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Little Miami Watershed Map
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Map MG-6

LITTLE MIAMI RIVER WATERSHED

by

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GEOLOGIC SETTING

To the casual observer, the terrain found within the drainage basin of the Little Miami River is nothing out of the ordinary. The landscape is varied and includes areas of gently rolling hills and strikingly flat topography. The Little Miami River and its multiple tributaries seem to randomly meander, twisting back and forth across the landscape. For the geologist, the topography and subtle bends of the river tell a series of interesting stories, both for this region itself and how it relates to events which helped shape the precursor of what we now refer to as North America.

The story begins with the underlying bedrock, which was deposited some 450 million years ago during the Ordovician Period. At that time, this area of Ohio was located roughly 30 degrees south of the equator and was submerged beneath a shallow tropical sea. On the bottom of this sea, alternating beds of limestone and shell-based material were deposited along with mud. This sea was frequently visited by large tropical storms (the equivalent of modern hurricanes or typhoons), which occasionally disrupted the normal pattern of sediment deposition. Coarse material such as shells, corals, and other related fragments settled out rapidly because of their size and weight and formed layers of shell-based limestone.

During calmer climate periods, finer mud and silt slowly settled out to form a cap of fine-grained shale or mudstone overlying the limestone. This process was very cyclical, repeating itself countless times during the Ordovician Period, and leaving assemblages of fossils that are valued by paleontologists throughout the world. By the end of the Ordovician Period, sea level had dropped, exposing the sediments to some erosion and weathering. These flat-lying Ordovician bedrock layers are relatively soft and erode easily, especially the mud- and silt-based shales.

Following the period of erosion at the end of the Ordovician Period, sea levels rose once again at the beginning of the Silurian Period, roughly 440 million years ago. A marine limestone covering the northern part of the region marks this deposition during the beginning of the Silurian Period. This limestone was deposited in a shallow marine environment and lacks the softer shale associated with the Ordovician deposits. A substantial portion of this Silurian carbonate rock is referred to by geologists as *dolomite*, which contains magnesium. This makes the rock harder and more resistant to dissolution and erosion. The resistant Silurian layers are also found along the Little Miami River streambed and form small waterfalls and narrows, whereas the softer, underlying Ordovician rocks have been eroded, undercutting the overlying Silurian bedrock. Clifton Gorge State Nature Preserve near Yellow Springs provides an excellent example of this. The record of bedrock deposition in this region ends with these flat-lying marine shale, limestone, and dolomite units. Since this deposition, nearly 440 million years of erosion have removed any subsequent bedrock deposits.

Near the end of this long erosional interval (around 1 million years ago), an old, northwesterly-flowing paleo-river system beginning in West Virginia flowed through Ohio, Indiana, and Illinois before turning south towards the Gulf of Mexico. This ancient river system is referred to as the *Teays River*, and it cut narrow, deep valleys into the underlying bedrock. Examples of such deep valleys can be observed around Cincinnati, along the Ohio River, and along portions of the Little Miami River. The Teays drainage entered Ohio near Portsmouth and flowed northward into Pickaway County before turning westward, eventually passing through western Ohio near Grand Lake St. Marys and into Indiana. Today, most of these valleys have been filled in by subsequent glacial deposits, but a few have been re-eroded to form anomalous, short, wide-open, flat-bottomed valleys. An early glacial advance about 730,000 years ago formed numerous temporary glacial lakes and new rivers, including the Ohio River, which roughly follows the limit of the continental glacial margin of the time. Past geologic history of glaciation and erosion from both pre- and post-glaciation river systems has shaped the history of the Little Miami River watershed for millions of years.

The Little Miami River Watershed includes much of the outer edge of the Illinoian Age glaciation (roughly 300,000–130,000 years ago). Because the ice is thought to have been relatively thin and lost much of its massive erosive power at its extreme southern edge, glacial sediments from the Illinoian Glaciation typically are thin (less than 40 feet) and flat lying, essentially mimicking the underlying and considerably older Ordovician and Silurian bedrock. The northern portion of this watershed was influenced by the Wisconsinan Glaciation (roughly 25,000–18,000 years ago) so that near South Charleston, the surrounding landscape may be as young as 18,000 years old. The Wisconsinan ice advance deposited a thicker blanket of glacial drift (30–80 feet) over the landscape. This landscape features some rolling hills and numerous gently rolling rises and lows. This bumpy appearance is referred to by geologists as a *hummocky glacial terrain*. There are also some more-pronounced ridges that are referred to as *end moraines*. These moraines approximate a standstill in the ice movement that resulted in a thicker accumulation of glacial drift.

Following the last (Wisconsinan) ice advance, the landscape slowly began to evolve into its present configuration. A network of streams began to develop, leading to what we now refer to as the Little Miami River Watershed. Dramatic natural events shaped the topography of the watershed during the course of millions of years. Numerous hurricanes, rising and falling ancient tropical seas, and at least two major ice advances all contributed to shaping this area into its current form.

The main stem of the Little Miami River has a 107-mile-long, uniform gradient broken only by an abrupt change at Clifton Gorge State Nature Preserve. This change in gradient occurs where the river crosses resistant, hard-to-erode Silurian dolomites at Clifton Gorge. Above Clifton Mill Falls, the landscape features a flat profile that abruptly ends on glacial end moraines. In this area, much of the river has been diked and bedrock is not exposed. From Clifton Mill Falls to the Ohio River, the longitudinal profile is very uniform and bedrock is more frequently exposed. Over this stretch between Clifton Mill Falls and the Ohio River, the Little Miami River consists of a series of quiet-water reaches separated by riffles formed by thin, resistant, Ordovician limestone ledges. The riffles contain slabs of limestone and scattered logs. On the inside of the river bends are gravel bars.

The Little Miami River and its tributaries feature numerous sharp bends or meanders that at first glance appear to be random. Between these sharp bends are relatively straight (or linear) stream segments. These straight portions of the river tend to follow the pattern of lineaments in the region (fig. 1). Lineaments are linear features in the landscape that are typically an expression of a deeper fault or fracture system in the underlying bedrock. Geologists scrutinize topographic maps, models, and aerial photos to map lineaments in a region.

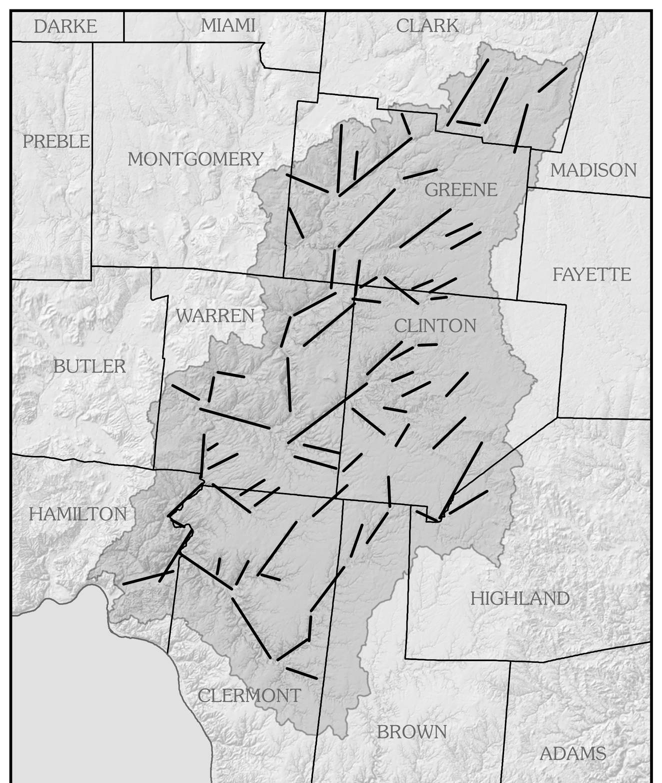

FIGURE 1. Lineaments in the Little Miami River Watershed.

The faults and fractures are a result of large tectonic forces that helped shape the continent over the millennium (fig. 2). The oldest rocks exposed at the land surface of the North American Continent are in Northern Canada. The pattern of faults and fractures observed on these rocks is then extended into the subsurface. Lineaments on the land surface represent these deeper faults and fractures. The regional lineaments trend mostly northwest and southeast. The trends for the Little Miami River Watershed area roughly match the major tectonic trends for the continent and help tell the story of how this landscape has evolved over time.

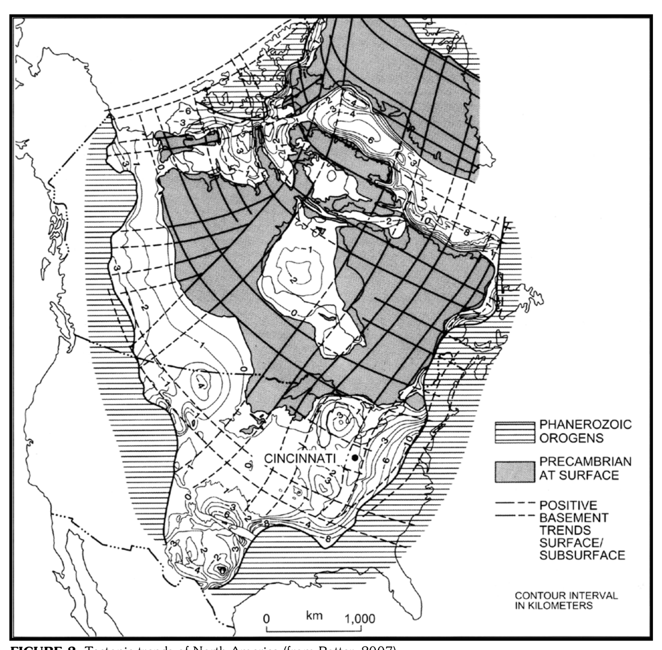

FIGURE 2. Tectonic trends of North America (from Potter, 2007).

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Brockman, C.S., Pavey, R.P., Schumacher, G.A., Shrake, D.L., Swinford, E.M., and Vorbau, K.E., 2004, Surficial Geology of the Ohio Portions of the Cincinnati and Falmouth 30 x 60 minute Quadrangles: Ohio Department of Natural Resources, Division of Geological Survey Map SG-2 Cincinnati-Falmouth, scale 1:100,000.

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Camp, M.J., 2006, Roadside Geology of Ohio: Missoula, Montana, Mountain Press Publishing Company, 410 p.

An excellent book that gives the reader a great perspective of the geology they are viewing along many of Ohio's major roadways.

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Meyer, D.L., and Davis, R.A., 2009, A sea without fish—life in the Ordovician sea of the Cincinnati Region: Bloomington, Indiana University Press, 346 p.

An excellent book that synthesizes more than 150 years of research on the fossil-rich Cincinnati region. The book describes and illustrates the fossils, the life habits and communities of the animals represented, and living relatives. Includes discussion of the nature of the rock strata in which they are found and the environmental conditions of the ancient sea.

Potter, P.E., 2007, Exploring the geology of the Cincinnati/Northern Kentucky Region: Kentucky Geological Survey, Special Publication 8.

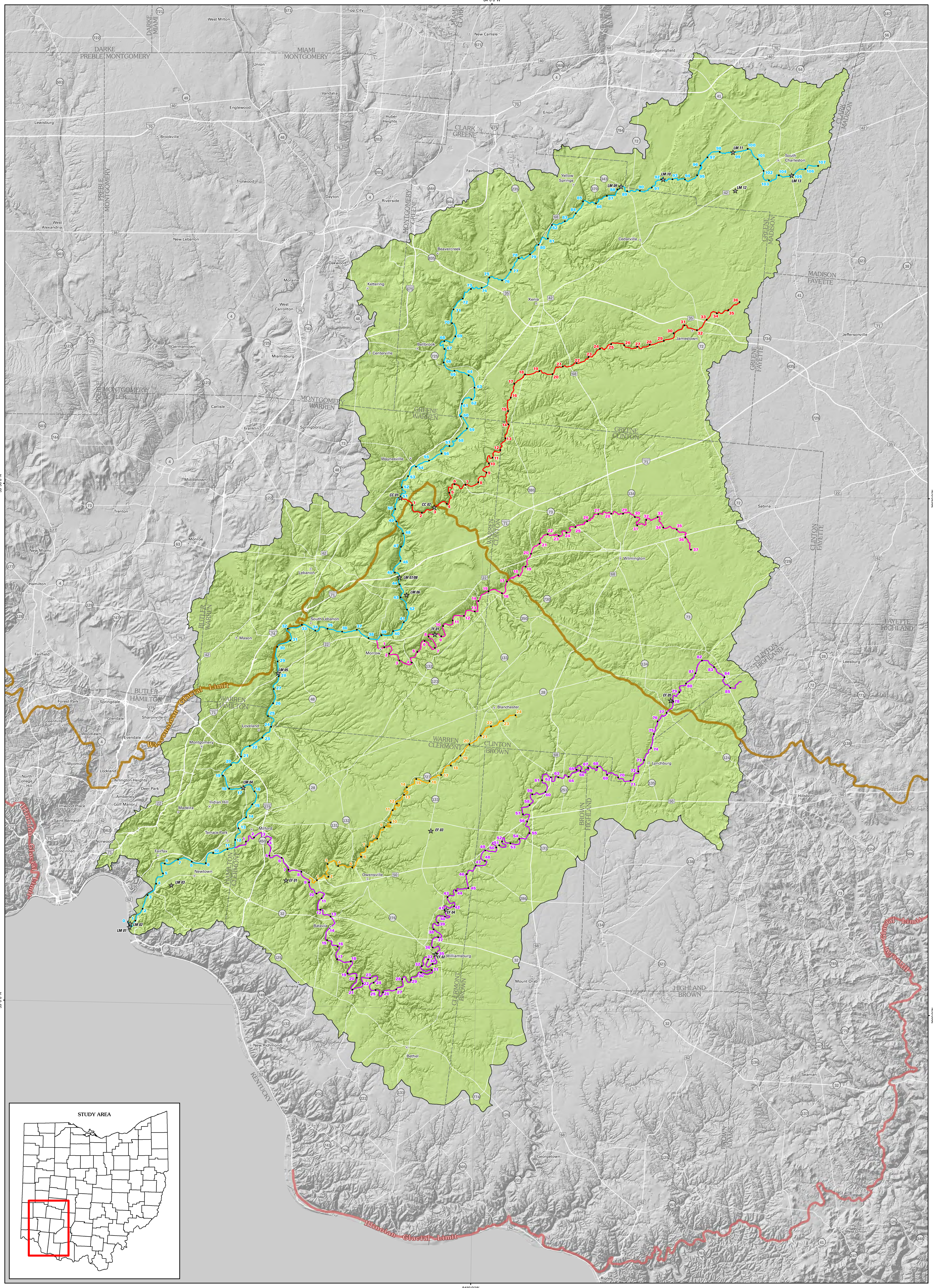
Provides an integrated overview from the basement (Precambrian) up to the glacial cover of the Greater Cincinnati through Northern Kentucky region. Includes discussions on regional drainage, the Cincinnati Arch, bedrock and surficial geology, and geologic processes. Eighty-seven illustrations; some background required.

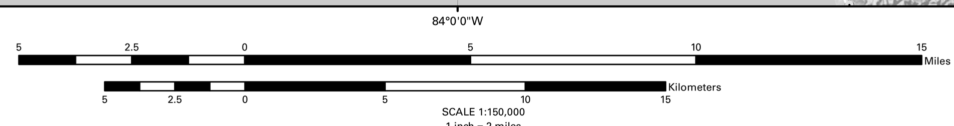
Schumacher, G.A., Mott, B.E., and Angle, M.P., 2013, Ohio's geology in core and outcrop—a field guide for citizens and environmental and geotechnical investigators: Ohio Department of Natural Resources, Division of Geological Survey Information Circular 63.

An outstanding, easy-to-understand and well-illustrated overview of Ohio's geology and its many aspects. Great book for those wanting to learn.

EXPLANATION

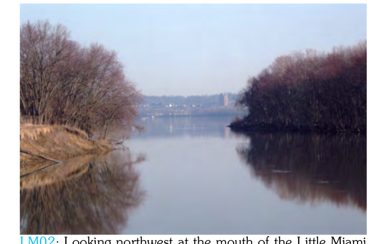
- Photograph Locations
- Mile Marker
- Caesar Creek
- East Fork Little Miami River
- Little Miami River
- Stonelick Creek
- Todd Fork
- Illinoian Glacial Limit
- Wisconsinan Glacial Limit
- Little Miami River Watershed





LITTLE MIAMI RIVER

LM01: Looking northwest to the mouth of the Little Miami River from its bank at the Greater Cincinnati Water Works, 5651 Kellogg Ave., California, Anderson Twp., Hamilton Co., Ohio. Both rivers have very broad, flat floodplains at the merger.

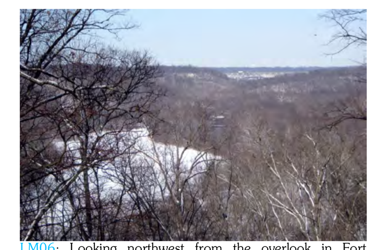


LM02: Looking northwest at the mouth of the Little Miami River and downstream along the Ohio River into Kentucky from the Cincinnati Waterworks in California, Anderson Twp., Hamilton Co., Ohio. The Little Miami River takes a sharp bend to the northwest immediately before joining the Ohio River.

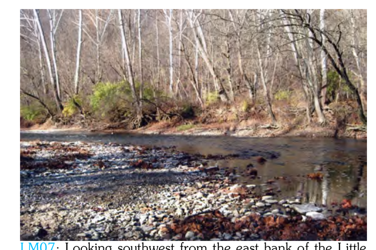
LM03: Looking westward across the wide valley of the Little Miami River from Mail Box 2988 on Saddleback Dr., Turpin Hills, Anderson Twp., Hamilton Co., Ohio. The wide valley contains thick sequences of glacial and alluvial deposits.

LM04: Looking downstream and east at the partially frozen Little Miami from the OH 126 bridge north of Camp Dennison, Hamilton Co., Ohio. The Little Miami River is relatively wide and shallow through this portion.

LM05: Looking upstream and north at a frozen Little Miami River from the parking lot at the east end of the old US 22 bridge at Foster, Hamilton Twp., Warren Co., Ohio. The Little Miami River has become considerably wider at this portion.



LM06: Looking northwest from the overlook in Fort Ancient up the narrow valley of the Little Miami River to the highest bridge in Ohio, the 280-foot-high span on I-71 northeast of Lebanon, Warren Co., Ohio. The Little Miami River has steeply downcut a gorge in this area, providing scenic overlooks.



LM07: Looking southwest from the east bank of the Little Miami River at a slabby gravel bar. Turtle Creek Twp. just below the I-71 bridge crossing the gorge of the river in Warren Co., Ohio. The gravel bar indicates the depositional nature of the Little Miami River in this reach.

LM08: Looking upstream and north at the I-71 bridge over the Little Miami River from the east bank about 1.3 miles north of OH 350 in Washington and Turtle Creek Twps., Warren Co., Ohio.

LM09: Looking southeast at the Little Miami River from John L. Rich Trail in John Bryan State Park, Miami Twp., Greene Co., Ohio. The river flows rapidly through this constricted portion.

LM10: Looking northwest down the Little Miami River from the bridge on Pitchin Rd. in Clark Co., Ohio. The rolling hills in this area are indicative of the Wisconsinan-age ground moraine in this area.

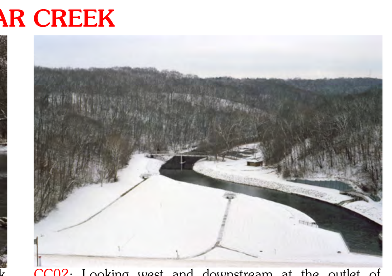
LM11: Looking east at the straightened and now channelized Little Miami from the bridge of Dolly Varden Rd., Madison Twp., Clark Co., Ohio. Portions of the Little Miami that seem unusually straight have often been artificially straightened. It was once believed that such straightening helped with flood control.

LM12: Looking west at north wall of Clifton Gorge in Clifton Gorge State Park, Greene CO., Ohio. The photo depicts the porous nature of the Silurian Cedarville Dolomite.

LM13: Looking west at the Little Miami River from the bridge on OH 41, just below South Charleston, Madison Twp., Clark Co., Ohio. Near the headwaters, the Little Miami is a small stream derived from precipitation runoff and minor shallow groundwater flow.

CAESAR CREEK

CC01: Looking southwest at the junction of Caesar Creek and the Little Miami River in Wayne Twp. off Corwin Rd., Warren Co., Ohio. The junction is near the margin and a major bend in the Wisconsinan glacial boundary.



CC02: Looking west and downstream at the outlet of Caesar Creek Dam at the narrow gorge of Caesar Creek in Wayne Twp., Warren Co., Ohio. This is one of the premier collecting areas for Ordovician-age fossils in southwest Ohio.

TODD FORK

TF01: Looking east and up Todds Fork from the bridge of Middlesboro Rd. in Washington Twp., Warren Co., Ohio. This portion of Todds Fork is relatively steep-sided and contains many bends and twists.

EAST FORK LITTLE MIAMI RIVER

EF01: Looking northeast across the floodplain, probably a slackwater surface of the East Fork from near Mail Box 1309 on Tealtown Rd., Union Twp., Clermont Co., Ohio. The slackwater surface indicates a former damming and ponding of the stream by sediment or ice.

EF04: Looking north at the valley wall and flood plain of the East Fork of the Little Miami River from Mail Box 3518 on Jackson Pike, Jackson Twp., Clermont Co., Ohio.

EF02: Looking northeast at very low flow of the East Fork of the Little Miami River from its bridge at Main St., Williamsburg, Batavia Twp., Clermont Co., Ohio. In this area, the Illinoian glacial cover is thin and the Ordovician bedrock is also a poor aquifer. Streamflow is dependent upon precipitation runoff and declines during the drier fall season.

EF05: Looking southeast at the wide, shallow valley of the East Fork of the Little Miami (distant tree line) north of Lynchburg, from Mail Box 8482 on Farmers Rd., Lark Twp., Clinton Co., Ohio. The flat nature of the Illinoian till plain remains evident.

EF03: Flat, poorly drained landscape of Illinoian till plain as seen from OH 133 in Jackson Twp., northeastern Clermont Co., Ohio. The thin, clayey Illinoian till plain closely mimics the flat, underlying Ordovician bedrock.

Recommended Bibliographic Citation

Potter, P.E., Powers, D.M., Aden, D.J., Martin, D.R., and Angle, M.P., 2020, Little Miami River Watershed: Ohio Department of Natural Resources, Division of Geological Survey Map MG-6, scale 1:150,000 (1 inch = 2 miles).

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