both are inactive mining sites.

#### MINERAL RESOURCES

The mineral resources of the glacial drift in Medina County consist of sand and gravel and ground water, which are discussed in detail below. The resources of the bedrock do not form a part of this report and only a brief summary is possible. Sharon (No. 1) coal was mined at several localities in Wadsworth Township in pioneer days (Wheat, 1878). Sandstone has been quarried for building stone, grindstones, and road building at many localities in the eastern part of the county (Wheat, 1878). Clay quarried south of Wadsworth led to the development of a substantial clay products industry. Clay and shale production was reported in 1986 in Medina County (Ohio Division of Geological Survey, 1987).

Oil was discovered in the Mississippian-age Berea Sandstone in Medina County in 1899 (Bownocker, 1903), and low to moderate production was developed in Chatham and Harrisville Townships. Some gas also has been produced from the Berea. A little oil is produced from the Silurian-age "Clinton" sandstone, but this formation is better known for its gas production in Medina County.

## SAND AND GRAVEL

Medina County contains large commercial resources of sand and gravel which have been exploited since the early 1900's. The sand and gravel deposits are associated with major pre-Wisconsinan valleys which are now partially buried. The sand and gravel occur in kames, an esker, kame terraces, outwash terraces, and alluvial (interstadial or interglacial) terraces. The principal deposits are discussed below.

## Lodi area

The largest sand and gravel deposits in Medina County are in the buried valley between Lodi and Seville in Harrisville and Westfield Townships near the southern margin of the county. At least 20 pits, past and present, have been operated in an area about 4 miles long and 1 mile wide (pl. 1). On aerial photos this area appears dotted with kettles and gravel pits.

The gravel in this area was first excavated in 1906-07 for fill beneath the B & O Railroad bed, which crossed kettles and swamps. For 40 or more years, only large kames were excavated. These kames covered an area 3 miles by ½ mile and were probably 20 to 40 feet high, as indicated on the 1906 Medina 15-minute topographic map. The edges of some of these large kames still remain but are covered by Hiram and Hayesville Tills as much as 12 feet thick.

In more recent times deeper excavations were made possible by new, larger equipment and by lowering the water table as much as 30 feet. Most of the gravel currently being excavated lies beneath the kames; it is also of kame origin, but is of higher quality than the younger kame gravels.

Large quantities of good-quality gravel still remain in the Lodi area, but most of it is either below the water table or beneath a covering of till, which may be 40 feet or more thick. In either situation, excavation will be more costly, but the demand for these resources probably will offset increasing costs of production.

Seville Sand and Gravel Company, which has operated pits in several places in the Lodi sand and gravel district, began a dredging operation in 1974 near the corner of Seville and Jamison Roads, 0.5 mile east of Ohio Route 83. The pit is in a valley where the water table is close to the surface, and gravel of commercial quality is dredged to a depth of 40 feet below water level. Overlying the thick sandy gravel is a coarse cobbly gravel about 4 feet thick, which in turn is overlain by Hayesville Till 6 feet thick.

The Baker Sand, Inc., pit along both sides of Friendsville Road just north of I-71 is the largest sand and gravel operation in the county. The extensive highwalls of the pit have provided excellent exposures of till and gravel for many years. Two separate gravel layers and two tills are clearly visible (fig. 17). The upper gravel is relatively thin (6 to 12 feet thick) and varies laterally from a coarse rubbly gravel to a fine sand or sandy gravel. The sand thickness increases southward and probably exceeds 12 feet in places. This sand apparently makes up the kames, most of which have been excavated in this area.

The upper gravel is overlain by thin, discontinuous Navarre Till and by Hayesville Till as much as 6 feet thick. The pockets of Navarre Till seem to be associated with the upper gravel, whereas the Hayesville Till tends to cover all older till and gravel like a blanket. The upper gravel, including the sandy kames, is assigned a Navarre age, although some of it could be older.

The lower gravel (or gravels) is sandy, of high quality, fairly well sorted, and suitable for most construction purposes. Much of this gravel is below the water table, and either lowering of the water table or use of a dredge, or both, are necessary to excavate the material. Millbrook Till as much as 25 feet thick separates the upper and lower gravels, interfingers with gravel similar to the lower gravel toward the south, and overlies the lower gravel toward the east. In places where the till is absent, the contact between the upper and lower gravels is marked by a black cemented manganese zone 1 to 3 inches thick underlain by a thick reddish, rusty zone up to 3 feet thick. The lower gravel is widespread and of high quality, but the Millbrook Till

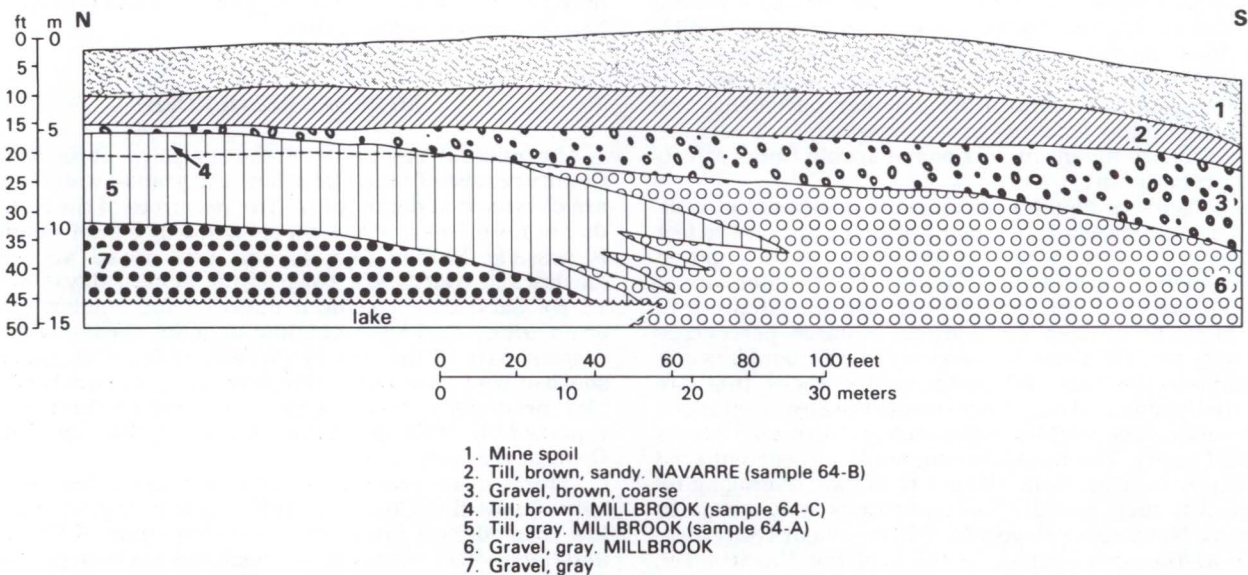


FIGURE 17.—Sketch of glacial deposits exposed in a gravel pit of Baker Sand, Inc., on east side of Friendsville Road, ¼ mile north of I-71, 3 miles southeast of Lodi, in Westfield Township.

thickness increases northward and eastward, and excavation of the gravel is restricted to places where the till overburden is less than about 30 feet.

The former Quillin Bros. pit, now operated by Baker Sand, Inc., was opened in 1929 south of Seville Road at the Westfield-Harrisville Township line. During the early history of the operation, only sandy kames were excavated. A peat bog near the pit was used as a tailings pond. About 1946, according to R. Hoops, the washing plant was moved and excavation of the lower gravels was begun. The water table has been artificially lowered by constant pumping of between 1 and 3 million gallons of water per day. This action has permitted excavation, by shovel and dredge, of the thick, high-quality gravels, which formerly were inaccessible.

The glacial materials exposed in several excavations within the pit present a varied and complex picture (figs. 18, 19, 20). In part of the pit, inclined layers of alternating coarse and fine sandy gravel underlie gray Millbrook Till. The surface has been disturbed, and 10 feet or more of material has been stripped above the gravel. A thin (about 2 feet thick) lens of Millbrook Till separates the upper gravel sequence from a lower sandy gravel sequence that is at least 20 feet thick above the water table; considerable thickness of gravel has been dredged from below the water table. Both gravels apparently are of Millbrook age.

In another part of the pit, an excavation exposed a bog in a kettle filled with clay and peat nearly 20 feet thick. A thick lens of till contained in gravel beneath and near the bog proved to be uneconomical to excavate, and thus the bog escaped excavation, at least temporarily. Only a wedge-shaped portion of the bog remained at the time of field work in 1975, but this remainder provided two excellent cross sections of the bog from its center to its edge (figs.

19, 20).

The bog originally covered an area approximately 150 by 300 feet and was bounded by kames on two or three sides. The gray sandy gravel that surrounds and underlies the bog (fig. 20, unit 8) has a maximum thickness of 12 to 15 feet. The gravel beds dip toward the center of the kettle at the same angle as the contact between the gravel and the overlying organic-rich material, so it seems most probable that the gravel is related to kames and outwash which buried a large ice block. When the ice block melted, the gravel settled, leaving a depression (kettle) at the surface that was the size and shape of the melted ice block. The uppermost sandy gravel has been dated as Navarre in nearby pits, and the stratigraphic relationships in the Quillin pit support this age assignment.

Organic material at the base of the kettle has a radiocarbon date of  $14,500 \pm 150$  years B.P. (ISGS 402). As the Navarre/Kent ice advance is dated at about 23,000 years B.P. at Cleveland, Ohio (White, 1968), it now appears that the ice block was buried in gravel approximately 20,000 years ago, then was overridden by the Hayesville and Hiram ice advances, and did not begin melting until about 5,000 years after it was buried. Dr. Linda C. K. Shane (1987, personal communication), who collected the organic matter which yielded the date, believes this basal litter layer may represent vegetation growing on sand directly above a melting ice block.

The first sediments deposited in the bog were gray pebbly silt and silty clay, 8 feet thick, that contain wood and wood fragments (fig. 20, units 6 and 7). These sediments are overlain by as much as 12 feet of gyttja and peat, which form a distinct black layer (units 4 and 5). At the top of the peat, thin, sandy marl contains mollusk shells, logs, and stumps, including a distinctive cypress log. The peat is

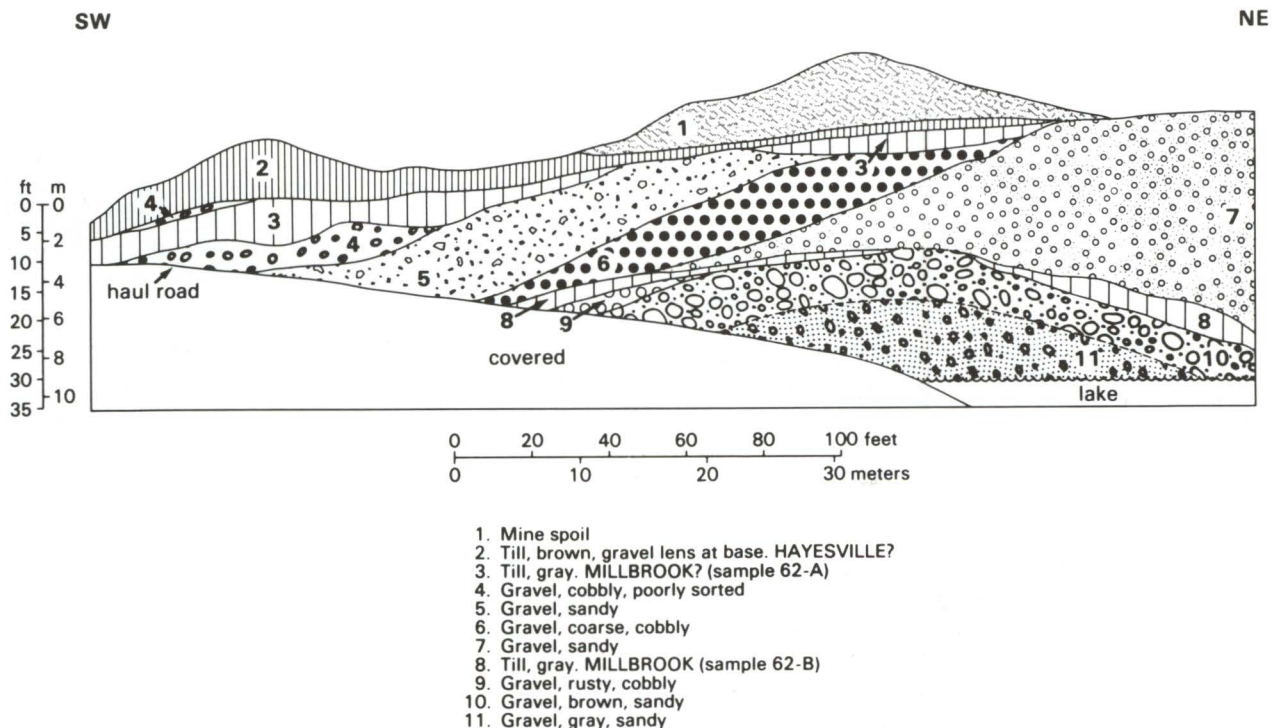


FIGURE 18.—Sketch of glacial deposits exposed in Quillin pit on south side of Seville Road 0.7 mile east of Ohio Rte. 83, 2 miles southeast of Lodi, in Harrisville Township.

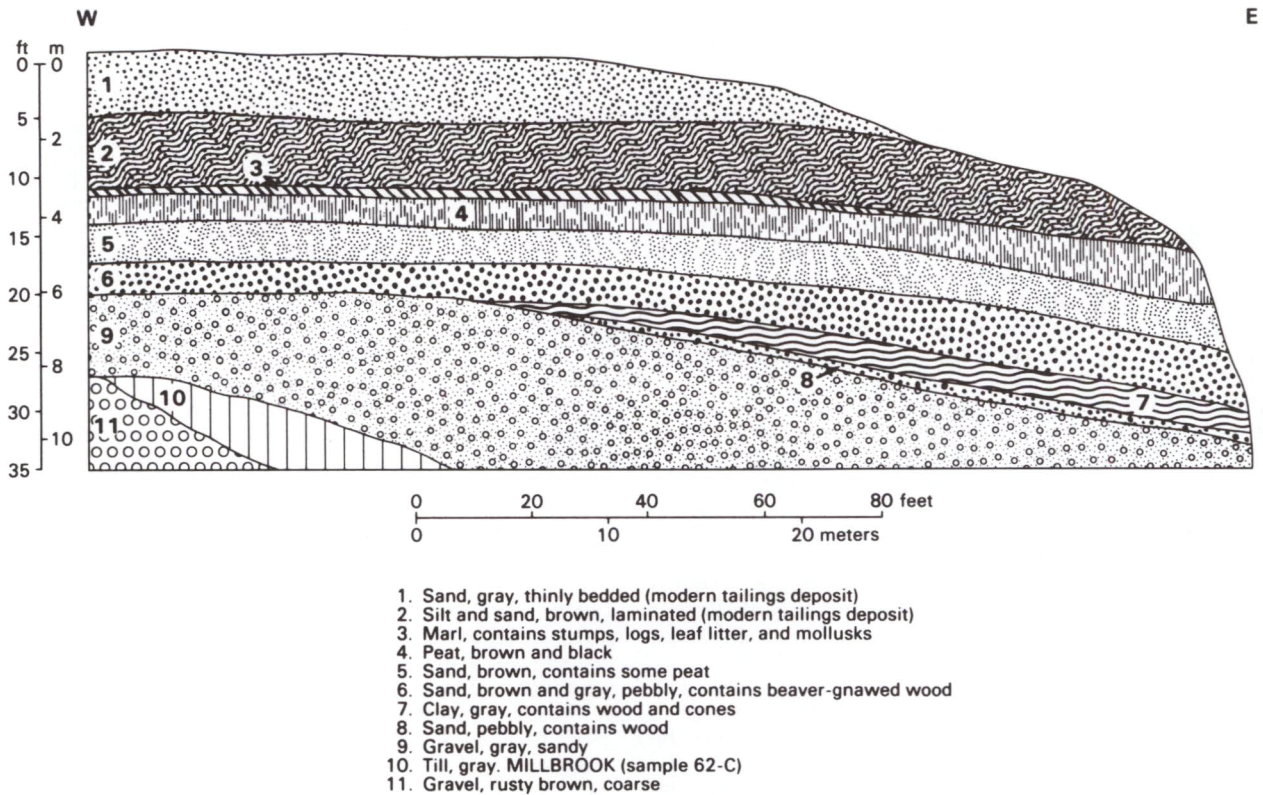


FIGURE 19.—Sketch of glacial deposits exposed in south-facing wall of Quillin pit on south side of Seville Road 1 mile east of Ohio Rte. 83 at the Harrisville-Westfield Township line.

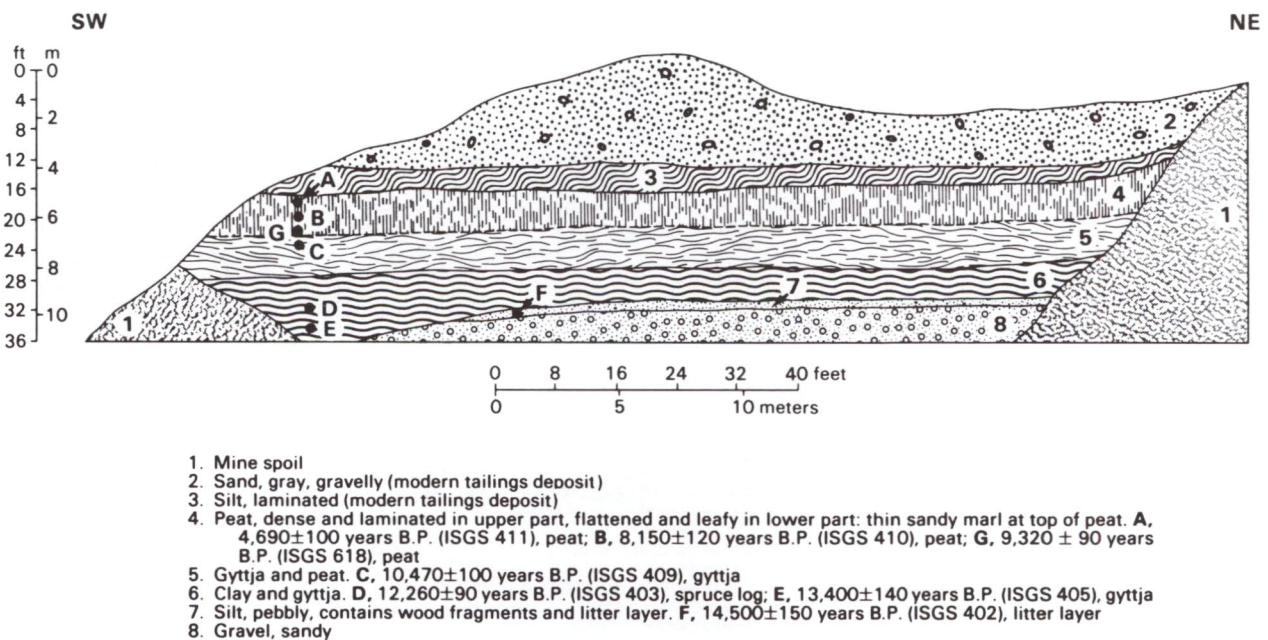


FIGURE 20.—Sketch of glacial deposits exposed in east-southeast-facing wall of Quillin pit on south side of Seville Road 1 mile east of Ohio Rte. 83 at the Harrisville-Westfield Township line. This section is about 100 feet east of section illustrated in figure 19.

overlain by laminated silt and gravelly sand of Recent age which accumulated as outwash in a tailings pond during the early period of gravel excavation. The upper part of the peat has a radiocarbon date of  $4,690 \pm 100$  years B.P. (ISGS 411), so the sediment filling the bog accumulated over a period of approximately 10,000 years.

Wood was collected from several horizons in the bog by Dr. Shane and was identified by R. B. Miller of the U.S. Forest Service. Spruce is dominant in the lower 12 feet of sediment, whereas fir, spruce, willow, and either aspen or cottonwood are present at a depth between 6 and 7 feet. The upper peat contains abundant pine needles. Many of the small logs and twigs in the deposit were gnawed and neatly trimmed at the ends. The striations or toothmarks on the wood ranged in width from 7 to 9 mm, which is the size made by the common beaver. The large quantity of gnawed wood matted together suggests a colony of beaver inhabited the bog for a considerable time. Beaver-gnawed wood is fairly common from Pleistocene lake deposits and was first recognized in Ohio by Newberry (1874, p. 32), who reported that wells penetrating the "Forest Bed" brought up chopped timber and wood chips. Newberry recognized these wood materials to be the work of beaver, and he suggested the chopping was done by the giant beaver, which is now extinct.

In the summer of 1976, a partial skull of a small rodent-like animal weathered out of the peat (fig. 20, unit 4). The skull was sent to Dr. Donald Hoffmeister of the University of Illinois, who identified it as the vole *Microtus pennsylvanicus*, commonly known as the meadow vole. This species now lives from the latitude of Ohio to the tree line in Alaska and Canada. According to Mills (1972, p. 12), meadow vole remains also have been found in late Pleistocene lake sediments near Dayton, Ohio.

In the fall of 1978, a well-preserved bird skull and related bones, as well as two additional vole bones, were found in the lower part of the same peat layer that yielded the vole. A sample of the peat had a radiocarbon date of  $9,320 \pm 90$  years B.P. (ISGS 618). Dr. J. Dan Webster and Dr. Robert W. Stover positively identified the bird as an English sparrow. Because the English sparrow is an introduced species in Ohio and is not considered native to North America, the bird fossil may be a contaminant.

#### Coddingville-Granger Lake area

A complex series of kames and an eskerlike feature near Coddingville have been exploited for small to moderate amounts of sand and gravel. The coarse, cobbly gravel in a pit in a kame 1 mile south of Coddingville probably is of Millbrook age. Millbrook sands and gravels generally are of high quality, and additional exploration is needed in this area to determine the thickness and extent of these deposits and the thickness of the till covering them.

Granger Lake is surrounded by outwash and kames, including the largest kame (80 feet high) in the county. Several small pits in the deposits have revealed only poor-quality rubbly sand and gravel. From what is known about these deposits, large quantities of sand and gravel are available, but the quality is poor. Sand and gravel of higher quality may be found at depth, as at Lodi, but further investigation will be necessary.

The kame terraces on both sides of Granger Ditch contain small deposits of poorly sorted sand and gravel. Very little of this material has been excavated, and it is not likely that sand and gravel of commercial quantity or quality will be found in these deposits.

#### Wolf Creek area

The short kame terrace of Wolf Creek contains coarse, stony sand and gravel, which have been excavated in several pits on both sides of the Medina-Summit County line. Additional quantities of outwash sand and gravel are known to occur beneath the kame terrace sand and gravel.

#### Hubbard Creek-River Styx area

The kame terrace on the east side of Hubbard Creek has not been exploited for sand and gravel as yet. The deposit probably is too small to be of commercial value, although it may have local use as bank-run material.

The kame terrace on the west side of River Styx is extensive, but its known thickness of 15 to 20 feet isn't sufficient for large-scale commercial operations. The sand and gravel exposed in a pit in the kame terrace is not of high quality and contains large slabs of local sandstone bedrock.

#### Valley trains

All of the major valleys leading south and east in the county funneled large quantities of glacial meltwater away from the ice margin. These glacial streams carried sediment which was deposited as sand and gravel in the valley bottoms. Most of these outwash deposits are below the modern drainage, and thus below the water table, so that excavation is more difficult. These deposits are relatively fine grained and become finer grained downstream. Relatively small amounts of valley-train sand and gravel have been exploited, the most notable being the lower gravels at Lodi.

#### Alluvial terraces

Most of the modern streams transport and deposit small to moderate amounts of alluvium, consisting of a wide range of grain sizes including sand and gravel. These alluvial deposits, as well as the older terrace deposits, are too fine grained, too limited, and of inferior quality to be exploited commercially. These deposits are used locally for fill.

#### Possible areas for exploration

The Lodi region has proven to be one of the important sand- and gravel-producing areas of northeastern Ohio and appears capable of maintaining this production for many years in the future. The Lodi sands and gravels are of good quality, and drilling records indicate the deposits are widespread in the buried valley between Lodi and Seville. Most of the sand and gravel remaining lie beneath till, clay, and/or peat of variable thickness; thus considerable stripping will be necessary, and exploration should be carried out to define areas of least overburden. The thickest overburden is till associated with moraines (pl. 1); intermorainic tracts such as the Clear Creek valley southwest of Lodi and Garden Isle Bog should be explored because these areas may require less stripping.

As a general rule at Lodi and elsewhere, the highest quality and thickest gravels occur below the water table. In at least two pits, the water table has been lowered 30 feet or more by pumping to provide access to the lower gravels, but dredging still is necessary to reach the deeper gravels. The present gravel operations near Lodi represent the second phase of excavation made possible by improved excavating

methods. Large quantities of gravel may remain which can't be exploited by current methods.

Besides the Lodi region, other areas worthy of exploration are the buried valleys (fig. 3), particularly (but not exclusively) those south and southeast of the main morainic system. Of special note are the valleys occupied by Granger Ditch in Granger Township and by Chippewa Creek and its tributaries north of Seville. In these valleys, water-well records indicate substantial sand and gravel deposits lie beneath a covering of clay or till generally 20 feet thick or less. Buried sand and gravel are extensive in other valleys such as the valley of River Styx, but a thick cover of clay or till appears to be a limiting factor in most cases. The kame-terrace segments along the valley sides of River Styx south of Montville Lakes warrant exploration. The quality and extent of these sands and gravels have been difficult to identify because of limited exposures and the covering of till. Risser has mapped the sand and gravel resources (1981) and surficial materials (1987) in Medina County.

#### WATER SUPPLY

This report does not deal with water supply in any detail, but a synopsis is given here. The report by Stout, Ver Steeg, and Lamb (1943, p. 445-452) gives some information about water supplies of the cities and villages in the county. A great deal of more recent information is available from the Ohio Department of Natural Resources, Division of Water in Columbus.

Springs were numerous and widely used in Medina County in pioneer days. Stout and others (1943, p. 451) note that the water supply for Wadsworth came from two springs from 1881 to 1898, when wells were drilled. One of the largest springs remaining is 2 miles north of Chippewa Lake at the intersection of Ballash and Wedgewood Roads.

Historically, most of the water used in Medina County has been from wells completed either in bedrock or in glacial drift. In the 1970's, a reservoir, known as Lake Medina (not shown on pl. 1), was constructed along the valley of West Branch Rocky River east of Medina to provide that city's water. Also in the 1970's, a far-reaching water system was constructed using water drawn from Lake Erie. These two projects probably will place the use of ground water in a secondary role in the county. However, ground water still is a valuable resource and should be utilized in those areas where it is available because of its superior quality and low long-term cost.

According to Schmidt (1978), moderate ground-water yields of 50 to, more rarely, 350 gallons per minute (gpm) may be obtained at depths of less than 100 feet from the Pennsylvanian-age Sharon conglomerate, which underlies the broad uplands and ridges in several areas of eastern Medina County. Lesser yields of 3 to 10 gpm may be obtained from Pennsylvanian-age Pottsville sandstones and shales which overlie the Sharon in the uplands of Wadsworth and southern Sharon Townships. Schmidt (1978) also indicates that yields of 3 to 15 gpm may be obtained from the Mississippian-age Cuyahoga Formation, which underlies the glacial deposits over most of the county. However, he cautions that brackish and salt water may be encountered in the bedrock in parts of Homer, Spencer, Harrisville, Chatham, Litchfield, York, and Liverpool Townships. Schmidt (1978) notes that oil residue and salt water related to petroleum exploration have contaminated ground water in bedrock in places, especially in Chatham and Spencer Townships.

Glacial sand and gravel hold much greater promise for

ground-water supplies than the bedrock. A number of wells have yielded considerable supplies of water from buried sand and gravel, which constitute significant aquifers, especially in the buried valleys. The major buried valleys appear to have good ground-water potential because they contain one or more layers of sand or gravel and have some opportunity for recharge, particularly from the surface streams, which tend to follow the buried valleys.

The hydrogeology of the deposits filling the preglacial channels is very complex because the deposits consist of interbedded till, clay, sand, and gravel; detailed investigation is necessary to establish the character and continuity of the aquifers. A common problem encountered in the buried valleys is that thick clay or till may overlie the deeper gravel, thereby diminishing greatly the amount of water that may recharge the gravel aquifers. Satisfactory wells, however, generally are secured in the sand and gravel at various depths, particularly when proper installation and maintenance methods are used.

Schmidt (1978) indicates ground-water yields of 500 to 1,000 gpm are possible in two small areas within buried valleys in Medina County. One area of potentially high yield is near the confluence of West Branch and North Branch Rocky River about 1 mile northeast of Medina at a depth of about 100 feet. The other area is in the Wolf Creek valley at the Medina-Summit County line. Relatively large yields of 100 to 500 gpm are possible from four relatively extensive areas within buried valleys (Schmidt, 1978). The largest of these is a 9-mile-long east-west buried valley near the Medina-Wayne County line between Lodi and Seville; the largest yields of ground water in this area are obtained at depths of 90 to 120 feet. Other buried valleys capable of yielding relatively large amounts of ground water include the valley occupied by River Styx from Wadsworth south 3 miles to the Medina-Wayne County line, the east-west valley occupied by Wolf Creek for 4 miles in eastern Sharon Township to the Medina-Summit County line, and the east-west valley occupied by Granger Ditch and partially filled with kames in eastern Granger Township. Portions of six southward- or southeastward-trending buried valleys in the southern and eastern parts of the county may yield moderate amounts of 25 to 100 gpm of ground water (Schmidt, 1978). These valleys are Chippewa Creek south of Chippewa Lake, East Branch Black River, River Styx, Granger Ditch, Tommy Run (southeastern Guilford Township), and Killbuck-Little Killbuck Creeks. Schmidt also notes that ground-water yields of less than 3 gpm are common from wells drilled into the till.

#### ENVIRONMENTAL AND ENGINEERING GEOLOGY

##### LAND USE

The environment is influenced in general by the major physiographic divisions (fig. 2) and in detail by the glacial and postglacial landforms and the materials that comprise or mantle them. The determination of constraints for structures and excavations built upon or within the glacial materials is a part of environmental geology referred to as engineering geology.

The glacial drift is an important factor in engineering performance of structures built upon or in the drift. The thickness, composition, and surface configuration of the drift must be considered. Of great importance for large structures or those involving deep excavation is the vertical variation in the drift, because at most places the tills at various depths are of different composition, texture, and

engineering properties (White, 1972, 1974). Gravel and sand may underlie the surface tills at depths ranging from a few feet to 50 feet or more, may be water bearing, and at depth may be under artesian pressure.

Engineering interpretations of the soils of Medina County have been treated in great detail in the report by Hayhurst and others (1977). That report should be consulted for specific engineering test data and classifications both in the Unified and in the AASHTO systems. The test data recorded by Hayhurst and others (1977) pertain to the upper 60 inches of the soil. This is the material in which plants grow and upon which many structures are built. The present geological report deals not only with the surface material, but also is concerned with the whole column of glacial deposits. These reports, therefore, complement each other. This geological report and map cannot provide sufficient detail for planning at a specific site, but can point out features of the glacial stratigraphy that should be anticipated in detailed, site-specific engineering investigations.

The subsurface material becomes of increasingly greater importance as larger and larger structures and deeper and deeper excavations become more common. The parent material of soils over about 63 percent of Medina County is the clayey Hiram Till, which has an average thickness of 30 inches. The material beneath the Hiram Till is less clayey and therefore has more desirable engineering properties. In some projects, it may be desirable to strip off and discard the clayey till to take advantage of the more permeable material below. It should be noted also that the interfaces between till units commonly are water bearing, and this factor must be taken into account in excavations because water seepage causes piping and slumping. Vertical joints or fractures in till also are important because they allow significant infiltration of fluids downward to bedrock. Although an individual sample of till may indicate relatively low or very low permeability, the joints and fractures may permit a fluid infiltration rate characteristic of more permeable material.

The engineering geology and land-use character of the various physiographic divisions of Medina County are discussed below.

#### Low plateau

The slightly dissected, gently sloping till plain of the low plateau in the northwestern part of the county is a predominantly rural area devoted to agriculture. Many small and a few large stream channels provide moderate drainage for the clayey surface. The drainage of this area has been improved considerably since pioneer days by dredging and tiling, so that most of the area is suitable for farming despite the high clay content of the soil. Homesites and other construction projects should be carefully planned to provide adequate drainage. Potential problems are wet basements and inoperative septic systems, particularly where homesites are closely spaced.

#### Morainic upland

The more or less rolling topography of the end moraines in Medina County is fairly well drained, scenically interesting, and suited for a wide variety of uses. The end moraines have been widely used for agriculture since pioneer days because they are better drained than the surrounding lowlands. Many of the early towns and villages such as Medina, Spencer, Westfield Center, Chatham, and Brunswick are located on end moraines. In the valley bottoms such as around Chippewa Lake, end moraines generally are

the only suitable building sites. Flowing down the short front and back slopes of the moraines are numerous small tributaries, many of which represent opportunities for construction of small lakes. The rolling hills coupled with the potential for lakes offer favorable conditions for excellent homesites. Caution should be used in the installation of septic waste-disposal systems, as the clayey Hiram Till at the surface over most of this area is very slowly permeable and will accept effluent with difficulty.

#### Drift-mantled upland

The drift-mantled upland in the southeastern part of the county is characterized by moderate to steep slopes and thin drift. The silty, clayey Hayesville Till is thin over most of the area, and older, more sandy till is at or near the surface. The more gentle slopes are well-suited for agriculture, whereas the steeper slopes are suited for pasture and woodlands. Drainage is good over most of the area and soil permeability generally is adequate for septic tanks.

#### Sandstone ledges

The steep sandstone walls of the ledges that flank the valley of East Branch Rocky River in Hinckley Township are impressive features. Hinckley Reservation, a portion of this scenic area, is part of the Cleveland Metropolitan Park District. Outside the confines of the reservation, the scenic wooded hills are becoming more and more attractive for development. Construction on these hillslopes requires careful planning and should be in harmony with the natural terrain lest the drainage and slope stability be disrupted. Modification of the natural drainage generally results in increased erosion, which causes deterioration of the environment. Most of the slopes, although underlain by sandstone, are mantled with till, which is highly susceptible to slumping and sliding if the slope angle is steepened or if vegetation is removed. The steep slopes also are subject to rapid runoff after heavy rains, as the numerous small streams and gullies attest.

#### Valley bottoms

The bottoms of the larger valleys in Medina County are surprisingly wide and contain three types of flat surfaces: floodplains, alluvial and outwash terraces, and lake plains. The floodplains are relatively narrow and occupy a relatively small portion of the total width of the valley. Floodplains are susceptible to annual flooding and should either remain in a natural wooded state or be utilized for agriculture. Floodplains are not suitable for homesites.

The alluvial and outwash terraces are relatively flat remnants of former floodplains that border modern floodplains at higher elevations. The silty and sandy terrace materials are more permeable than till, and terrace soils generally are better drained than other soils. The lower terraces may flood occasionally, but most terrace surfaces in the county are suitable for building sites. Valley City, Lodi, and Seville have been built on terraces. The water table may be high under the terrace surface, and excavations for basements or pipelines may encounter water, particularly during the spring.

Lake plains, some of them quite extensive (pl. 1), occur in nearly every large valley. The surface material generally is silt, clay, and/or peat, drainage generally is poor, and the water table is high. Late-glacial Lake Spencer, which extended from Lodi northwestward to the Lorain-Medina County line, was an exception in that the lake was short lived, and little difference exists between the lake plain and

the till plain. The lake plains are swampy unless they have been artificially drained and generally are not suitable for homesites. When drained, these areas are suitable for agriculture; if undrained they should remain as wetlands for wildlife. In places where the soil has a high organic content, as the Garden Isle Bog south of Lodi, the lake plain will support specialized agriculture such as truck farming.

#### WASTE DISPOSAL

##### Solid waste

Safe and prudent disposal of solid waste is becoming more and more important as the population increases, the amount of waste multiplies, and environmental regulations become more detailed. Open burning and dumping have been illegal in Ohio since 1969, and the sanitary-landfill method has become the standard method of disposing of solid waste. Suitable landfill sites in Medina County are most likely to be found in areas that have a thick till cover, a low water table, a slight to gentle slope, and that are not close to urban centers. Areas where bedrock is within 25 feet of the surface, sand and gravel deposits, valley bottoms, and steep hillsides have a low probability of containing suitable landfill sites.

In general, the end-moraine areas in the western part of the county appear more suitable for landfill sites than other areas of Medina County. The buried valleys in the

eastern and southern parts of the county present a great possibility of contaminating sand and gravel aquifers. A careful engineering study must be made before a proposed landfill site is selected.

A comprehensive review of geologic considerations for selecting landfill sites is given by Groenewold (1974). Risser (1987) has prepared a map of the surficial materials in Medina County that can be used as a guide for selecting landfill sites. Her report includes size and engineering analyses of Medina County till samples.

##### Septic tanks and tile fields

The disposal of sewage effluent from septic tanks is a significant problem in those areas of the county not served by municipal sewers and sewage-treatment plants. The geologic factors which affect the operation of septic tanks include permeability of the soil, depth to bedrock, depth to the water table, slope, and drainage. Hayhurst and others (1977, p. 52-64) list limitations affecting proper disposal for each of the soil series in the county. In general, the soils of Medina County have severe limitations, mostly due to the very low permeability of the Hiram Till, which is the surface material over much of the county, and to the low permeability of the underlying Hayesville Till. Many localities have a seasonally high water table, and tile fields may be flooded by rising water levels in wet seasons.

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**APPENDIX.—RESULTS OF ANALYSES OF MEDINA COUNTY TILL SAMPLES**

**EXPLANATION**

Size ranges: gravel, >2 mm; coarse sand, 2 mm - 0.42 mm; fine sand, 0.42 mm - 0.074 mm; silt, 0.074 mm - 0.0039 mm; clay, <0.0039 mm.

Percent gravel based on approximate 500 g split of total sample; percent sand, silt, and clay based on approximate 35 g split and calculated as percent of the <2 mm fraction.

Till identification: Ha, Hayesville; Hi, Hiram; Mi, Millbrook; Na, Navarre.

Atterberg limits: Liquid limit is the percent of moisture content at which a material no longer undergoes plastic deformation but flows like a liquid when subjected to pressure. Plastic limit is the percent of moisture content at which a material begins to exhibit plastic deformation when subjected to pressure. Plasticity index is the difference between the moisture percent at the plastic limit and the moisture percent at the liquid limit. The difference between these two percents defines the range of moisture over which a material will flow plastically.

Color: B, brown (oxidized); G, gray (unoxidized).

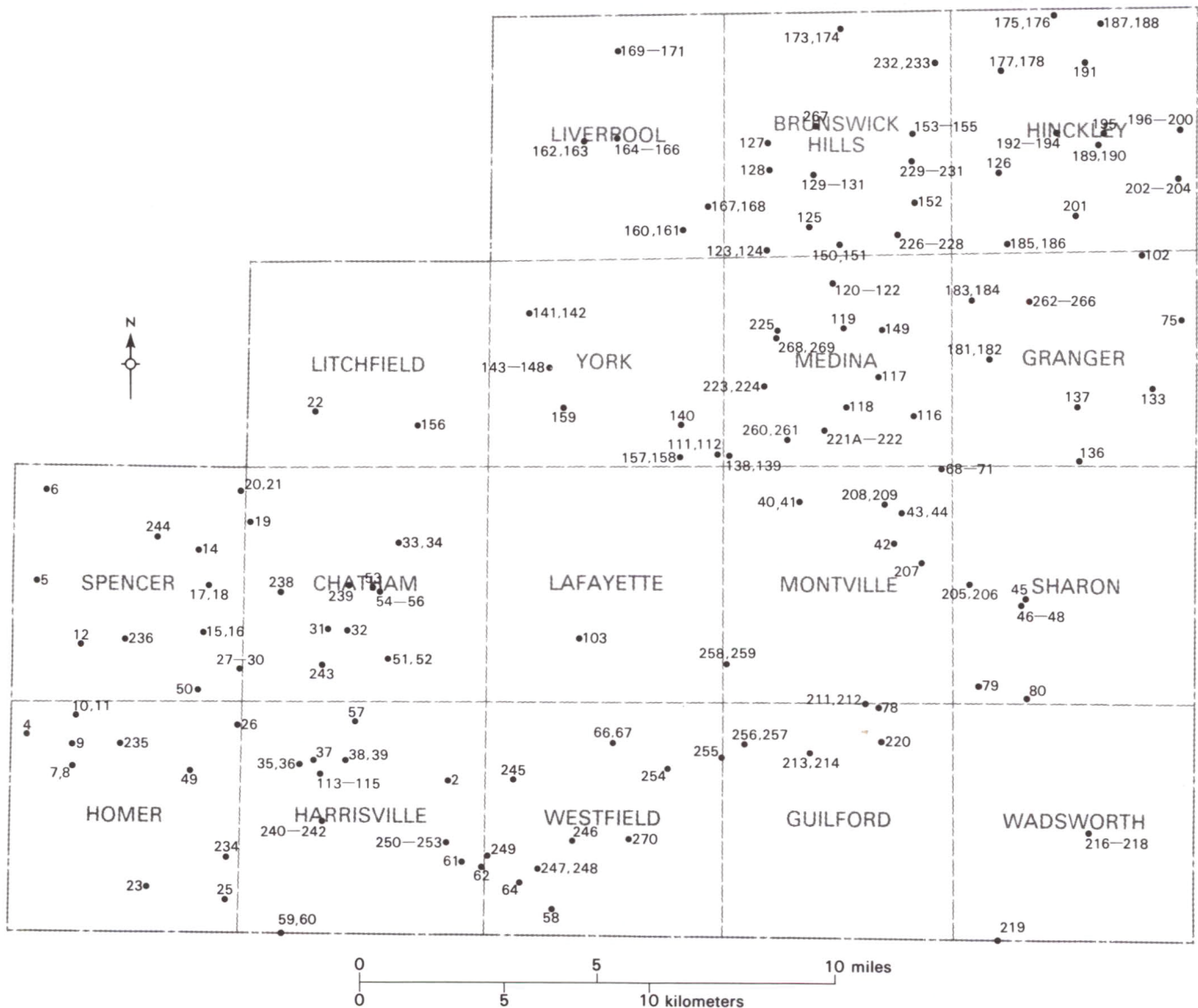


FIGURE 21.—Medina County till-sample locations.

Sample no.	Township	Till identification	Size analysis (%)					Atterberg limits			Color
			Gravel	Coarse sand	Fine sand	Silt	Clay	Liquid limit	Plastic limit	Plasticity index	
2	Harrisville	Ha	8.2	6.7	9.3	42.9	40.1	32	20	12	B
4	Homer	Ha	4.4	5.7	12.2	42.3	39.8	30	19	11	B
5	Spencer	Ha	4.0	6.0	10.7	40.7	42.6	33	20	13	B
6	Spencer	Ha	3.9	6.0	12.1	45.8	36.0	28	18	10	B
7	Homer	Hi	3.5	4.4	11.2	44.3	40.0	30	20	10	B
8	Homer	Hi	5.0	5.0	12.6	43.4	39.0	29	18	11	B
9	Homer	Hi	2.4	4.0	10.9	40.1	45.0	32	19	13	B
10	Homer	Hi	3.3	6.7	12.2	40.5	40.6	32	20	12	B
11	Homer	Hi	6.9	6.9	12.4	41.5	39.3	29	19	10	B
12	Spencer	Hi	6.4	6.6	10.9	40.2	42.2	33	20	13	B
14	Spencer	Hi	7.1	7.4	14.3	43.2	35.1	30	20	10	B
15	Spencer	Hi	5.2	7.0	14.0	40.0	38.3	29	19	10	B
16	Spencer	Ha	5.3	6.9	16.6	45.0	31.5	25	17	8	B
17	Spencer	Hi	4.0	5.9	8.5	47.5	38.0	28	20	8	B
18	Spencer	Ha	3.7	3.9	4.4	37.8	53.9	36	22	14	G
19	Chatham	Hi	2.9	3.8	7.0	33.8	55.4	38	22	16	B
20	Spencer	Hi	7.2	7.0	11.6	39.0	42.4	31	18	13	B
21	Spencer	Ha	22.5	17.4	13.1	35.6	33.9	29	20	9	B
22	Litchfield	Ha	6.3	5.2	10.4	40.2	44.2	34	21	13	B
23	Homer	Ha	7.2	5.6	12.2	45.0	37.1	29	19	10	B
25	Homer	Na	8.4	7.7	16.0	46.2	30.2	27	18	9	B
26	Homer	Hi	4.7	6.0	12.0	39.2	42.7	34	20	14	B
27	Spencer	Na	6.4	14.2	23.7	36.0	26.2	23	16	7	B
28	Spencer	Mi	7.5	13.8	22.6	37.0	26.6	23	16	7	B
29	Spencer	Mi	12.9	12.0	20.3	37.3	30.4	25	17	8	G
30	Spencer	Mi	8.0	11.4	20.4	37.2	31.0	22	15	7	G
31	Chatham	Hi	6.0	5.4	9.9	46.1	46.1	34	20	14	B
32	Chatham	Hi	5.4	6.6	10.7	40.0	42.7	34	20	14	B
33	Chatham	Hi	5.6	6.0	11.3	40.2	42.5	31	19	12	B
34	Chatham	Ha	9.7	10.6	18.3	40.6	30.5	25	17	8	B
35	Harrisville	Ha	5.7	9.0	18.5	38.5	34.0	26	17	9	B
36	Harrisville	Na	6.8	11.3	15.4	39.7	33.6	27	18	9	B
37	Harrisville	Ha	7.1	6.7	12.3	39.7	41.3	32	19	13	B
38	Harrisville	Ha	4.3	6.9	12.6	43.5	32.0	28	19	9	B
39	Harrisville	Ha	7.3	7.2	13.8	44.0	34.9	25	16	9	G
40	Montville	Ha	9.7	12.6	15.8	37.6	34.0	31	20	11	B
41	Montville	Na	5.3	5.4	11.5	44.0	39.1	30	21	9	B
42	Montville	Hi	1.9	2.9	6.2	38.9	51.9	34	21	13	B
43	Montville	Hi	4.0	4.6	11.4	45.7	38.2	27	18	9	B
44	Montville	Hi	2.5	4.7	9.4	45.5	40.3	27	18	9	G
45	Sharon	Na	13.3	13.7	30.6	41.7	13.9	19	16	3	B
46	Sharon	Hi	9.2	7.4	16.6	44.7	31.3	29	18	11	B
47	Sharon	Ha	6.6	8.7	14.5	45.2	31.5	25	17	8	B
48	Sharon	Na	9.0	9.0	16.3	44.4	30.3	27	17	10	B
49	Homer	Hi	3.5	5.7	11.2	38.8	44.3	30	20	10	B
50	Spencer	Ha	5.4	7.7	10.3	38.9	43.1	32	19	13	B
51	Chatham	Hi	10.4	5.0	9.7	45.1	40.2	32	21	11	B
52	Chatham	Ha	6.6	4.9	10.7	47.0	37.4	30	20	10	B
53	Chatham	Hi	13.4	7.3	11.7	39.6	41.4	31	20	11	B
54	Chatham	Ha	3.7	4.8	9.7	46.5	39.0	28	20	8	B
55	Chatham	Na	17.0	6.6	16.1	51.3	26.0	23	17	6	B
56	Chatham	Na	10.5	77.0	8.4	43.6	41.0	30	19	11	G
57	Harrisville	Ha	4.9	5.8	14.5	42.0	37.7	28	19	9	B
58	Westfield	Ha	10.0	9.4	14.9	39.6	36.1	29	18	11	B
59	Harrisville	Ha	4.9	8.4	15.3	42.6	33.7	28	18	10	B
60	Harrisville	Na	5.3	6.9	12.1	45.0	36.0	29	20	9	B
61	Harrisville	Ha	7.0	6.3	11.5	41.4	40.8	26	16	10	G
62A	Harrisville	Mi?	9.4	11.5	20.4	44.7	23.5	20	14	6	G
62B	Harrisville	Mi	6.9	10.5	15.5	41.7	32.3	27	18	9	G
62C	Harrisville	Mi	4.7	5.4	10.5	45.5	38.5	27	17	10	G
64A	Westfield	Mi	14.4	18.2	37.8	29.8	14.2	15	12	3	G
64B	Westfield	Na	3.9	11.0	17.5	44.6	26.9	25	17	8	G
64C	Westfield	Mi	9.5	10.3	16.1	45.3	28.3	25	17	8	B
64D	Westfield	Ha	4.7	6.0	9.7	43.0	41.2	32	21	11	B
66	Westfield	Ha	10.0	6.7	10.5	42.3	40.5	33	20	13	B

## GLACIAL GEOLOGY OF MEDINA COUNTY

Sample no.	Township	Till identification	Size analysis (%)					Atterberg limits			Color
			Gravel	Coarse sand	Fine sand	Silt	Clay	Liquid limit	Plastic limit	Plasticity index	
67	Westfield	Na	9.3	12.2	20.8	47.2	19.7	23	17	6	B
68	Montville	Ha	6.8	4.8	11.4	44.7	39.1	28	19	9	B
69	Montville	Na	6.2	8.1	17.5	46.2	28.1	25	18	7	B
70	Montville	Mi	5.5	5.4	9.6	50.4	34.6	28	20	8	B
71	Montville	Mi	6.9	6.2	10.3	47.8	35.7	26	16	9	G
75	Granger	Hi	1.8	2.5	5.3	43.9	48.4	37	21	16	B
78	Guilford	Ha	6.4	6.8	14.4	49.4	29.4	26	19	7	B
79	Sharon	Ha	6.0	7.7	14.4	47.7	30.1	24	18	6	B
80	Sharon	Ha	2.9	5.0	14.2	45.3	35.5	27	20	7	B
102	Granger	Hi	0.02	0.4	0.4	32.0	67.2	43	24	19	B
103	Lafayette	Ha	4.3	6.1	16.0	45.3	32.6	26	19	7	B
111	York	Hi	7.0	7.1	11.9	42.4	38.6	29	20	9	B
112	York	Ha	6.5	7.3	13.0	43.2	36.5	31	19	12	B
113	Harrisville	Hi	5.9	7.4	11.3	43.6	37.7	29	18	11	B
114	Harrisville	Ha	6.4	8.0	16.0	40.1	35.9	27	18	9	B
115	Harrisville	Ha	6.2	6.5	12.6	45.3	35.6	25	16	9	G
116	Medina	Ha	6.6	4.8	12.1	44.4	38.6	30	18	12	B
117	Medina	Hi	2.6	3.4	9.7	43.3	43.6	31	19	12	B
118	Medina	Hi	3.7	4.4	9.5	36.9	41.9	31	20	11	B
119	Medina	Hi	3.9	4.6	8.9	40.3	46.3	34	21	13	B
120	Medina	Hi	3.7	4.5	9.2	42.4	44.0	30	20	10	B
121	Medina	Ha	6.7	5.9	12.3	41.5	40.3	29	19	10	B
122	Medina	Ha	3.5	5.0	10.7	43.3	41.0	26	17	9	G
123	Brunswick Hills	Hi	3.5	6.1	9.2	41.3	43.4	31	20	11	B
124	Brunswick Hills	Ha	4.2	5.5	9.6	41.7	43.2	29	19	10	B
125	Brunswick Hills	Ha	6.1	6.8	10.6	42.6	40.0	30	20	10	B
126	Hinckley	Ha	6.6	5.4	9.9	48.3	36.4	29	20	9	B
127	Brunswick Hills	Ha	9.7	5.9	9.5	44.0	40.6	31	20	11	B
128	Brunswick Hills	Ha	7.3	9.7	10.1	43.2	36.9	29	20	9	B
129	Brunswick Hills	Hi	6.4	8.6	12.4	42.7	36.3	28	18	10	B
130	Brunswick Hills	Ha	6.0	7.3	10.9	43.1	38.7	29	19	10	B
131	Brunswick Hills	Ha	5.9	5.1	9.5	40.9	44.4	27	19	8	G
133	Granger	Ha	4.5	6.0	14.2	47.1	32.6	27	19	8	B
136	Granger	Ha	5.4	6.6	12.1	46.1	35.2	29	17	12	B
137	Granger	Ha	8.8	8.1	14.8	44.6	32.5	26	18	8	B
138	Medina	Hi	2.9	3.2	10.0	36.6	50.2	35	21	14	B
139	Medina	Ha	1.0	2.5	7.5	37.8	52.2	33	19	14	B
140	York	Ha	5.2	5.3	10.1	41.2	43.3	30	19	11	B
141	York	Hi	2.2	4.5	11.2	40.8	43.5	31	19	12	B
142	York	Ha	4.1	7.3	11.0	40.3	41.4	29	19	10	B
143	York	Hi	3.4	5.3	11.9	40.9	41.8	30	20	10	B
144	York	Ha	4.7	6.6	11.7	41.2	40.5	28	19	9	B
145	York	Ha	4.0	6.4	11.2	41.5	41.0	27	17	10	G
146	York	Na	10.1	13.7	13.9	36.7	35.7	28	18	10	B
147	York	Na	9.5	9.5	16.1	47.0	27.4	22	17	5	G
148	York	Mi	8.0	8.3	14.0	50.1	27.6	24	18	6	B
149	Medina	Ha	5.3	5.9	10.7	37.6	45.8	30	19	11	B
150	Brunswick Hills	Hi				no data available					B
151	Brunswick Hills	Ha	3.6	5.4	11.4	44.1	39.1	30	20	10	B
152	Brunswick Hills	Ha	4.9	5.6	9.0	47.2	38.2	30	20	10	B
153	Brunswick Hills	Ha	5.8	5.0	8.1	39.3	47.6	34	23	11	B
154	Brunswick Hills	Na	9.0	8.3	15.4	49.2	27.1	24	18	6	B
155	Brunswick Hills	Mi	8.9	7.9	11.1	48.2	32.8	26	19	7	B
156	Litchfield	Ha	5.2	6.9	9.1	42.7	41.3	32	21	11	B
157	York	Na	4.2	5.8	11.6	43.7	38.9	28	20	8	B
158	York	Na	6.9	7.0	16.4	44.0	36.6	28	20	8	B
159	York	Ha	2.5	3.6	9.3	43.7	43.4	30	20	10	B
160	Liverpool	Ha	7.8	7.6	9.6	41.1	41.8	31	21	10	B
161	Liverpool	?	7.3	8.4	10.6	41.9	39.1	27	17	10	G
162	Liverpool	Hi	0.7	1.7	2.7	43.5	43.5	29	20	9	B
163	Liverpool	Mi	2.9	4.7	26.0	45.2	24.1	21	15	6	B
164	Liverpool	Ha	6.5	7.8	15.2	46.2	30.7	25	17	8	B
165	Liverpool	Na	7.0	10.5	18.5	44.7	26.2	23	17	6	B
166	Liverpool	Mi	6.0	5.6	24.8	44.8	24.8	20	14	6	G
167	Liverpool	Hi	5.8	5.8	8.0	40.0	46.1	33	20	13	B

Sample no.	Township	Till identification	Size analysis (%)					Atterberg limits			Color
			Gravel	Coarse sand	Fine sand	Silt	Clay	Liquid limit	Plastic limit	Plasticity index	
168	Liverpool	Ha	6.6	6.3	9.3	41.9	42.5	29	19	10	B
169	Liverpool	Hi	4.9	7.2	11.3	41.2	39.7	30	19	11	B
170	Liverpool	Ha	5.0	5.7	8.6	46.1	39.6	28	18	10	B
171	Liverpool	Ha	6.4	5.4	11.3	49.0	34.3	24	16	8	G
173	Brunswick Hills	Ha	6.4	4.9	7.9	41.2	46.0	32	21	11	B
174	Brunswick Hills	Na	7.6	7.2	9.5	42.8	40.5	30	20	10	B
175	Hinckley	Ha	3.7	4.6	8.3	33.9	53.2	39	23	16	B
176	Hinckley	Ha	1.7	2.6	3.8	34.0	59.6	32	21	11	G
177	Hinckley	Hi	3.3	4.6	10.5	43.3	41.6	29	19	10	B
178	Hinckley	Ha	5.2	4.8	13.1	49.7	32.4	27	17	10	B
181	Granger	Ha	4.9	2.8	13.7	45.1	38.4	29	19	10	B
182	Granger	Na	9.2	8.5	14.4	45.6	31.5	26	19	7	B
183	Granger	Ha	5.7	5.7	11.6	46.5	36.2	29	19	10	B
184	Granger	Ha	10.3	8.3	9.7	49.8	32.1	24	17	7	G
185	Hinckley	Ha	5.8	6.8	13.9	44.7	34.6	28	19	9	B
186	Hinckley	Na	13.6	12.3	17.1	42.2	28.4	24	17	7	B
187	Hinckley	Ha	6.8	5.8	4.5	43.9	42.7	32	21	11	B
188	Hinckley	Na	10.3	7.2	5.4	51.2	36.2	32	23	9	B
189	Hinckley	Ha	3.6	5.8	9.8	42.5	41.9	32	20	12	B
190	Hinckley	Ha	4.9	5.5	12.3	44.2	38.0	26	16	10	G
191	Hinckley	Hi	1.4	2.3	4.9	29.6	62.7	36	22	14	B
192	Hinckley	Hi	3.8	6.0	11.8	42.1	40.1	31	19	12	B
193	Hinckley	Ha	5.8	6.5	14.1	42.7	36.7	27	18	9	B
194	Hinckley	Na	6.2	8.0	16.6	40.7	34.7	26	17	9	B
195	Hinckley	Ha	4.3	5.6	7.8	41.9	44.7	27	18	9	G
196	Hinckley	Ha	5.2	5.9	7.5	46.6	40.0	29	19	10	B
197	Hinckley	Ha	7.1	3.3	6.0	41.5	49.2	27	18	9	G
198	Hinckley	Na	10.2	9.1	14.9	44.6	31.4	25	16	9	B
199	Hinckley	Mi	11.3	8.5	14.6	51.7	25.2	23	18	5	B
200	Hinckley	Mi	12.8	10.6	17.1	43.0	29.3	21	14	7	G
201	Hinckley	Na	10.2	9.7	17.9	43.5	28.9	24	17	7	G
202	Hinckley	Na	11.6	9.6	23.2	40.2	27.0	22	16	6	B
203	Hinckley	Mi	7.0	5.7	13.0	50.4	30.9	25	17	8	B
204	Hinckley	Mi	6.7	8.2	22.1	39.0	30.7	20	14	6	G
205	Sharon	Mi	11.1	11.5	25.9	44.3	18.4	21	17	4	B
206	Sharon	Mi	14.7	9.0	17.4	49.4	24.1	23	17	6	G
207	Montville	Ha	6.5	7.9	12.5	49.4	30.1	24	16	8	G
208	Montville	Hi	1.3	1.9	2.9	35.6	59.5	38	23	15	B
209	Montville	Ha	10.5	8.6	13.0	51.9	26.4	22	16	6	G
211	Montville	Ha	6.8	6.6	13.9	45.6	33.9	29	19	10	B
212	Montville	Na	7.1	8.2	15.0	45.6	31.2	26	17	9	B
213	Guilford	Ha	9.3	8.1	14.2	44.4	33.3	26	18	8	B
214	Guilford	Na	7.6	8.7	13.2	44.4	33.7	28	18	10	B
216	Wadsworth	Na	11.9	8.8	30.4	41.6	19.2	20	15	5	B
217	Wadsworth	Mi	10.1	10.5	57.9	50.4	17.0	19	16	3	B
218	Wadsworth	Mi	12.0	11.6	29.4	40.4	18.6	18	14	4	G
219	Wadsworth	Ha	1.1	2.0	6.4	56.4	35.1	29	21	8	B
220	Guilford	Na				no data available					B
221A	Medina	Ha				no data available					B
221	Medina	Ha	5.6	5.6	10.9	43.8	39.7	26	18	8	G
222	Medina	Ha	9.9	10.9	17.9	42.5	28.6	25	17	8	
223	Medina	Ha	6.5	5.6	10.0	41.8	42.6	30	19	11	B
224	Medina	Mi	9.7	8.1	14.0	49.0	28.9	21	16	5	G
225	Medina	Ha	3.7	2.9	6.7	40.2	50.3	37	22	15	B
226	Brunswick Hills	Ha	6.2	6.8	12.9	50.8	29.5	26	19	7	B
227	Brunswick Hills	Mi	11.2	8.9	15.1	47.0	29.0	25	20	5	B
228	Brunswick Hills	Mi	10.4	10.0	15.7	46.8	27.5	22	16	6	G
229	Brunswick Hills	Ha	11.2	9.8	12.5	41.8	35.9	28	20	8	B
230	Brunswick Hills	Mi	6.0	11.3	12.0	42.9	33.8	26	19	7	B
231	Brunswick Hills	Mi	10.5	9.2	14.8	47.1	28.8	22	16	6	G
232	Brunswick Hills	Mi	6.9	5.9	10.2	43.3	40.6	29	19	10	B
233	Brunswick Hills	Mi	8.8	6.0	9.5	44.9	39.6	25	18	7	G
234	Homer	Na	6.1	7.8	14.5	44.5	33.2	28	20	8	B
235	Homer	Ha	7.1	7.1	13.2	40.0	39.8	28	19	9	B
236	Spencer	Ha	5.9	5.6	10.5	39.4	44.5	32	22	10	B

## GLACIAL GEOLOGY OF MEDINA COUNTY

Sample no.	Township	Till identification	Size analysis (%)					Atterberg limits			Color
			Gravel	Coarse sand	Fine sand	Silt	Clay	Liquid limit	Plastic limit	Plasticity index	
238	Chatham	Ha	3.4	5.4	11.1	39.5	44.0	35	22	13	B
239	Chatham	Ha	6.1	7.3	10.5	40.1	42.1	31	20	11	B
240	Harrisville	Hi	4.2	6.4	11.8	42.3	39.4	31	20	11	B
241	Harrisville	Ha	6.5	6.9	14.3	43.5	35.3	28	19	9	B
242	Harrisville	Ha	4.4	5.4	10.1	44.9	39.6	28	17	11	G
243	Chatham	Ha	3.5	4.6	11.1	41.0	43.3	31	20	11	B
244	Spencer	Ha	7.3	7.0	10.1	36.8	46.0	33	20	13	B
245	Westfield	Ha	5.5	5.6	10.7	45.3	38.4	28	20	8	B
246	Westfield	Mi	9.2	7.9	13.3	44.3	34.5	28	19	9	B
247	Westfield	Ha	4.2	5.7	10.7	44.0	39.5	30	19	11	B
248	Westfield	Mi	4.6	7.5	15.0	49.0	28.5	24	18	6	B
249	Westfield	Na	6.8	5.2	9.6	46.3	38.9	29	20	9	B
250	Harrisville	Mi	5.8	7.2	13.2	49.7	29.9	22	15	7	G
251	Harrisville	Ha	3.3	3.0	6.8	38.5	51.8	34	21	13	B
252	Harrisville	Ha	4.8	5.5	8.6	38.6	47.2	34	21	13	G
253	Harrisville	Mi	10.8	11.3	15.7	39.3	33.7	27	18	9	G
254	Westfield	Hi	2.8	3.7	15.1	49.6	31.5	27	19	8	B
255	Westfield	Na	10.6	9.2	16.0	44.9	29.9	25	18	7	B
256	Guilford	Na	10.2	6.6	12.1	48.7	32.6	27	19	8	B
257	Guilford	Mi	7.4	7.0	11.6	47.0	34.4	27	18	9	B
258	Montville	Ha	5.5	6.5	13.3	46.0	34.3	28	19	9	B
259	Montville	Na	8.3	10.7	17.1	44.6	27.5	24	18	6	B
260	Medina	Ha	3.5	4.4	9.8	44.4	41.4	30	21	9	B
261	Medina	Mi	4.8	5.9	9.5	43.6	41.0	26	18	8	G
262	Granger	Na	13.9	17.9	23.8	36.8	21.6	21	15	6	B
263	Granger	Na	6.6	8.5	13.4	42.5	35.6	27	18	9	G
264	Granger	Mi	8.4	9.9	15.7	43.2	31.2	24	17	7	G
265	Granger	Mi	17.6	17.1	22.3	37.9	22.7	20	15	5	G
266	Granger	Mi	6.8	6.8	12.7	47.0	33.5	25	17	8	G
267	Brunswick Hills	Ha	6.7	5.3	9.5	41.4	43.8	32	20	12	B
268	Medina	Mi	3.1	4.2	9.3	45.0	41.4	29	19	10	B
269	Medina	Mi	5.9	3.7	8.3	45.4	42.6	27	18	9	G
270	Westfield	Mi	4.8	11.2	21.2	42.2	25.4	19	14	5	G

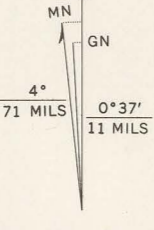
- Recent**
- cf**  
*Made land.* Areas of excavation or filling where original land surface has been modified by man
  - al**  
*Alluvium.* Silt, sand, and gravel on floodplains. Thickness highly variable
  - Wl**  
*Lake deposits.* Sand, silt, clay, peat, and muck of variable thickness in kettle holes, proglacial lakes, and valleys dammed by end moraines
  - Wo** **Wal**  
*Outwash.* Sand and gravel in valley trains (Wo) preserved as terraces along valley sides; includes silt, sand, and gravel in alluvial terraces (Wal) formed by streams graded to higher levels of Lake Erie. May be in two or more levels
  - Wk**  
*Kames and kame terraces.* Sand and gravel in knolls or in terraces; overlain by till in many places
- Quaternary**
- Woodfordian**
- g**  
*Ground moraine.* Till, generally thin and discontinuous, in gently rolling topography; till thickness generally less than 25 feet
  - g**  
*End moraine.* Till in linear belts of hummocky topography; till thickness generally greater than 25 feet. Areas of gravelly moraine shown by overprint
  - Whg** **Whe**  
*Hiram Till.* Silty clayey till, generally about 4 feet thick
  - Whag** **Wheg**  
*Hayesville Till.* Silty clayey till, generally less than 6 feet thick

- Boundary of deposit or landform, dashed where approximate
- Approximate boundary of Hiram Till
- Approximate boundary of continuous Hayesville Till
- 900- Contour on bedrock surface, contour interval 100 feet
- ⊗ Gravel pit, active
- ⊗ Gravel pit, small or abandoned
- ⊗ Rock quarry

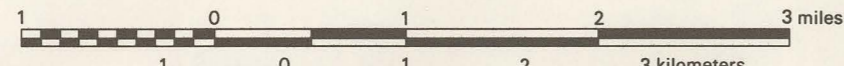
10,000-foot grid based on Ohio coordinate system, north zone  
 1927 North American datum



LOCATION MAP



UTM GRID AND 1973 MAGNETIC NORTH  
 DECLINATION AT CENTER OF WESTFIELD CENTER QUADRANGLE



PHOTOTYPESetting BY JEAN M. LESHER  
 CARTOGRAPHIC DRAFTING BY LISA VAN DOREN  
 CONTOURS ON BEDROCK SURFACE BY MICHELE L. RISSER

WILLIAMSON (1933)	WELLS (1933)	WEST CREEK (1961)	WESTERN (1933)	WESTFIELD (1933)
WILSON (1933)	WELLS (1933)	WELLS (1933)	WELLS (1933)	WELLS (1933)
WELLS (1933)	WELLS (1933)	WELLS (1933)	WELLS (1933)	WELLS (1933)
WELLS (1933)	WELLS (1933)	WELLS (1933)	WELLS (1933)	WELLS (1933)
WELLS (1933)	WELLS (1933)	WELLS (1933)	WELLS (1933)	WELLS (1933)

1:24,000 U.S. GEOLOGICAL SURVEY TOPOGRAPHIC  
 QUADRANGLE MAPS COVERING MEDINA COUNTY (DATES  
 IN PARENTHESES INDICATE DATE OF NEGATIVES USED  
 TO COMPLETE BASE)

County lies within Connecticut Western Reserve  
 CONTOUR INTERVAL 5 AND 10 FEET  
 DATUM IS MEAN SEA LEVEL

