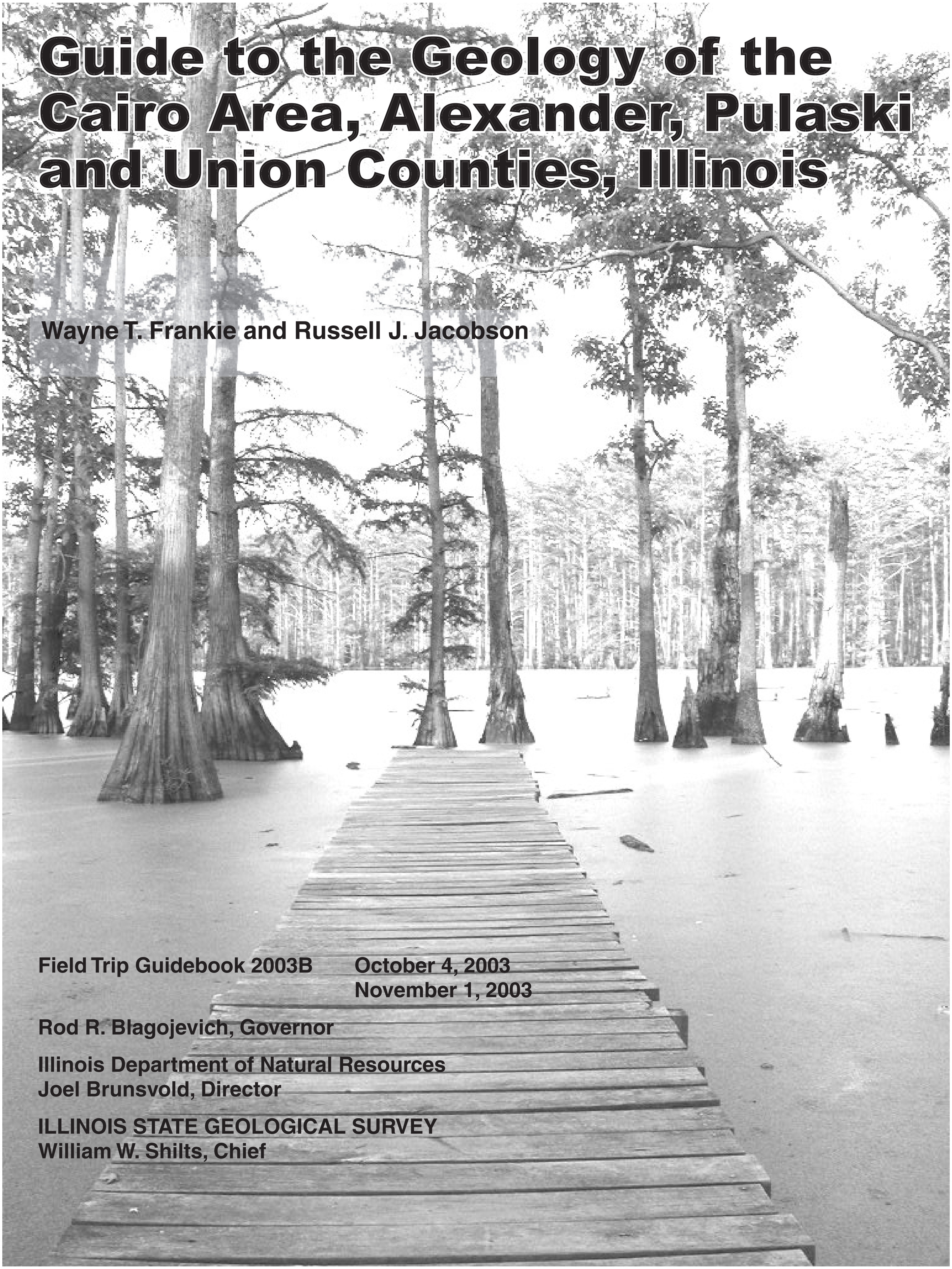
Guide to the Geology of the Cairo Area, Alexander, Pulaski and Union Counties, Illinois



Wayne T. Frankie and Russell J. Jacobson

Field Trip Guidebook 2003B October 4, 2003
November 1, 2003

Rod R. Blagojevich, Governor

Illinois Department of Natural Resources
Joel Brunsvold, Director

ILLINOIS STATE GEOLOGICAL SURVEY
William W. Shilts, Chief

Cover photo: *Bald cypress trees at Horseshoe Lake State Conservation Area, in Alexander County (photo by W. T. Frankie).*

Geological Science Field Trips The Illinois State Geological Survey (ISGS) conducts four tours each year to acquaint the public with the rocks, mineral resources, and landscapes of various regions of the state and the geological processes that have led to their origin. Each trip is an all-day excursion through one or more Illinois counties. Frequent stops are made to explore interesting phenomena, explain the processes that shape our environment, discuss principles of earth science, and collect rocks and fossils. People of all ages and interests are welcome. The trips are especially helpful to teachers who prepare earth science units. Grade school students are welcome, but each group of five must be accompanied by a parent or guardian. High school science classes should be supervised by at least one adult for each ten students. Preregistration is required.

A list of guidebooks of earlier field trips for planning class tours and private outings may be obtained by contacting the Geoscience Outreach Coordinator, Illinois State Geological Survey, Natural Resources Building, 615 East Peabody Drive, Champaign, IL 61820-6964. Telephone: (217) 333-4747. This information is on the ISGS home page: http://www.isgs.uiuc.edu.

Nine USGS 7.5-Minute Quadrangle maps (Cache, Cairo, Charleston, Dongola, Mill Creek, Olmsted, Pulaski, Tamms, and Wyatt) provide coverage for this field trip area.

This field guide is divided into four sections. The first section serves as an introduction to the geology of southern Illinois and in particular Alexander, Pulaski, and Union Counties and the area surrounding Cairo Illinois. The second section is a road log for the trip, and the third section provides detailed stop descriptions. The final sections include supplementary materials that are important to the field trip area.

ILLINOIS DEPARTMENT OF NATURAL RESOURCES

ISGS Illinois State Geological Survey

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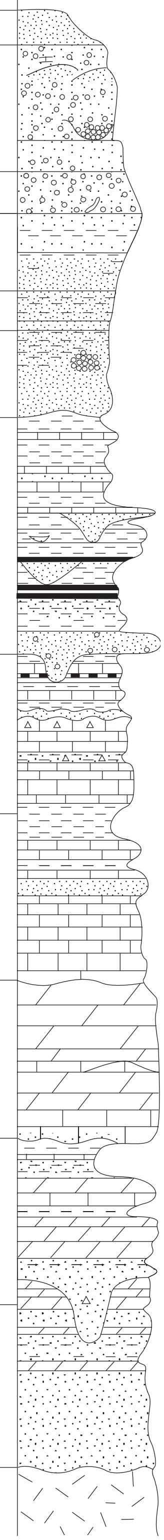
CONTENTS

Era		Period or System and Thickness	Epoch	Age (years ago)	General Types of Rocks
CENOZOIC "Recent Life"	Age of Mammals	Quaternary 0-500'	Holocene	10,000	Recent–alluvium in river valleys
			Pleistocene Glacial Age	1.8 m	Glacial till, glacial outwash, gravel, sand, silt, lake deposits of clay and silt, loess and sand dunes; covers nearly all of state except northwest corner and southern tip
		Tertiary 0-500'	Pliocene	5.3 m 33.7 m	Chert gravel, present in northern, southern and western Illinois
			Eocene	54.8 m	Mostly micaceous sand with some silt and clay; presently only in southern Illinois
			Paleocene	65.0 m	Mostly clay, little sand; present only in southern Illinois
MESOZOIC "Middle Life"	Age of Reptiles	Cretaceous 0-300'		144 m 290 m	Mostly sand, some thin beds of clay, and, locally, gravel, present only in southern Illinois
PALEOZOIC "Ancient Life"	Age of Amphibians and Early Plants	Pennsylvanian 0-3,000' ("Coal Measures")		323 m	Largely shale and sandstone with beds of coal, limestone, and clay
		Mississippian 0-3,500'		354 m	Black and gray shale at base, middle zone of thick limestone that grades to siltstone chert, and shale; upper zone of interbedded sandstone, shale, and limestone
	Age of Fishes	Devonian 0-1,500'		417 m	Thick limestone, minor sandstones and shales; largely chert and cherty limestone in southern Illinois; black shale at top
	Age of Invertebrates	Silurian 0-1,000'		443 m	Principally dolomite and limestone
		Ordovician 500-2,000'		490 m	Largely dolomite and limestone but contains sandstone, shale, and siltstone formations
		Cambrian 1,500-3,000'		543 m	Chiefly sandstones with some dolomite and shale; exposed only in small areas in north-central Illinois
		Precambrian			Igneous and metamorphic rocks; known in Illinois only from deep wells



Generalized geologic column showing succession of rocks in Illinois.

INTRODUCTION

Southern Illinois Regional Setting

The extreme southern part of Illinois, known as Little Egypt, is one of the state's most historic areas, both in terms of geologic and human development. This geological science field trip will acquaint you with the *geology*[1], landscape, and mineral resources for part of Alexander, Pulaski, and Union Counties, Illinois. The starting point for the field trip is at Fort Defiance State Park, located approximately 2 miles south of Cairo at the confluence of the Mississippi and Ohio Rivers. Before there was a Cairo or a Fort Defiance, this area was called Bird's Point. Cairo is 374 miles south of Chicago, 227 miles southeast of Springfield, and 153 miles southeast of East St. Louis.

Alexander County was formed from an original part of Johnson County on March 4, 1819. The county is named for William M. Alexander, an early settler of the district and the Speaker of the Illinois State House of Representatives in 1822. Cairo (pronounced "care-oh"), the county seat and largest city in the region, is listed in the *National Register of Historic Places.* The city of Cairo was established on September 25, 1818, after a treaty was signed with the Kaskaskia and Peoria tribes. Meriwether Lewis signed the treaty as the Governor and Superintendent of Indian Affairs. Pulaski County was formed on March 3, 1843, from Alexander County. Pulaski County is named for Count Casimir Pulaski, Polish hero who was killed in the attack on Savanna in 1779. Union County was formed on January 2, 1818, and is named for the Federal Union of the American States.

The Cairo area geological science field trip is located in extreme southern Illinois, in one of only two regions in Illinois where Paleozoic, Mesozoic, and Cenozoic strata occur together (see Generalized geologic column, facing page). The field trip area lies within parts of four Physiographic Provinces: Interior Low Plateaus Province, Ozark Plateaus Province, Central Lowland Province, and Coastal Plain Province. Most of the field trip is within the northern part of the Coastal Plain Province, a region of low, gentle hills formed upon soft Mesozoic and Cenozoic sediments. A portion of the field trip is within the southeastern part of the Ozark Plateaus Province, a region of rugged hills and high surface elevations, underlain by deeply weathered Paleozoic chert and cherty limestone formations. The last stop is along the southwestern edge of the Shawnee Hills Section of the Interior Low Plateaus Province, a region of rugged, scenic terrain developed on resistant Paleozoic strata. The Physiographic Provinces are discussed in more detail later in this guide.

GEOLOGIC FRAMEWORK

Precambrian Era

Through several billion years of geologic time, the area encompassing the extreme southern portion of Illinois has undergone many changes.

Bedrock strata in the area range in age from more than 520 million years (the Cambrian *Period*) to less than 1.8 million years old (the Tertiary Period). Figure 1 shows the succession of Paleozoic rock strata a drill bit would penetrate in this area if the rock record were complete and all the *formations* were present.

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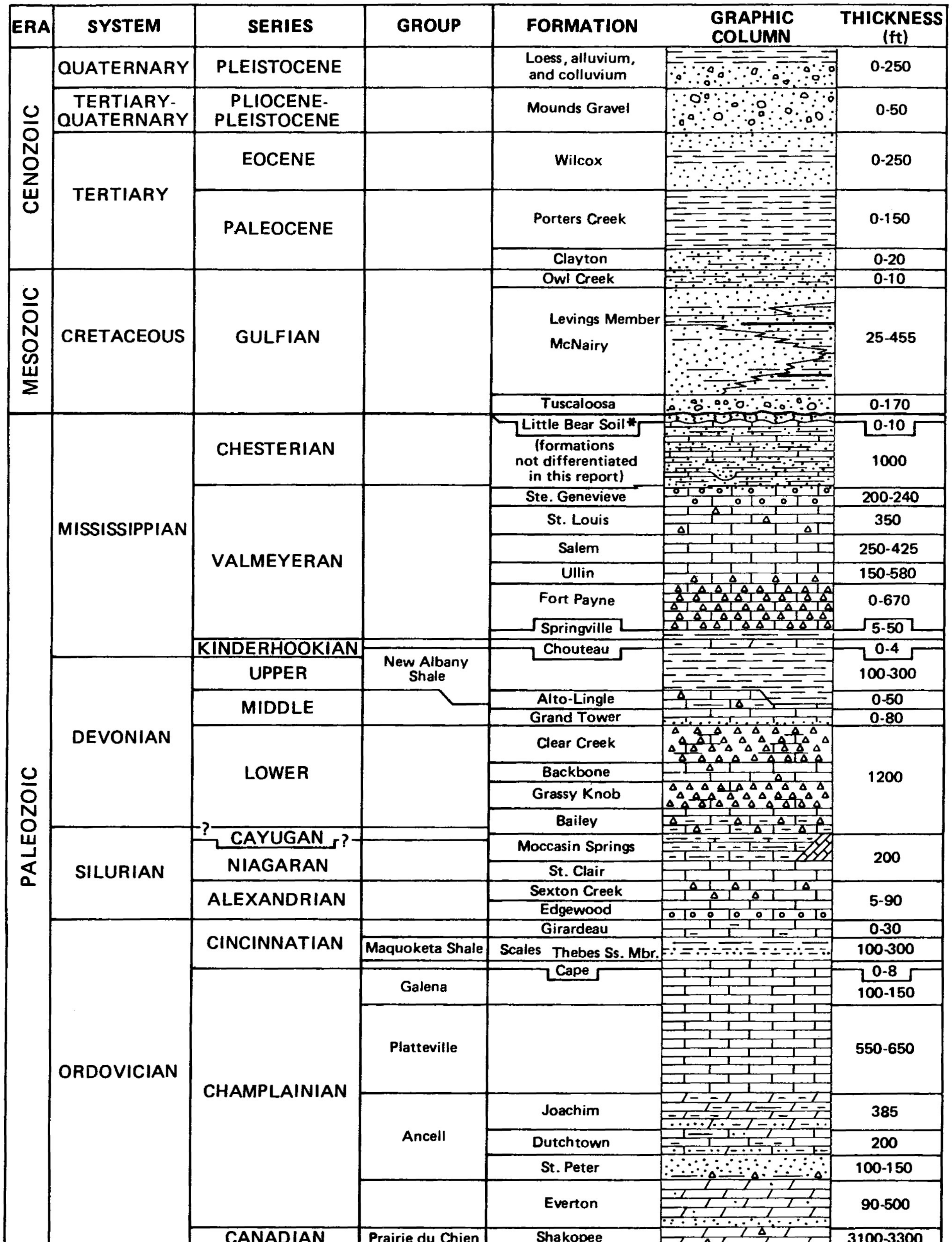
[1] Terms in italics (except for Latin names) are defined in the glossary at the back of the guidebook. Also, please note: although all present localities have only recently appeared within the geologic time frame, the present names of places and geologic features are used because they provide clear reference points for describing the ancient landscape.



*Soil developed on Paleozoic rocks that range in age from Ordovician to Mississippian.

Figure 1 Generalized stratigraphic column of the upper rock formations in the field trip area (modified from Kolata et al. 1981).

The boundary between two major geologic structures, the Illinois Basin to the north and the Mississippi Embayment to the south, occurs along the northern part of the field trip area (fig. 2). The Illinois Basin is a large bedrock structure containing a thick sequence of Paleozoic sedimentary rocks that have been warped into a great spoon-shaped depression, 250 to 300 miles in diameter, that covers most of Illinois and adjacent parts of Indiana and Kentucky (figs. 1, 2, and 3). The deepest part of the basin in Illinois is about 65 miles northeast of Cairo. The Precambrian rocks are more than 10,000 feet below sea at Cairo, and the Paleozoic rocks thicken to the north from about 10,300 feet at Cairo to more than 11,300 feet near Olmsted.

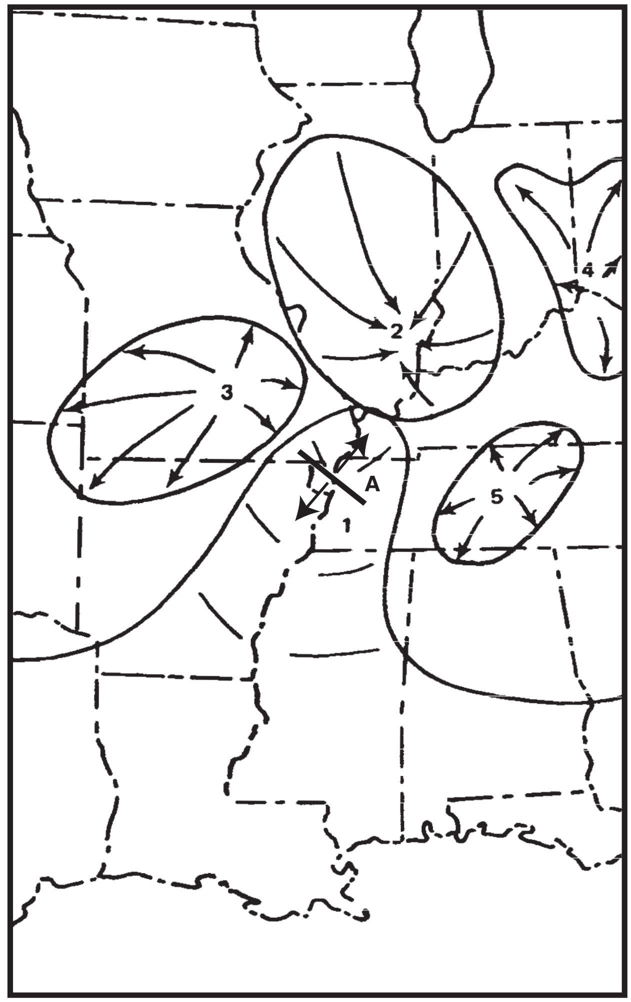


Figure 2 Index map, showing the location of the Mississippi Embayment (1) and adjacent major structures: (2) Illinois Basin, (3) Ozark Dome, (4) Cincinnati Arch, (5) Nashville Dome, and (A) Pascola Arch.

Paleozoic Era

After the beginning of the Paleozoic Era, about 520 million years ago in the late Cambrian Period, the hilly Precambrian landscape began to sink slowly on a broad regional scale, allowing the invasion of a shallow sea from the south and southwest. During the 280 million years of the Paleozoic Era, the area that is now called the Illinois Basin continued to accumulate sediments that were deposited in the shallow seas that repeatedly covered this subsiding basin. The region continued to sink until at least 20,000 feet of sedimentary strata were deposited in the deepest part of the basin in southeastern Illinois and western Kentucky. At various times during this era, the seas withdrew, and deposits were weathered and eroded. As a result, some gaps exist in the sedimentary record in Illinois.

The Cairo field trip area is situated near the extreme southern margin of the Illinois Basin where it is underlain by about 12,500 feet of Paleozoic rocks, ranging in age from Cambrian up to middle Mississippian. Only Paleozoic rocks of Devonian and middle Mississippian age are exposed in this field trip area (fig. 1). Devonian rocks consist largely of chert and cherty limestone formations and some sandstone. The middle Mississippian (Valmeyeran) consists predominantly of limestone although some siltstone and sandstone are present. These Mississippian strata were deposited about 330 million years ago in shallow seas that covered the midcontinent region. Hundreds of feet of younger Mississippian and Pennsylvanian strata, which occur a few miles to the north and east, also once covered the Cairo area, but erosion stripped them away during the 150 to 190 million years or so that followed the withdrawal of the Pennsylvanian seas and preceded the advance of the upper Cretaceous sea.

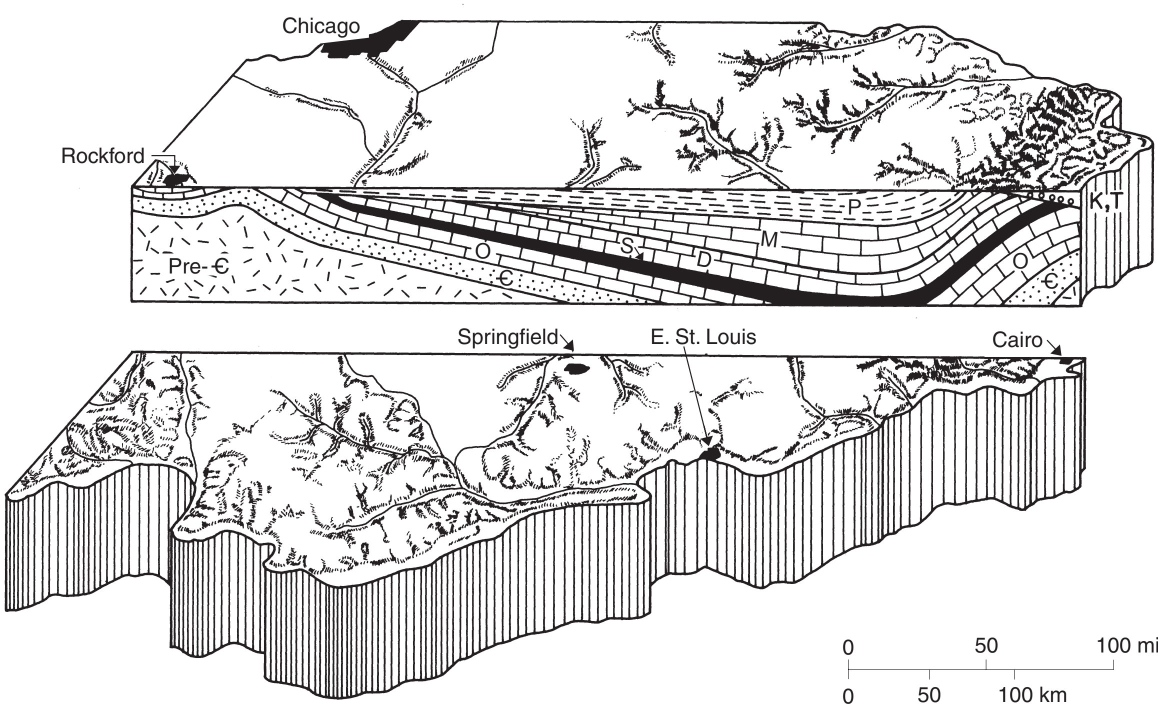


Figure 3 Stylized north-south cross section shows the structure of the Illinois Basin. To show detail, the thickness of the sedimentary rocks has been greatly exaggerated and younger, unconsolidated surface deposits have been eliminated. The oldest rocks are Precambrian (Pre-€) granites. They form a depression filled with layers of sedimentary rocks of various ages: Cambrian (C), Ordovician (O), Silurian (S), Devonian (D), Mississippian (M), Pennsylvanian (P), Cretaceous (K), and Tertiary (T). Scale is approximate.

It seems likely that an undetermined thickness of younger strata of the Permian System (the youngest Paleozoic rocks) were deposited across this region and then subsequently removed by erosion over millions of years. The base of the Cambrian sedimentary rocks rests upon an ancient Precambrian basement of crystalline granitic rocks more than 1 billion years old (fig. 3).

STRUCTURAL SETTING

The tectonic uplifting of the Pascola Arch is responsible for the regional northward dipping nature of the Paleozoic rocks along the southern portion of the Illinois Basin (fig. 3). This uplifting and subsequent erosion created the east-west escarpment of Mississippian and Pennsylvanian aged strata in southern Illinois. This escarpment forms the southern edge of the Illinois Basin. South of this escarpment the deeply eroded Paleozoic rocks are overlain by Cretaceous and Tertiary aged sediments, which were deposited in an area called the Mississippi Embayment (fig. 2). The geologic map (fig. 4) shows the distribution of the rock *systems* of the various geologic time periods as they would appear if all the glacial, wind-blown, and surface materials were removed.

Regionally the Paleozoic strata are tilted downward about 2 degrees to the north and east into the Illinois Basin (fig. 3). The Cairo area is located close to that portion of southern Illinois where faulting of Paleozoic strata has been extensive, and, as a consequence, stratigraphic relationships of the various rock units are complicated. In the field trip area, however, only a few, short, northward-trending faults with just a few feet of vertical displacement are known. Available data indicate that these faults developed sometime after the close of the Pennsylvanian Period nearly 290 million years ago.

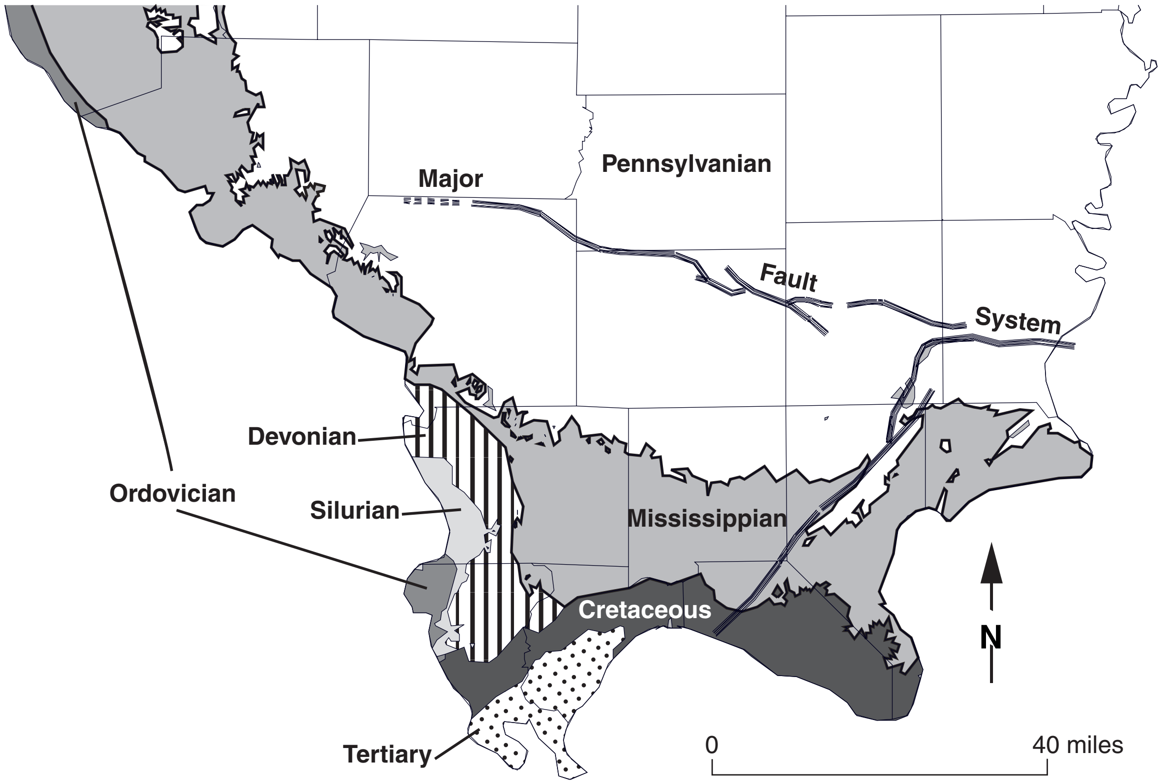


Figure 4 Bedrock geology in southern Illinois.

Mississippi Embayment

The Mississippi Embayment, floored by Paleozoic strata, is a broad, gentle *syncline*, or trough, that deepens southward toward the Gulf of Mexico; the northern part of the axis of the syncline trends northeastward, paralleling the major structural trend in extreme southern Illinois. This trough, also called the Embayment Syncline, is bordered on the west by the Ozark Dome, on the east by another large bedrock arch in western Tennessee known as the Nashville Dome, and on the north by the southern margin of the Illinois Basin (fig. 2). The Embayment Syncline was formed by movements of the Earth's crust, which began during late Cretaceous time (about 90 million years ago) and continued until the end of the Eocene Epoch in Tertiary time (about 33.7 million years ago). As the trough subsided, an arm of the sea advanced northward into the Embayment from the present site of the Gulf of Mexico, inundating the southern tip of Illinois at least twice during Cretaceous time and twice during Tertiary time. The Tertiary inundation during the Eocene Epoch marked the last time that the sea reached into Illinois. The Cretaceous and Tertiary strata deposited during these invasions fill the Embayment Syncline and form a wedge-shaped body of unconsolidated marine and nonmarine clays, silts, sands, and gravels. Gradually the wedge thickens southward from a thin erosional edge in extreme southern Illinois to more than 3,000 feet near Memphis, Tennessee. In the Cairo area, a maximum thickness of about 600 feet of these relatively young sedimentary strata overlaps and rests unconformably upon the much older Paleozoic sedimentary rocks (figs. 1, 3, and 5).

After the sea withdrew at the end of Eocene time, the region was uplifted, and erosion has continued to the present. At some time during the Pliocene Epoch, which lasted from about 5.3 million years ago until some 1.8 million years ago, a great river system flowed across the region. Streams from this system deposited an extensive sheet of sand and coarse gravel over a large area of

Era	System	Series	Formation	Graphic Column	Thickness (feet)
CENOZOIC	Quaternary	Pleistocene	Peoria, Roxana, Loveland, and older silts; Cahokia, Equality, and undifferentiated alluvial and colluvial sediments		0–250
	Tertiary–Quaternary	Pliocene–Pleistocene	Mounds Gravel		0–50
	Tertiary	Eocene	Wilcox		0–250
		Paleocene	Porters Creek "clay"		0–150
			Clayton		0–20
MESOZOIC	Cretaceous	Gulfian	Owl Creek		0–10
			McNairy "sand"		25–455
			Tuscaloosa "gravel"		0–170
PALEOZOIC	Mississippian–Ordovician		Little Bear Soil		0–10
			Bedrock; mostly limestone, chert, and sandstone		

Figure 5 Mississippi Embayment stratigraphic column.

southern Illinois. These materials, called the Mounds Gravel, thinly mantle the Paleozoic, Mesozoic, and earlier Cenozoic strata and cap most of the hills in the Cairo area (fig. 5).

PLEISTOCENE HISTORY

The extensive continental glaciers that covered northern North America and large portions of Illinois and the Midwest during the Pleistocene Epoch, commonly referred to as "The Great Ice Age," did not extend as far south as the Cairo area. The Illinois Glacial Episode was the most extensive in the state and advanced to an irregular margin extending westward from north of Harrisburg (Saline County) to south of Carbondale (Jackson County). The southernmost point of continental glaciation is about 1.5 miles south of the north boundary of Johnson County, approximately 45 miles north-northeast of Cairo. Although till deposited directly by the glaciers is not found here, other materials called *outwash,* composed of silt, sand, and gravel, were deposited by sediment-laden meltwater streams pouring away from the ice fronts during both advance and retreat of the glaciers. Major river valleys, such as the Mississippi and Ohio Valleys, were the main channels for the escaping meltwaters, and thus these valleys were greatly deepened and widened during times of greatest flood. When meltwater flow decreased, however, the valleys became filled and choked with outwash called *valley trains* far beyond the ice margins. Near Cairo, outwash deposits in the Mississippi River are as much as 250 feet thick. About 13,000 years ago, near the end of the last glacial stage (the Wisconsin Episode) in Illinois, a great flood of meltwater poured down these valleys and caused major changes in the channels of the Mississippi and Ohio Rivers. The changes affecting the Ohio River will be discussed in detail at the lunch stop.

Covering the landscape, like icing on a cake, is a thin cover of material called *loess* (pronounced "luss"). These sediments were deposited by the wind during all of the glacial episodes, from the earliest pre-Illinois glacial episode (about 1.6 million years ago) to the last glacial episode, the Wisconsin Episode (about 25,000 to 13,500 years ago). These loess deposits mantle the Devonian, Mississippian, Cretaceous, Tertiary, and glacial outwash deposits throughout the field trip area. The silt was blown from the floodplains of the Mississippi River and the ancient Ohio River when it occupied the Cache River–Bay Creek Valley. Although thicknesses greater than 25 feet are known along the Mississippi Valley, the loess thins eastward to a maximum of about 15 feet in the field trip area. The loess is generally less than 3 feet thick on the lower river terraces because of erosion.

GEOMORPHOLOGY

Physiography

The field trip area is located near the junction of, and is influenced by, four prominent Physiographic Provinces (fig. 6). These include the southern portion of the Shawnee Hills Section (Interior Low Plateaus Province), the northern portion of the Mississippi Embayment Section (Coastal Plain Province), the southeastern portions of the Salem Plateau Section (Ozark Plateaus Province), and the southern portion of the Till Plains Section (Central Lowland Province). A major influence on the geomorphology of the field trip area was established by Pleistocene meltwaters (relict glacio-fluvial features). Oddly enough, the physiographic boundary for the most influential Physiographic Province (Central Lowland Province, Till Plains Section) is 50 miles to the north, and, although very nearby, is farther away than the other three major Physiographic Provinces. Although the area of this field trip was not glaciated, the present landforms and courses of the Ohio and Mississippi Rivers were significantly modified during the Wisconsin Episode (the last major glaciation). Subsequent erosion by wind and rain has continued to modify the landscape.

The convergence of four or more major Physiographic Provinces is a rare geologic phenomenon that occurs in only five other places in the United States. Of the six areas in the country where four or more of these physiographic regions overlap, the Mississippian Embayment–Cache River Valley is thought to be the most diverse. Specifically, it is bounded on the west by the Ozark Hills, on the north and east by the Shawnee Hills, and on the south (ignoring low lines of hills that, strictly speaking, define the watershed) by the Mississippi and Ohio Rivers. The result is an unusually diverse assemblage of species and natural communities in close proximity to one another.

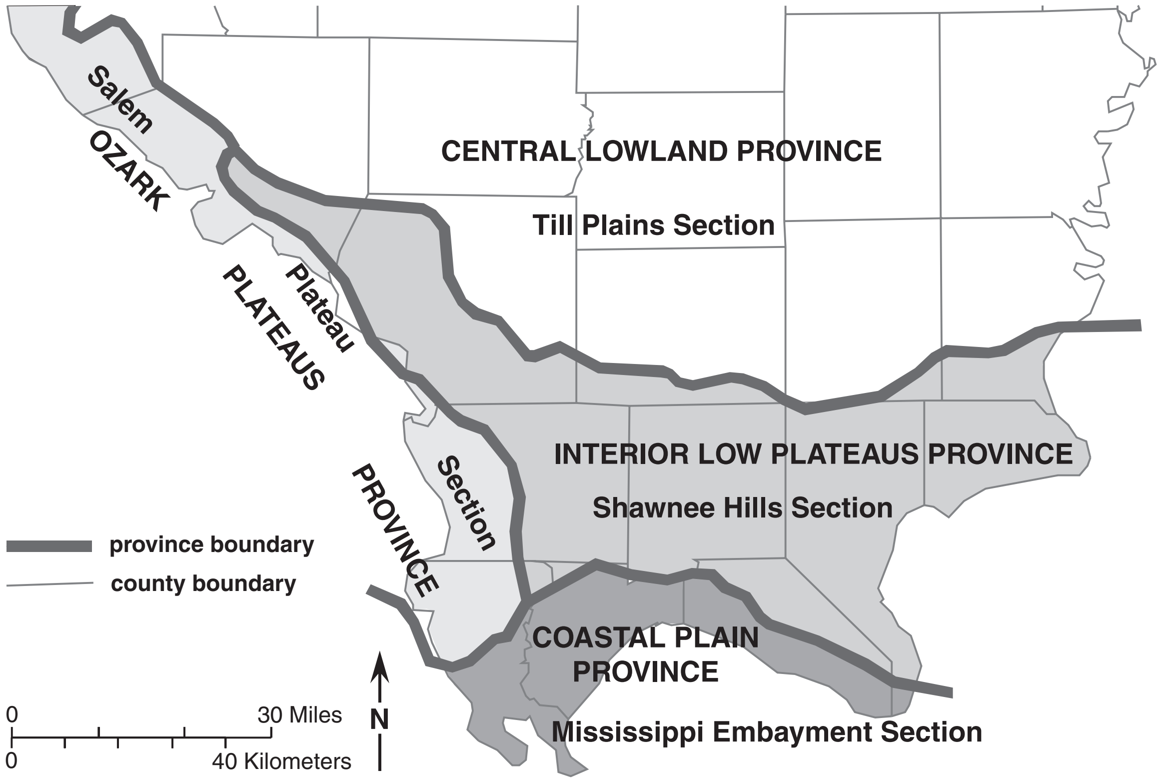


Figure 6 Physiographic divisions of Illinois (modified from Leighton et al. 1948).

NATURAL RESOURCES

Mineral production

Economic minerals that have been mined in Alexander County include sand and gravel, chert, and tripoli. Mining in Union County includes crushed stone from limestone quarries, sand and gravel, and loess. Mining in Pulaski County includes crushed stone from limestone quarries, dredged sand and gravel from alluvium deposits along the Ohio River, excavating of Mounds Gravel, and mining of Porters Creek clay, a specialized type of absorbent clay known as fuller's earth, used in the production of kitty litter.

GUIDE TO THE ROUTE

We will start the field trip at the Boatmen's Memorial at Fort Defiance State Park, located at the confluence of the Mississippi and Ohio Rivers (NE, SW, SW, SW, Sec. 32, T17S, R1E, 3rd P.M., Wyatt 7.5-minute Quadrangle, Alexander County). Mileage will start at the parking lot in front of the Boatmen's Memorial. Set your odometer to 0.0.

You must travel in the caravan. Please drive with headlights on while in the caravan. Drive safely but stay as close as you can to the car in front of you. Please obey all traffic signs. If the road crossing is protected by an Illinois State Geological Survey (ISGS) vehicle with flashing lights and flags, please obey the signals of the ISGS staff directing traffic. When we stop, park as close as possible to the car in front of you and turn off your lights.

Private property Some stops on the field trip are on private property. The owners have graciously given us permission to visit on the day of the field trip only. Please conduct yourselves as guests and obey all instructions from the trip leaders. So that we may be welcome to return on future field trips, follow these simple rules of courtesy:

- Do not litter the area.
- Do not climb on fences.
- Leave all gates as you found them.
- Treat *public* property as if you were the owner—which you are!
- Stay off all mining equipment.
- Parents must closely supervise their children at all times.

When using this booklet for another field trip with your students, a youth group, or family, remember that *you must get permission from property owners or their agents before entering private property*. No trespassing, please.

Nine USGS 7.5-Minute Quadrangle maps (Cache, Cairo, Charleston, Dongola, Mill Creek, Olmsted, Pulaski, Tamms, and Wyatt) provide coverage for this field trip area.

START: Fort Defiance State Park On the day of the field trip, we will start at the parking lot in front of the Boatmen's Memorial (NE, SW, SW, SW, Sec. 32, T17S, R1E, 3rd P.M., Wyatt 7.5-minute Quadrangle, Alexander County).

Miles to next point	Miles from start	
0.0	0.0	At the parking lot in front of the Boatmen's Memorial, set your odometer to 0.0. Follow the park road to the entrance to Fort Defiance State Park and the intersection of U.S. Routes 60 and 62.

0.7	0.7	From the park entrance, TURN RIGHT onto U.S. Routes 60 and 62. A historical sign is located at the entrance to the park. See stop descriptions for inscription on the sign.
0.05	0.75	STOP LIGHT (intersection of U.S. Routes 60, 62 and 51). CONTINUE AHEAD. Follow U.S. Route 51 north. This intersection serves as the beginning of several scenic routes in Illinois: the southern branch of the Lincoln Heritage Trail, the Ohio River Scenic Byway, and the Illinois portion of the National Route of the Great River Road.
0.65	1.4	Enter Cairo (population 4,846). The actual site of Fort Defiance was in this area, immediately south of Cairo.
0.4	1.8	Illinois National Guard Building on the right, south of Fifth Street.
0.1	1.9	Church of the Redeemer on the right, south of Sixth Street, constructed in 1888 at a cost of $30,899. The beautiful brown stone edifice is made from Pennsylvanian age sandstone that was quarried near Makanda, in Jackson County. The church has a slate roof, cupola, stained glass windows, and a gold gilt cross. One of its treasures is a solid silver bell reportedly cast from a thousand silver dollars and once the prized possession of the *James Montgomery*, a steamboat used to transport Civil War troops.
0.1	2.0	St. Patrick Catholic Church is on the left. The present church, built in 1894, is a stately Romanesque structure of Bedford limestone. The oldest church in Cairo, St. Patrick has three bells and numerous stained glass windows.
0.05	2.05	Hewer Statue is on the right, south of Tenth Street. The Hewer Statue was sculpted by George Grey Barnard and exhibited at the St. Louis World's Fair. This original bronze nude was presented to the City of Cairo in 1906 by Mrs. W.P. Halliday and children in memory of Captain W.P. Halliday. This bronze statue was declared by Laredo Taft to be one of the finest nudes in America.
0.25	2.3	U.S. Custom House on the right, located north of Fourteenth Street. The U.S. Congress on August 3, 1854, made Cairo a port of delivery. The decision to build a Custom House was made in 1859; however, the Civil War delayed the appropriation of funds. Construction of the U.S. Custom House began in 1867 and was completed in 1872 for the then costly sum of $225,000. The Custom House was placed on the *National Register of Historic Places* in 1973. This historic limestone structure is one of the few remaining works of noted government architect Alfred B. Mullett, who also designed the San Francisco Mint, the U.S. Treasury Building, and the old State Department in Washington, D.C. The Cairo building housed the U.S. Post Office, then ranked third in national importance, on the first floor. The second floor was for government offices, which were then scattered throughout Cairo, and the third floor was constructed to house the federal courthouse. The building is currently used as a historical museum. Among the many historical items is a desk once used by Gen. U.S. Grant while he was headquartered in Cairo during the Civil War. The limestone used in the Custom House was reportedly from quarries located near Shawneetown.

The U.S. Post Office and Court House are immediately north of the Custom House. Both of these buildings are made from native limestone. On the left, just north of Sixteenth Street, is the Cairo Public Library, built in 1883.

0.3	2.6	New Court House, on the right, south of Division Street.
0.4	3.0	Cross Twenty-eighth Street. The entrance to Cairo's Historic Park District is to the left. Millionaires' row, located on Washington Street, contains several homes listed on the National Register of Historic Places. The sites include these three:

1. Magnolia Manor: The 14-room, Italianate-style brick structure is five stories high. It was constructed by Charles. A. Galigher in 1869 at an estimated cost of about $75,000, including furnishings. The bricks for this mansion were a special order in color and form. They were made in the Kline Brickyards of Cairo. Mr. Charles A. Galigher came to Cairo from Zanesville, Ohio, and made his fortune in the milling business. During the Civil War, he had a government contract to furnish flour to the Union troops. He also installed large ovens at the mill and made hardtack for the soldiers. Yes! Grant slept here, and the manor contains the original bed in which General Ulysses S. Grant slept back in 1880. The manor is open to the public.
2. Riverlore: Located across from Magnolia Manor, this elegant Victorian mansion, built in the French Second Empire style, is a photographer's delight. Riverlore was built in 1865 for Captain William Parker Halliday who was the president of Cairo's first bank. His earlier steamboat career prompted him to build a captain's walk atop the third story of the house. Beautiful gardens surround the home. The Riverlore was recently purchased by the city of Cairo and is open to the public.
3. St. Mary's Park: This city park with pavilion was the site of President Theodore Roosevelt's address during his visit to Cairo in 1907.

0.7	3.7	Pass under Illinois Central Gulf Railroad viaduct and through the north Cairo floodgate.
0.05	3.75	Cairo High School is on the left.
0.05	3.8	CAUTION: Cross single-track railroad track (signal lights ONLY; no guard gates). Then pass under a series of railroad trestles and bridges.
0.4	4.2	Enter Future City (population unmarked).
0.6	4.8	Approach stop light and intersection of U.S. Route 51/Illinois Route 3 and Illinois Route 37. Merge to the right.
0.1	4.9	STOP LIGHT (intersection of U.S. Route 51/Illinois Route 3 and Illinois Route 37). TURN RIGHT onto Illinois Route 37 (north), following Ohio Scenic Byway.

Note: The topographic map designates Illinois Route 37 as U.S. Route 51. Illinois Route 37 follows the old U.S. Route 51 highway. U.S. Route 51 is now designated as following Interstate 57.

1.0	5.9	Enter Urbandale (population unmarked).
0.3	6.2	T-intersection from the left (Sears and Roebuck Road). CONTINUE AHEAD.
0.3	6.5	Historical marker on the right. This sign is identical to the one at the entrance to Fort Defiance State Park. See the stop description section of this guidebook.
0.4	6.9	View of Interstate 57 to the left.
0.55	7.45	T-intersection from the left (Golden Lilly Road). CONTINUE AHEAD.
0.05	7.5	T-intersections from the left (Taylor Road). CONTINUE AHEAD.
0.2	7.7	T-intersection from the left (Redmond Road). CONTINUE AHEAD. The entrance to the Old Channel Access to the Cache River is located to the left, off Redmond Road. The parking lot is visible on the left.
0.2	7.9	Cross the Old Channel of Cache River and enter Pulaski County. View the Old Channel of the Cache River on the left.
0.4	8.3	Approach the Y-intersection; prepare to turn right.
0.15	8.45	Y-intersection (Mounds Road/Old U.S. Route 51 and Illinois Route 37). TURN RIGHT. Follow Illinois Route 37.
0.1	8.55	Entrance to Mound City National Cemetery on the left. The Mound City National Cemetery was declared a national cemetery on July 17, 1862. Located in the center of the cemetery is a monument erected by the State of Illinois in 1874 at a cost of $25,000. The base of the monument is 25 feet square by 4 feet in height and is made of granite and marble. Upon this base is a pedestal 15 feet high that supports a marble shaft. At the top of the monument is a statue of the Goddess of Liberty in marble. Two statues of the same material, a soldier and a sailor, stand at the foot of the shaft. Soldiers from the Confederate and Union sides of the Civil War are buried side by side. The Mound City National Cemetery has 4,827 Civil War interments, of which 2,367 are known and 2,460 are unknown. One grave is marked "Confederate Spy." Also buried here are 50 nurses from the Mound City and Cairo Civil War hospitals. The Mound City National Cemetery holds the remains of veterans of the Civil War, the Spanish-American War, World War I, World War II, the Korean War, and Vietnam conflicts.

Along the avenue from the main entrance are seven plaques containing verses from Theodore O'Hara's "Bivouac of the Dead"

> No rumor of the foe's advance,
> Now swells upon the wind,
> No troubled thought at midnight haunts,
> Of loved ones left behind.
>
> Rest on embalmed and sainted dead,
> Dear as the blood ye gave,
> No impious footstep shall here tread,
> The herbage of your grave.
>
> No vision of the morrow's strife,
> The warrior's dream alarms,
> No braying horn nor screaming fife,
> At dawn shall come to arms.
>
> The neighing troop the flashing blade,
> The bugle's stirring blast,
> The charge the dreadfully cannonade,
> The din and shout are past.
>
> On Fame's eternal camping ground,
> Their silent tents to spread,
> And glory guards with solemn round,
> The bivouac of the dead.
>
> Your own proud land's heroic soil,
> Shall be your fitter grave,
> She claims from war his richest spoil,
> The ashes of her brave.
>
> The muffled drum's sad roll has beat,
> The soldier's last tattoo,
> No more on life's parade shall meet,
> That brave and fallen few.

See www.cem.va.gov/pdf/moundcity.pdf for a detailed description of the Mound City National Cemetery.

0.55	9.1	Enter Mound City (population 750). Mound City, located at the confluence of the Ohio and Cache Rivers, was founded at the abandoned settlement of Trinity in 1854.
0.15	9.25	Historical marker on the left. A portion of the following description is modified from the historical sign erected on January 1, 1935, by the State of Illinois. With the coming of the Civil War, the river front became an extremely important Union naval facility for the Mississippi Squadron. A repair facility for the squadron was moved to Mound City because of the lack of space at Cairo. Throughout the Civil War, the Mound City naval depot was the only repair facility for the Mississippi Squadron, a fleet that numbered 80 ships.

During the Civil War, the naval depot of the western river fleet was located at Mound City. Here the keels of three of the famous Eads ironclad gunboats were laid, and a large force of workmen was employed to keep the fleet in fighting trim. The current marine ways are 400 yards south of here. (*Note:* The historical Marine Ways are no longer operational.)

The Mound City Marine Ways was built between 1857 and 1859 and then leased beginning in August 1861 by the U.S. Navy for ship construction and repair purposes. The famous Civil War ironclad river gunboats U.S.S. *Cairo,* U.S.S. *Cincinnati,* and U.S.S. *Mound City* and others were built there, and the naval repair station was kept busy during the war. The naval station was the headquarters for the U.S. Navy's Mississippi Squadron. As many as 1,500 are reported to have been employed by the Marine Ways at the height of the Civil War.

0.15 9.4 Route 37 curves to the left and enters old business district of Mound City.

0.15 9.55 CAUTION: Cross dual-track railroads (signal lights only; no guard gates). The old railroad station is to the left.

A historical marker is on the left, just past the railroad tracks. A portion of the following description is modified from the historical sign erected on April 21, 1961, by the Illinois State Historical Society:

United States Military Hospital
The southern portion of the brick building at the Ohio levee, 150 yards to the east, was part of a large warehouse that was converted into a military hospital in 1861 and staffed during the Civil War by Catholic nuns of the Order of the Holy Cross at Notre Dame, South Bend, Indiana. Following the Battle of Shiloh 2,200 Union and Confederate wounded were patients here. (*Note:* The brick building is no longer standing.)

High death rates from wounds and disease led to the establishment of the Mound City National Cemetery. The hospital at Mound City was able to accommodate from 1,000 to 1,500 patients. The first patients at the Mound City General Hospital were the wounded from the Battle of Belmont, Missouri, November 7, 1861. Heavy fighting at Fort Donelson in February 1862 and at Shiloh in April 1862 brought many more patients to the Mound City and Cairo hospitals. The death rate from wounds and all prevalent diseases was high in the hospitals of the Civil War period.

The Navy's first hospital ship, the USS *Red Rover*, also was stationed for a time at Mound City during the Civil War. Confiscated from the Confederate Navy, it was outfitted as a hospital ship in 1862 and helped transport wounded to the hospital at Mound City.

0.85 10.4 Leave Mound City and cross the levee protecting Mound City. Route 37 parallels an Ohio River levee on the right. After leaving Mound City, the large expanse of flat-lying land to the left is part of the ancient Ohio River valley, now occupied by the old channel of the Cache River.

1.0 11.4 To the left in the far distance are two water towers located along a ridge north of the city of Mound. This topographically high ridge separates the modern

		Ohio River valley located on the left and on the other side of the levee on the right, from the Cache River Valley located on the other side of the ridge. The ancient Ohio River once flowed through what is now known as the Cache River valley.
1.4	12.8	Crossroad intersection (400 North and Illinois Route 37/630E). Mounds Road to the left and Lake Road to the right. CONTINUE AHEAD. The slightly rolling land surface here represents an old Ohio River floodplain terrace. The surface elevation is about 340 feet above mean sea level.
1.4	14.2	T-intersection from the right (Bellview Lane/750E). CONTINUE AHEAD.
0.35	14.55	T-intersection from the left (Shoemaker Road/500N and Illinois Route 37/782E). CONTINUE AHEAD.
0.25	14.8	Crossroad intersection (American Road/800 East). Road to the community of America to the right and Old Highway 37 to the left. CONTINUE AHEAD.
		“The Capital of the United States Is Moving to Southern Illinois.” Imagine that headline! Fewer than 10 years after President Jefferson closed Fort Wilkinsonville, and only a few miles downstream along the Ohio River, a new city was built to replace Washington, D.C., as the hub of the country, both geographically and politically. Fort Wilkinson was located south of Grand Chain along the Ohio River, approximately 8 miles north of America.
		After Washington, D.C., was burned by the British during the War of 1812, planners drew elaborate maps of a new city just north of Mound City to replace the nation’s capitol. The new city for a time was home to 700 people but it faded. River boats couldn’t land there because of a sandbar. Fire, possibly arson, burned the town. Disease epidemics took many lives. Washington, D.C., was rebuilt. Although the southern Illinois town is still listed on some maps as “America,” and some street signs still bear the names of states, America now consists of only a few rural houses. What if?
		For more information about Fort Wilkinsonville check your local library or the Web for the Wilkinson-Aaron Burr conspiracy. Fort Wilkinsonville is also known as Cantonment Wilkinsonville and is often confused with Fort Massic, which is located near Metropolis.
1.05	15.85	Cross Hodges Creek, locally known and on some maps as Hodges Bayou.
0.6	16.45	T-intersection from the left (Old Highway37/635N and Illinois Route 37/870E). CONTINUE AHEAD.
0.25	16.7	T-intersection from the right (Hummingbird Lane/652N). CONTINUE AHEAD. Old Club 37 is on the left.
0.3	17.0	T-intersection from the left (Olmsted Road/725N and Illinois Route 37/894E). CONTINUE AHEAD.

0.1	17.1	T-intersection from the left (South Oakwood Street/742N and Illinois Route 37/900E). CONTINUE AHEAD.
0.15	17.25	Enter city limits of Olmsted, population 350. The town, first named Olmstead, was laid out by E. B. Olmstead in 1872. Later the name of the town was spelled Olmsted.
0.6	17.85	Crossroad intersection (800N). West Cedar Street is to the right, and S Vienna Road W is to the left. CONTINUE AHEAD. The Olmsted business district is to the right of the intersection.
0.45	18.3	Prepare to turn left.
0.3	18.6	Crossroad intersection (Feather Trail Road/866N and Illinois Route 37/972E). TURN LEFT onto Feather Trail Road. During the mid-1840s, local inhabitants found North Caledonia to be as good a shipping point as it was a good river landing. North Caledonia was on a high elevation above flooding and had roads that led into the interior, over which the farmers brought their produce. So many chickens were shipped that tradition says the road from Jonesboro to Caledonia was known as "Feather Trail," and feathers from the birds marked the entire route. The area of North Caledonia was located immediately east of Olmsted along the Ohio River.
0.4	19.0	Prepare to turn left. Road begins gentle curve to the right.
0.1	19.1	T-intersection from the left (Clay Pit Road /900N and Feather Trail Road/938E). TURN LEFT.
0.4	19.5	Enter Oil-Dri Corp., Olmsted Clay Pit.

STOP 1: Oil-Dri Clay Pit Porters Creek and Clayton Formations, Paleocene, located northwest of Olmsted (SE, SE, SE, Sec. 16, T15S, R1E, 3rd P.M., Olmsted 7.5-minute Quadrangle, Pulaski County). On the day of the field trip, park along the entrance road

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0.0	19.5	Leave STOP 1. Retrace route back to Feather Trail Road.
0.4	19.9	STOP (one-way). T-intersection (Clay Pit Road /900N and Feather Trail Road/938E). TURN RIGHT.
0.6	20.5	STOP (two-way). Intersection (Feather Trail Road/866N and Illinois Route 37/972E). TURN RIGHT.
0.2	20.7	Enter city limits of Olmsted (population 350).
0.6	21.3	Crossroad intersection (West Cedar Street/S Vienna W/800N). CONTINUE AHEAD. The Olmsted business district is to the left of the intersection.

0.7	22.0	T-intersection from the right (South Oakwood Street/742N and Illinois Route 37/900E). CONTINUE AHEAD.
0.1	22.1	T-intersection from the right (Olmsted Road/725N and Illinois Route 37/894E). CONTINUE AHEAD.
0.25	22.35	T-intersection from the left (Hummingbird Lane/652N). CONTINUE AHEAD.
0.3	22.65	T-intersection from the right (Old Highway37/635N and Illinois Route 37/870E). CONTINUE AHEAD.
0.55	23.2	Cross Hodges Creek/Bayou.
1.1	24.3	Crossroad intersection (American Road/800E). Road to the community of America to the left and Old Highway 37 to the right. CONTINUE AHEAD.
0.2	24.5	T-intersection from the right (Shoemaker Road/500N and Illinois Route 37/782E). CONTINUE AHEAD.
0.35	24.85	T-intersection from the left (Bellview Lane/750E). CONTINUE AHEAD.
0.95	25.8	Road curves 90 degrees to the left.
0.3	26.1	Prepare to turn right.
0.15	26.25	Crossroad intersection (400 North and Illinois Route 37/630E). Mounds Road is on the right and Lake Road is on the left. TURN RIGHT onto Mounds Road.
0.35	26.6	Crossroad intersection (Meridian Road/600E and Mounds Road/400N). CONTINUE AHEAD. The north-south Meridian Road is on the Third Principal Meridian. The Third Principal Meridian was established at the original confluence of the Ohio and Mississippi Rivers at Cairo. A principal meridian is the dividing line between the east and west ranges of the township and range system.
0.6	27.2	Meridian High School is on the right.
0.2	27.4	T-intersection from the right (Valley Road/525E and Mounds Road/400N). CONTINUE AHEAD. Approaching Interstate 57/U.S. Route 51 junction.
0.3	27.7	The northbound entrance ramp is on the right. CONTINUE AHEAD.
0.1	27.8	Cross over Interstate 57/U.S. Route 51.
0.1	27.9	The southbound entrance ramp is on the left. CONTINUE AHEAD.
0.5	28.4	You are approaching a stop sign.

0.25	28.65	STOP (one-way). T-intersection (Mounds Road and Old Highway 51) TURN LEFT onto Old Highway 51. The northern water tower that was visible from Route 37 (see mile 11.4) is northeast of the intersection. CAUTION: Fast-moving traffic.
0.35	29.0	Pass Kent Street.
0.15	29.15	Pass Fourth Street/350N.
0.05	29.2	Pass Thistlewood Cemetery on the right and left.
0.1	29.3	Enter city of Mounds (population 1,800).
0.1	29.4	Cross unnamed creek and prepare to turn right at the base of the hill.
0.05	29.45	Intersection (Sycamore Street and North Blanch Street/Old Highway 51). TURN RIGHT onto Sycamore Street.
0.2	29.65	CAUTION: Cross dual set of railroad tracks (signal lights and guard gates).
0.05	29.7	T-intersection from the left (Railroad Street). CONTINUE AHEAD. St. Mary's Cemetery to the right. The Oil-Dri processing plant is located 0.75 miles to the left at the end of Railroad Street.
0.25	29.95	T-intersection from the right (Britton Lane). CONTINUE AHEAD.
0.05	30.0	Entrance to Sam Moses' Pit on the right. TURN RIGHT.

STOP 2: Sam Moses' Pit Pliocene-Pleistocene Mounds Gravel, located at Mounds (Center of NW, SW, Sec.15, T16S, R1W, 3rd P.M., Cairo 7.5-minute Quadrangle, Pulaski County). On the day of the field trip, follow the lead vehicle into the pit and obey ISGS staff directing traffic.

0.0	30.0	Leave Stop 2. Retrace route back to Sycamore Street and TURN RIGHT (heading west and leaving the city of Mounds). *Note:* Sycamore Street becomes Olive Branch Road when you leave Mounds.
0.75	30.75	T-intersection from the left (Hawkins Lane). CONTINUE AHEAD.
0.25	31.0	T-intersection from the right (Kays Lake Road). CONTINUE AHEAD.
0.35	31.35	T-intersection from the right (Lufkin Road/195E and Olive Branch Road/326N). CONTINUE AHEAD.
0.1	31.45	T-intersection from the left (Moses Road/181E). CONTINUE AHEAD. Road curves 45 degrees to the right.
0.9	32.35	T-intersection from the left (Hillcrest Lane). CONTINUE AHEAD.

0.35	32.7	Road makes a large, gentle 45-degree curve to the left.
0.4	33.1	Road curves 45 degrees to the right.
0.2	33.3	Road enters a series of “S” curves. Exposure of loess, 12+ feet on the left. The loess is being excavated and used for fill material for the construction of a new Bridge over the Cache River immediately ahead. CAUTION: Slow down; you are entering a construction zone.
0.4	33.7	Road descends into Cache River Valley. CAUTION: Construction zone. A new bridge is being constructed over the Cache.
0.3	34.0	Cross Cache River. Enter Alexander County.
0.1	34.1	STOP (four-way). Crossroad intersection (Illinois Route 3 and Illinois Route 127). CONTINUE AHEAD. Follow North Illinois Route 3 (heading west). Signs at the intersection mark the southern branch of the Lincoln Heritage Trail and the National Route of the Great River Road. Olive Branch is straight ahead, Cairo is to the left, and Jonesboro is to the right.
0.6	34.7	Cross Lake Creek and enter a portion of Shawnee National Forest.
0.3	35.0	T-intersection from the left (Promised Land Road/1295E and Illinois Route 3/31120N). TURN LEFT onto Promised Land Road.
0.4	35.4	Forested wetland to the left. The land along the road is part of a wildlife refuge.
1.0	36.4	T-intersection from the left (Roth Crossing Road/1200E and Promised Land Road/1025N). CONTINUE AHEAD.
1.2	37.6	T-intersection from the right (East Side Drive/1100E and Promised Land Road/955N). TURN RIGHT and pull into the parking lot in front of the large pavilion.

STOP 3: Lunch, Horseshoe Lake (SE, SE, NE, Sec. 21, T16S, R2W, 3rd P.M., Cache 7.5-minute Quadrangles, Alexander County).

0.0	0.0	Leave Stop 3. Reset your odometer to 0.0 at the intersection (East Side Drive/ 1100E and Promised Land Road/955N). TURN RIGHT onto Promised Land Road.
0.1	0.1	Cross spillway.
0.3	0.4	T-intersection from the right (West Side Drive/ 1060E and Promised Land Road/950N). TURN RIGHT onto West Side Drive. The large cypress trees along West Side Drive have been planted.

1.35	1.75	Boat dock on the right.
1.0	2.75	Entrance to west side campground on the right.
0.85	3.6	Road curves 90 degrees to the right. Old farmhouse and conservation area maintenance facilities are on the left before the curve. Cross manmade levee across Horseshoe Lake.
0.4	4.0	STOP (one-way). T-intersection (Miller City Road/890E and West Side Drive/1100N). TURN RIGHT onto Miller City Road.
0.3	4.3	T-intersection from the left (Shasta Road/1125N and Miller City Road/885E). CONTINUE AHEAD.
1.3	5.6	Cross Black Creek.
0.15	5.75	T-intersection from the right (Island Road/1265N and Miller City Road/910E). CONTINUE AHEAD.
0.2	5.95	T-intersection from the right (Pett Road/1280N and Miller City Road/910E). CONTINUE AHEAD.
0.55	6.5	T-intersection from the left (Pecan Road). CONTINUE AHEAD.
0.35	6.85	T-intersection from the right (Pecan Road/1352N and Miller City Road/950E). CONTINUE AHEAD.
0.05	6.9	T-intersection from the right (Old Horseshoe Lake Road/1352N). CONTINUE AHEAD.
0.05	6.95	STOP (two-way). Crossroad intersection (Miller City Road/950E and Illinois Route 3/1360N). TURN RIGHT onto Illinois Route 3. The bluffs immediately to the north are the Lower Devonian Bailey Limestone formation.
0.05	7.0	T-intersection from the left (Railroad Street/955E and Illinois Route 3/1360N). TURN LEFT onto Railroad Street.
0.6	7.6	T-intersection from the right (Old Mill Road/1000E and Railroad Street/1400N). CONTINUE AHEAD. *Note:* Railroad Street changes its name north of this intersection to Tamms/Olive Branch Road. An abandoned silica mine is located in the bluffs on the left.
0.6	8.2	T-intersection from the right (Sandy Ridge Road). CONTINUE AHEAD. Another abandoned silica mine is located in the bluffs on the left. The flat-lying land to the right is the floodplain of the ancient Ohio River valley, now occupied by the modern Cache River.
0.7	8.9	T-intersection from the right (Clank Road/1500N and Tamms/Olive Branch Road/1060E. CONTINUE AHEAD.

0.3	9.2	Cross Road Run Creek.
0.7	9.9	T-intersection from the right (Dave Road/1600N and Tamms/Olive Branch Road/1095E). CONTINUE AHEAD.
1.25	11.15	T-intersection from the right (Sandy Creek Road/1715N and Tamms/Olive Branch Road/1120E). CONTINUE AHEAD and immediately cross Wolf Creek.
0.1	11.25	T-intersection from the left (Wolf Creek Road/1725N and Tamms/Olive Branch Road/1120E). CONTINUE AHEAD.
0.15	11.4	Cross West Branch of Sandy Creek.
0.3	11.7	Egyptian Community School on the left.
0.1	11.8	T-intersection from the left (Diswood Road/1730N and Tamms/Olive Branch Road/1110E). CONTINUE AHEAD.
0.05	11.85	Cross Sandy Creek.
0.15	12.0	STOP (one-way). Y-intersection (Grape Vine Trail/1790N to the left and Tamms/Olive Branch Road/1120E to the right). TURN LEFT onto Grape Vine Trail. This intersection is identified as the community of Diswood on the Tamms 7.5 minute quadrangle.
0.9	12.9	The road follows the valley cut by Sandy Creek; the creek is on the left.
2.6	15.5	Cross Sandy Creek.
0.2	15.7	T-intersection from the right. Entrance to UNIMIN silica quarry. TURN RIGHT.
0.2	15.9	Cross ford of Sandy Creek
0.8	16.7	CAUTION: Entrance to quarrying operation on the right. TURN RIGHT and stay on the right side of the road.

STOP 4: Birk-McCrite Quarry UNIMIN Specialty Minerals, Inc., Lower Devonian Clear Creek Chert. Located northwest of Tamms (SE, SE Sec. 21 and NE, NE, NE, Sec. 28, T14S, R2W, 3rd P.M., Mill Creek 7.5-minute Quadrangle, Alexander County). On the day of the field trip, park along the road. Follow directions of ISGS staff.

0.0	16.7	Leave Stop 4. Retrace the route back to Grape Vine Trail.
1.1	17.8	STOP (one-way). T-intersection (UNIMIN Quarry Road and Grape Vine Trail). TURN LEFT onto Grape Vine Trail.

3.3	21.1	McCrite Cemetery is to the left on the south side of the hill.
0.4	21.5	Y-intersection (Grape Vine Trail/1790N and Tamms/Olive Branch Road/1120E). BEAR LEFT onto Tamms/Olive Branch Road, heading east toward Tamms.
0.05	21.55	Cross Jim Branch of Sandy Creek.
0.1	21.65	T-intersection from the left (McDaniel School Road/1130E). CONTINUE AHEAD.
0.55	22.2	Notice the road cut, an exposure of Devonian Clear Creek Chert. A fault is located on the eastern end of the outcrop.
0.4	22.6	Angled intersection from the right (Old Diswood Road/1210E and Tamms/Olive Branch Road/1850N). CONTINUE AHEAD.
0.9	23.5	Crossroad intersection (Steel Road/1300E). CONTINUE AHEAD.
0.6	24.1	Enter Tamms (population 940).
0.3	24.4	Crossroad intersection (Railroad Street). TURN LEFT. Tamms UNIMIN processing plant is located south of the intersection. On the right, after making the turn, is the historical Tamms Railroad Station built in the 1890s. This uniquely designed curved depot was constructed to allow the clerk to watch both the Chicago and Eastern Illinois (C & EI) and the Gulf Mobile and Ohio (GM & O) railroads that crossed at an acute angle. This restored depot is on the *National Register of Historic Places,* and currently serves as a museum and the Tamms City Hall.
1.7	26.1	Crossroad intersection (Super Max Road/1975N and Old Elco Road/1380E). TURN LEFT. *Note:* Railroad Street becomes Old Elco Road at this intersection.
0.1	26.2	Main Road curves to the left. T-intersection from the right, entrance to abandoned gravel pit and quarry. TURN RIGHT. The main road leads to the Illinois Department of Corrections, Tamms super maximum facility. The Mill Creek 7.5-minute quadrangle identifies this junction as Tatumville.
0.3	26.5	Enter abandoned Markgraf Materials Company's, Novaculite Gravel Quarry.

STOP 5: Abandoned Novaculite Gravel Quarry Formerly operated by Markgraf Materials Co., Lower Devonian Grassy Knob Chert formation. Located north of Tamms at Tatumville (NE and SE of NW, Sec. 36, T14S, R2W, 3rd P.M., Mill Creek 7.5-minute Quadrangle, Alexander County).

0.0	26.5	Exit quarry and retrace your route to the intersection of Super Max Road.

0.25	26.75	Intersection of Super Max Road/1975N. TURN LEFT.
0.1	26.85	Crossroad intersection (Super Max Road/1975N and Old Elco Road/1380E). CONTINUE AHEAD.
0.55	27.4	Cross Jackson Creek, and prepare to stop.
0.2	27.6	T-intersection (Super Max Road/1975N and Illinois Route 127). TURN LEFT.
1.3	28.9	Crossroad intersection (Newell Road/2100N and Illinois Route 127/1480E). CONTINUE AHEAD. The community of Ullin is 4 miles to the right. An abandoned tripoli mine is 0.3 miles to the left.
1.5	30.4	T-intersection from the right (Rifle Range Road/2225N and Illinois Route 127/1470E). CONTINUE AHEAD.
0.3	30.7	T-intersection from the left (Bridge Street/2250N). CONTINUE AHEAD. The community of Elco is to the left.
0.2	30.9	UNIMIN Speciality Minerals Inc., Elco Plant, and headquarters on the left. CONTINUE AHEAD.
0.2	31.1	Outcrop of Mississippian age Fort Payne is on the right.
0.7	31.8	T-intersection from the left (road to Sims Cemetery). CONTINUE AHEAD.
0.6	32.4	T-intersection from the right. (Dexter Road/2410N and Illinois Route 127/1475E). CONTINUE AHEAD.
0.4	32.8	T-intersection from the left (Sycamore Road/2450N and Illinois Route 127/1480E). CONTINUE AHEAD.
0.3	33.1	Cross Cooper Creek.
0.2	33.3	T-intersection from the left (unmarked). CONTINUE AHEAD. Enter Union County.
0.3	33.6	Enter Mill Creek (population 100). A millennium before Mill Creek had a post office, it had a huge mining operation in nearby hills, for *chert* by Native Americans. The Illinois State Museum Web site says this:

> Hoes made from Mill Creek chert were stronger and more durable than hoes previously made from shell or bone. In comparison to other nearby chert sources, Mill Creek appears to be ideal for hoe manufacture and use. Although other cherts are equally fine-grained, Mill Creek chert occurs as relatively large tabular nodules, a shape well suited for the manufacture of broad bifaces . . . large chert quarries in the Shawnee Hills and the movement of large volumes of Mill Creek chert into the American Bottom continued for several hundred years. No matter

how these stone quarrying, trading, and hoe-making activities were organized—be it specialized traders and hoe-making craftsmen (less likely), or individual farmers making yearly treks south to quarry and make their personal hoes (more likely), or down-the-line trading of complete hoes from village to village (always likely)—chert mining and manufacture of chert hoes were clearly important to maize agriculture and to the Mississippian economy as a whole.

0.1	33.7	T-intersection from the right. (Lake Road/035N and Illinois Route 127/1500E). CONTINUE AHEAD.
0.8	34.5	Cross Lingle Creek. T-intersection on the left before the creek (Lingle Creek Road/100N) and on the right after the creek (Sweet Potato Road/105N). CONTINUE AHEAD.
0.15	34.65	Cross small creek, a branch of Mill Creek.
0.85	35.5	T-intersection from the right (Jonesboro Quarry Road/205N, and Illinois Route 127/1425E). TURN RIGHT.
0.2	35.7	Exposure of loess on the left, 10+ feet.
0.8	36.5	Crossroad intersection (Miller Road to the right and Jonesboro Quarry Road/225N). CONTINUE AHEAD. Jonesboro Quarry Road turns north at this intersection. Entrance to Vulcan Materials Co. Jonesboro Quarry is straight ahead.
0.1	36.6	Scale house is on the right.

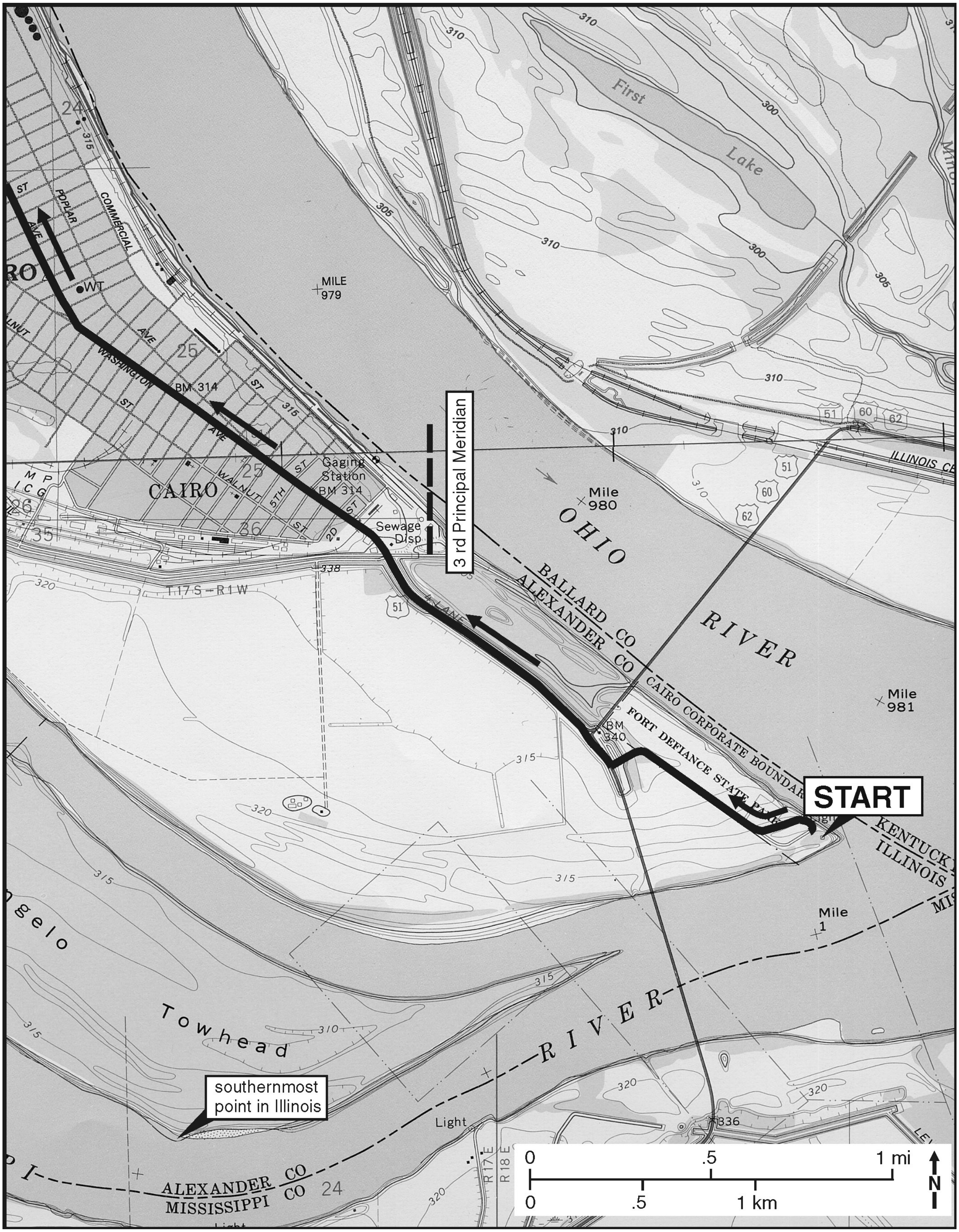
STOP 6: Vulcan Materials Company, Jonesboro Quarry Mississippian Ullin Limestone, located south of Jonesboro (NW, NE, and SE of the SW, Sec. 20, T13S, R1W, 3rd P.M., Dongola 7.5-minute Quadrangle, Union County). On the day of the field trip, follow the lead vehicle into the quarry and obey ISGS staff directing traffic.

After leaving the last stop, retrace the route back to Illinois Route 127.

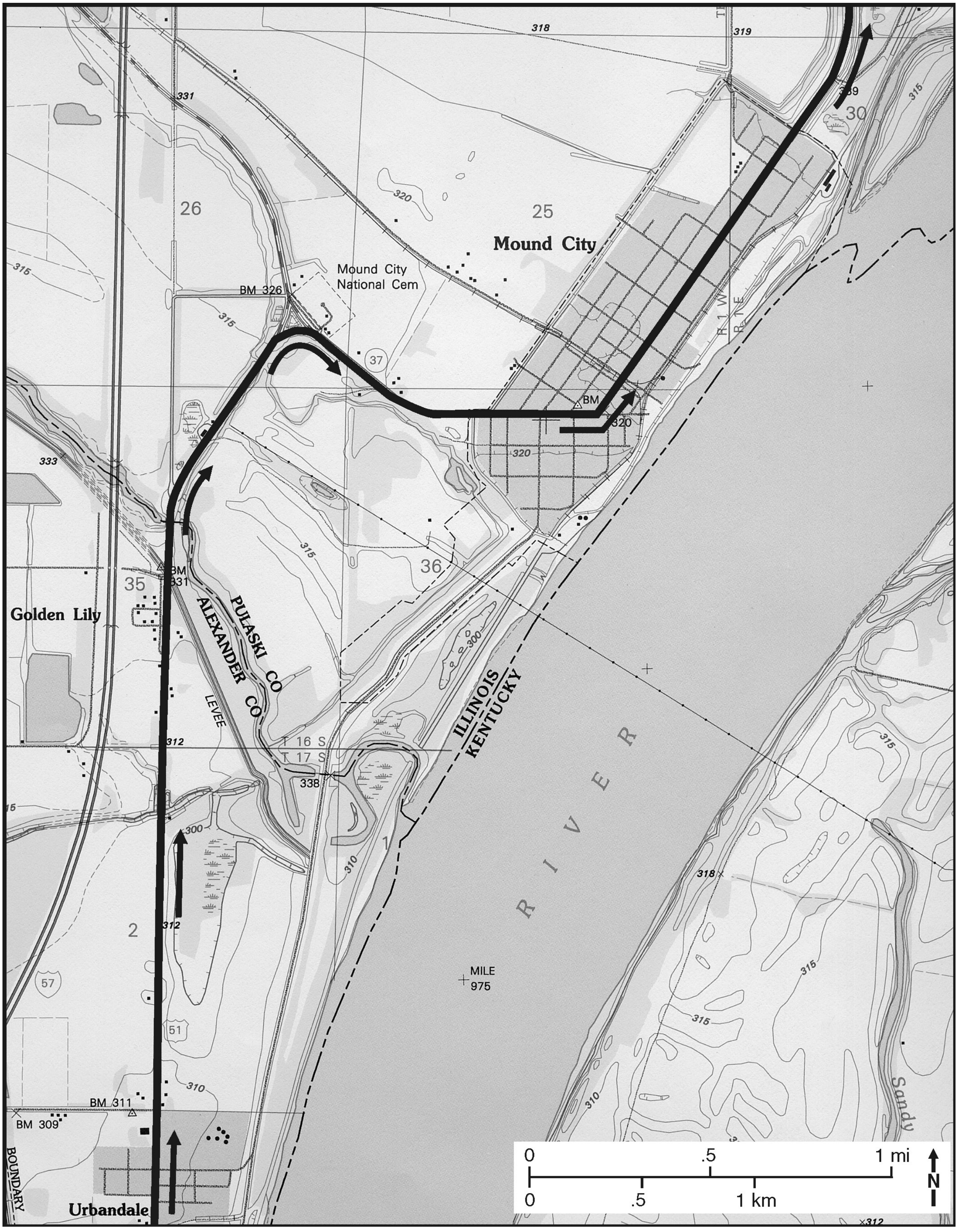
You can gain access to Interstate 57 by turning right (north) onto Illinois 127, which heads toward Jonesboro. Take Illinois Route 146 (east) at Jonesboro to reach Interstate 57.

If you turn left (south) onto Illinois 127, it will take you to the intersection with Illinois Route 3. Following Route 3 (south) will take you to Cairo.

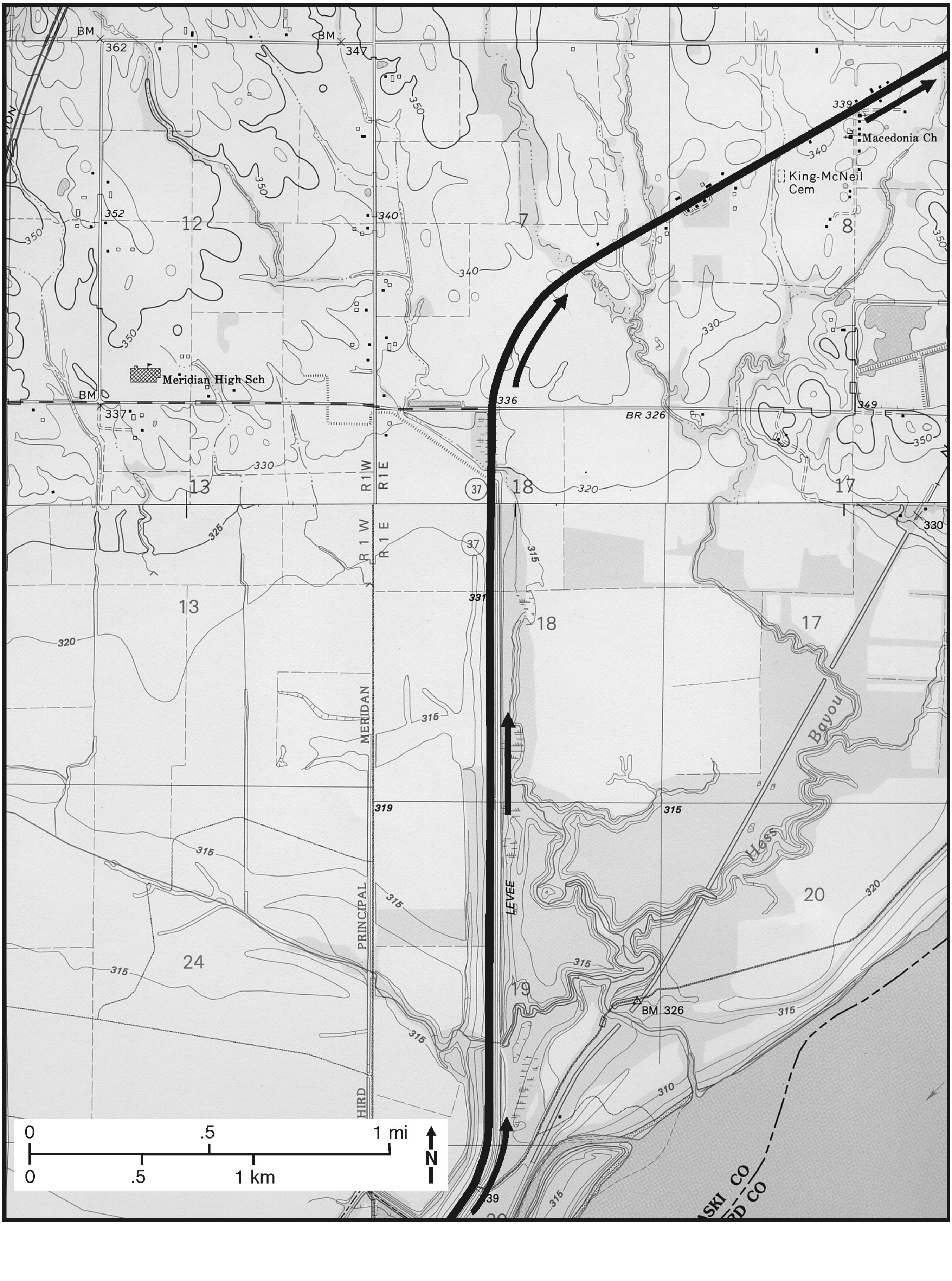
END OF TRIP! HAVE A SAFE JOURNEY HOME.


START
3 rd Principal Meridian
southernmost point in Illinois
CAIRO
OHIO RIVER
BALLARD CO
ALEXANDER CO
CAIRO CORPORATE BOUNDARY
FORT DEFIANCE STATE PARK
KENTUCKY
ILLINOIS
First Lake
MILE 979
Mile 980
Mile 981
Mile 1
Gaging Station BM 314
Sewage Disp
BM 314
BM 340
T 17 S – R 1 W
Towhead
RIVER
ALEXANDER CO
MISSISSIPPI CO
Light
0 .5 1 mi
0 .5 1 km
N

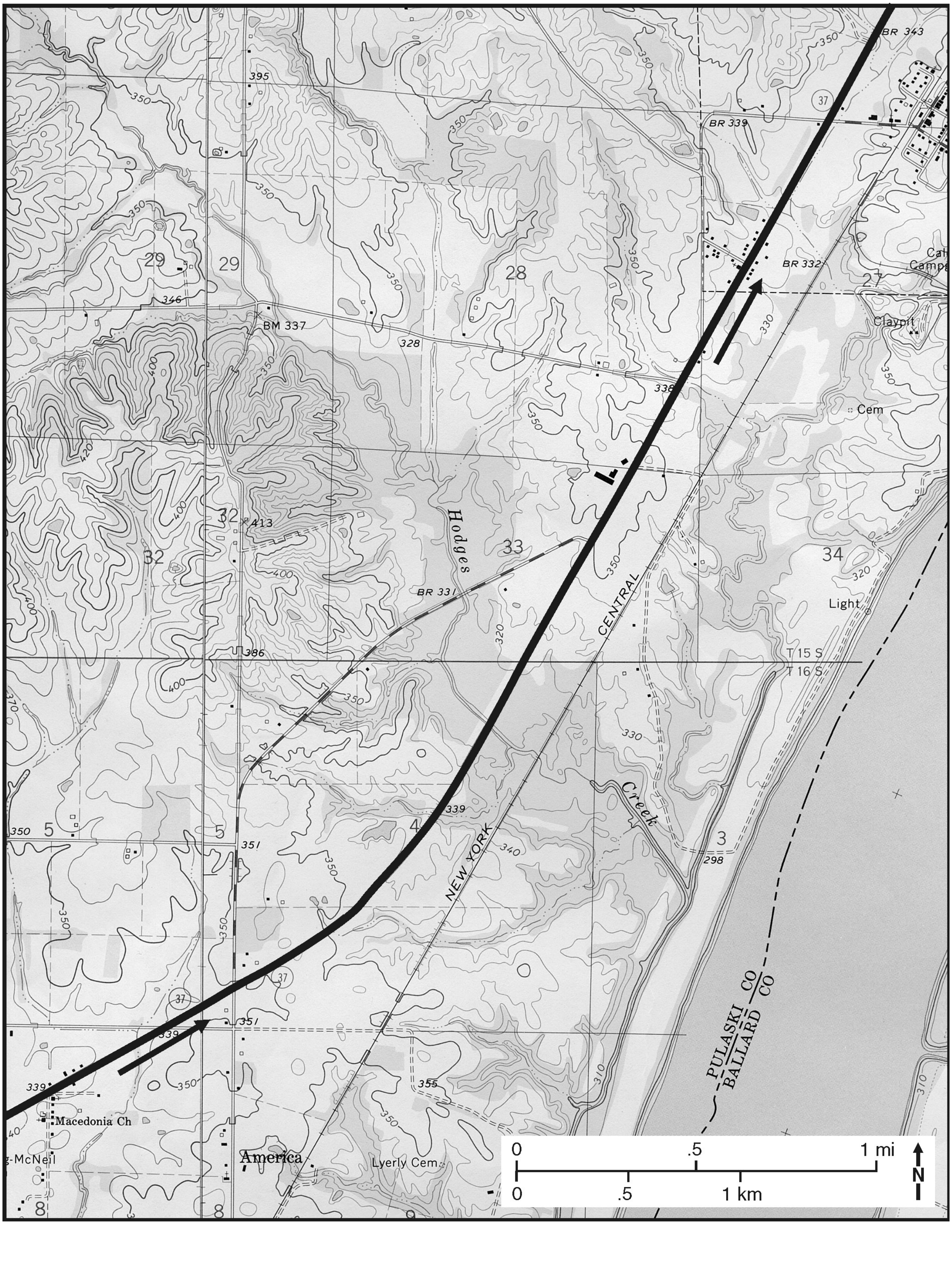

Urbandale
BOUNDARY
OHIO
Cairo Junction
BM 314
BM 310
LEVEE
Future City
BALLARD CO
ALEXANDER CO
BM 314
BM 338
Waterworks
Athletic Field
BM 311
CORP
ALEXANDER CO
MISSISSIPPI CO
BDY
37TH
WASHINGTON
SYCAMORE
POPLAR
COMMERCIAL
Park
PARK
28TH
WALNUT
CAIRO
SWT
MILE 6
MILE 979
0
.5
1 mi
1 km
N



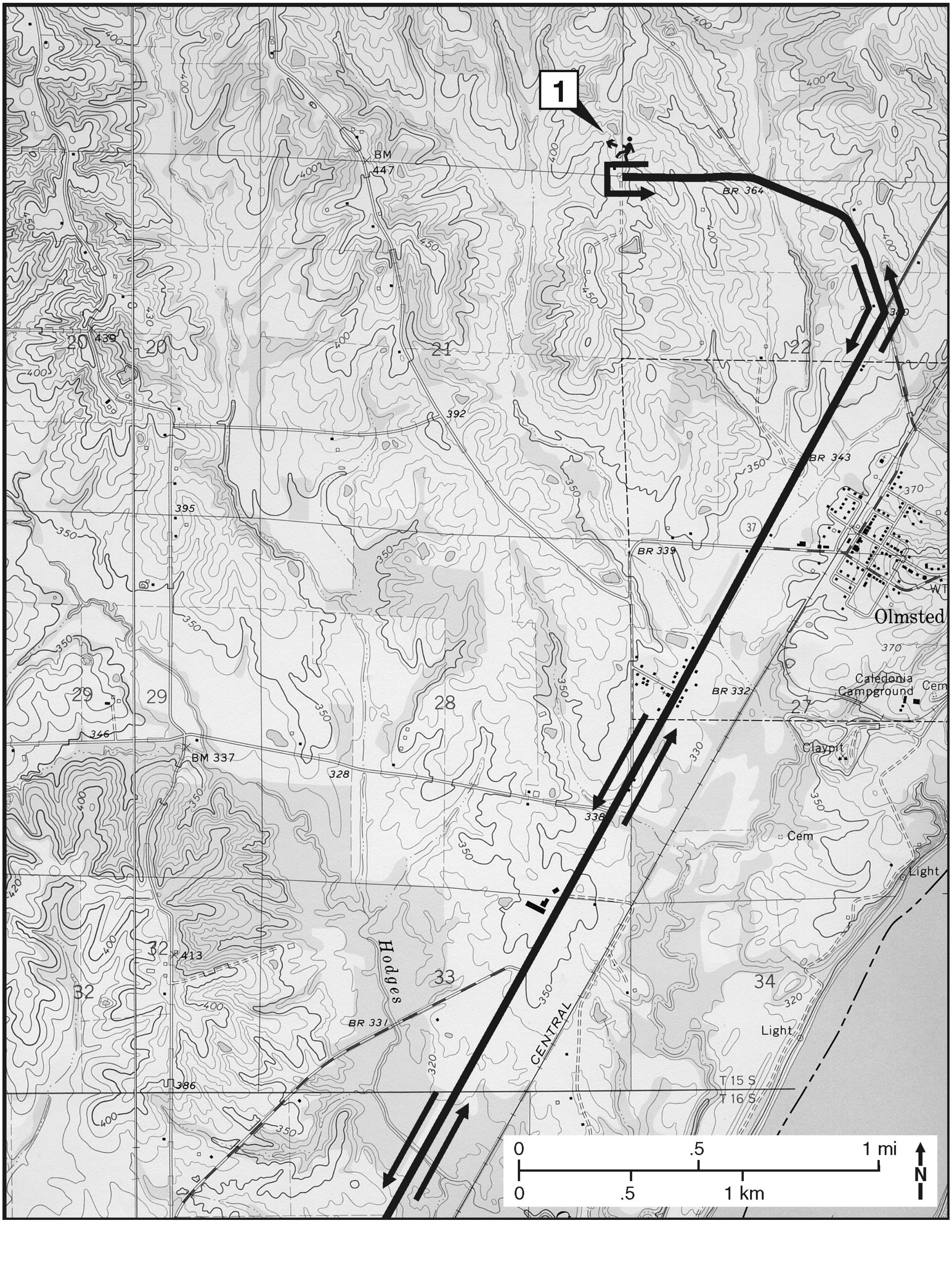
Mound City
Mound City
National Cem
Golden Lily
Urbandale
PULASKI CO
ALEXANDER CO
ILLINOIS
KENTUCKY
R I V E R
LEVEE
BOUNDARY
Sandy
MILE
975
BM 326
BM
331
BM 311
BM 309
BM
T 16 S
T 17 S
R 1 W
R 1 E
26
25
35
36
2
1
30
37
57
51
0
.5
1 mi
0
.5
1 km
N

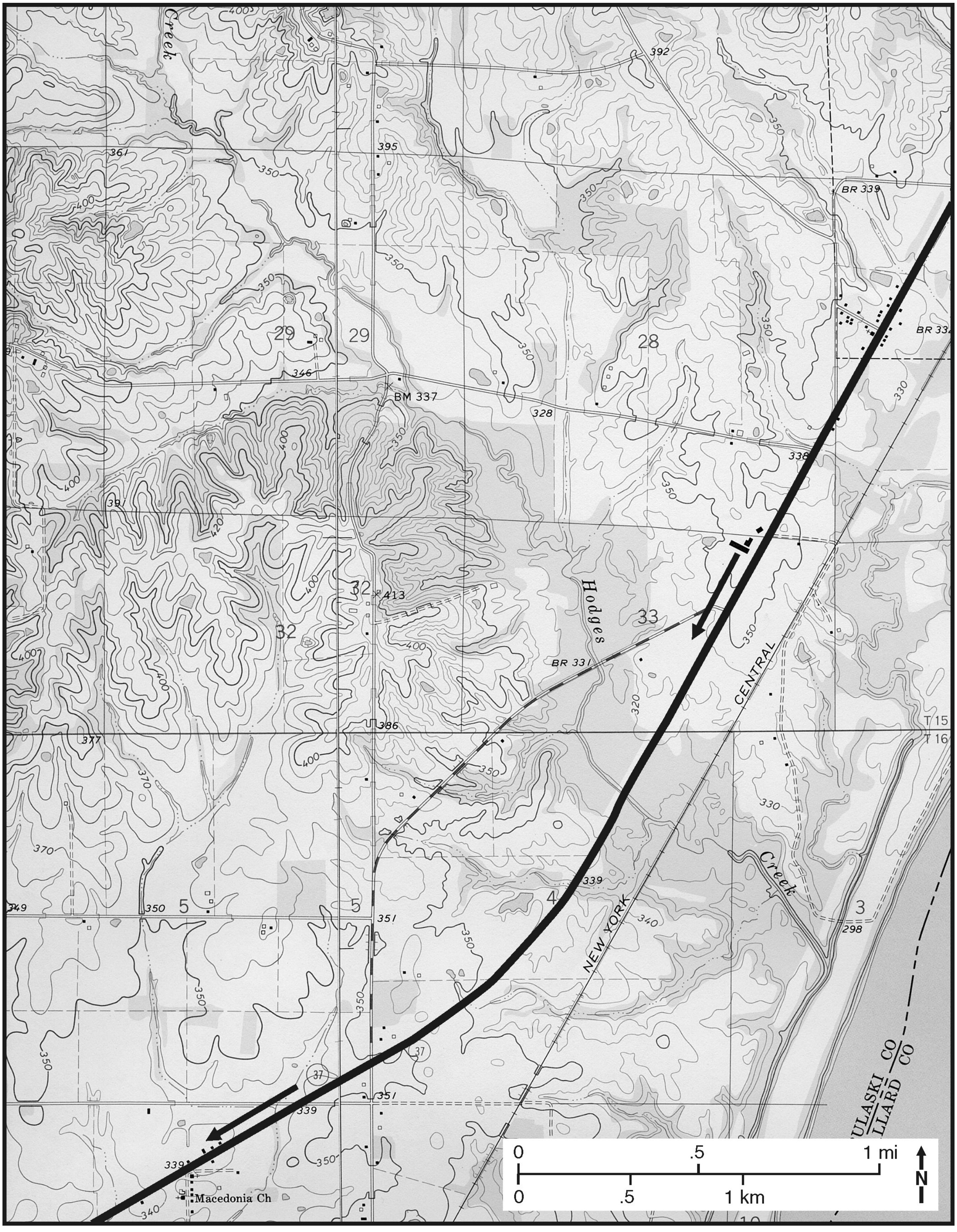


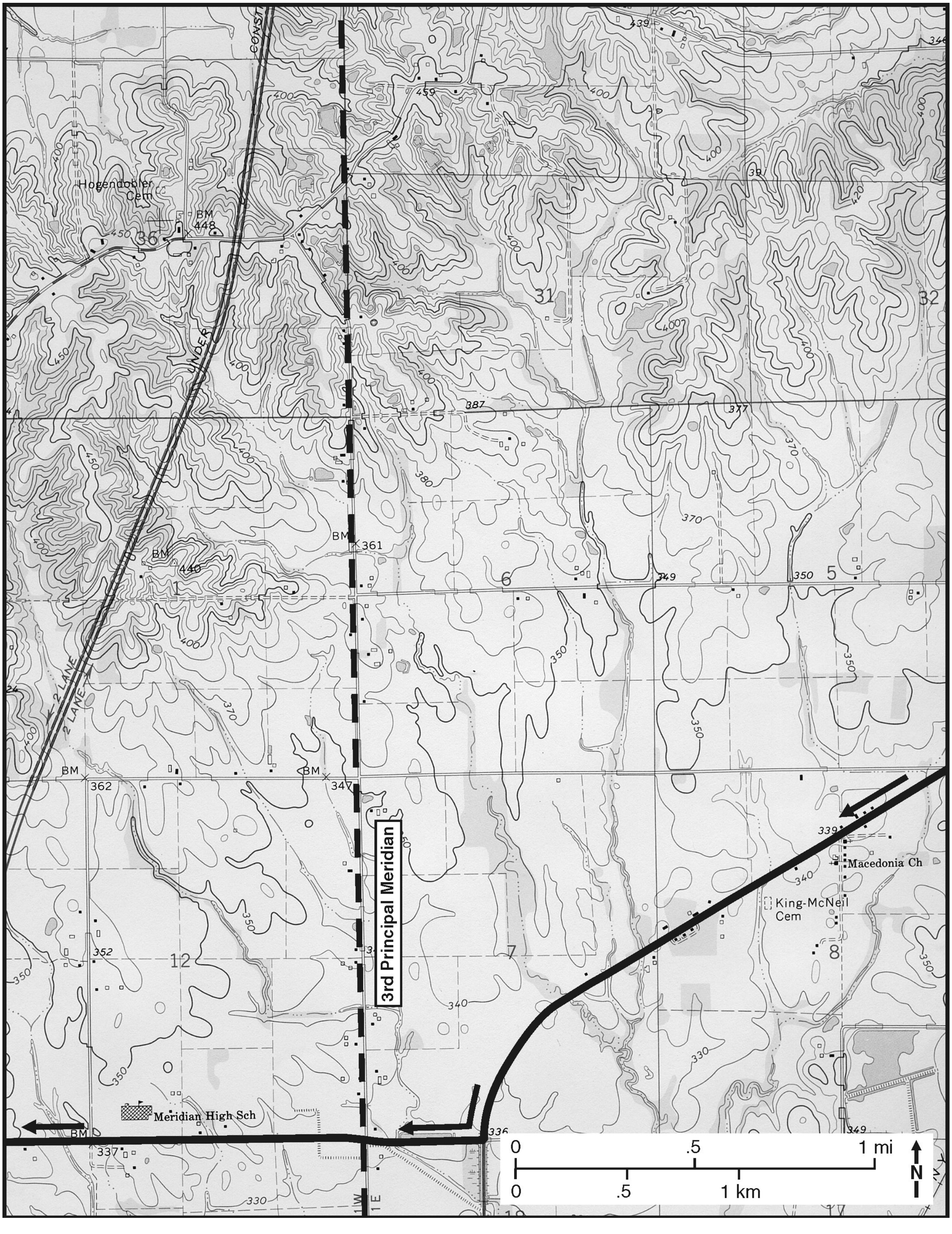
Macedonia Ch
King-McNeil Cem
Meridian High Sch
BR 326
LEVEE
MERIDAN
PRINCIPAL
Hess
Bayou
BM 326
0
.5
1 mi
0
.5
1 km
N



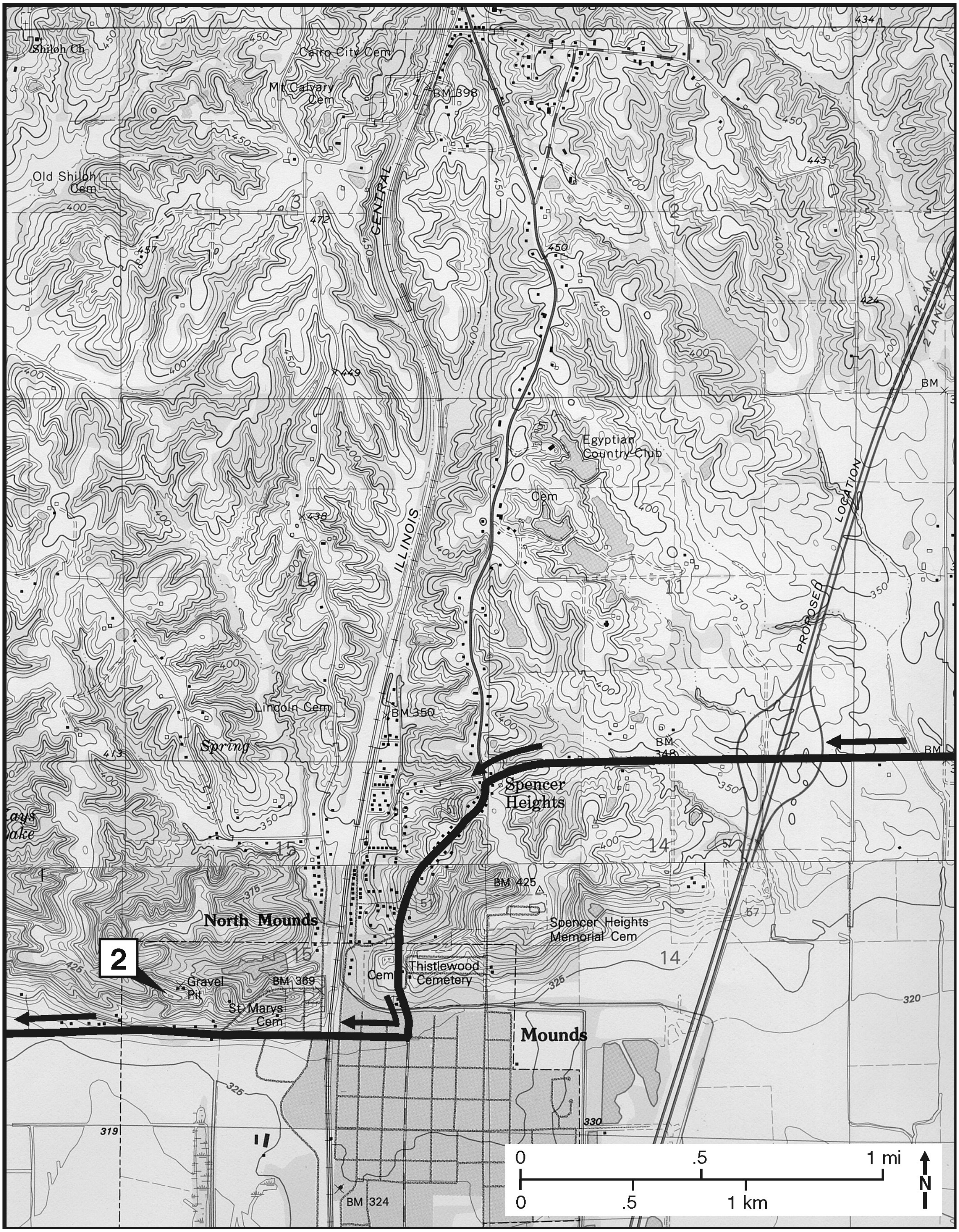
Hodges
Creek
NEW YORK
CENTRAL
PULASKI CO
BALLARD CO
Macedonia Ch
America
Lyerly Cem
Claypit
Cem
Light
BM 337
BR 343
BR 339
BR 332
BR 331
T 15 S
T 16 S
0 .5 1 mi
0 .5 1 km
N


1
BM
447
BR 364
BR 343
BR 339
BR 332
BR 331
392
395
346
BM 337
328
338
386
413
439
Olmsted
Caledonia
Campground
Claypit
Cem
Light
Hodges
CENTRAL
T 15 S
T 16 S
20
21
22
27
28
29
32
33
34
37
0
.5
1 mi
1 km
N

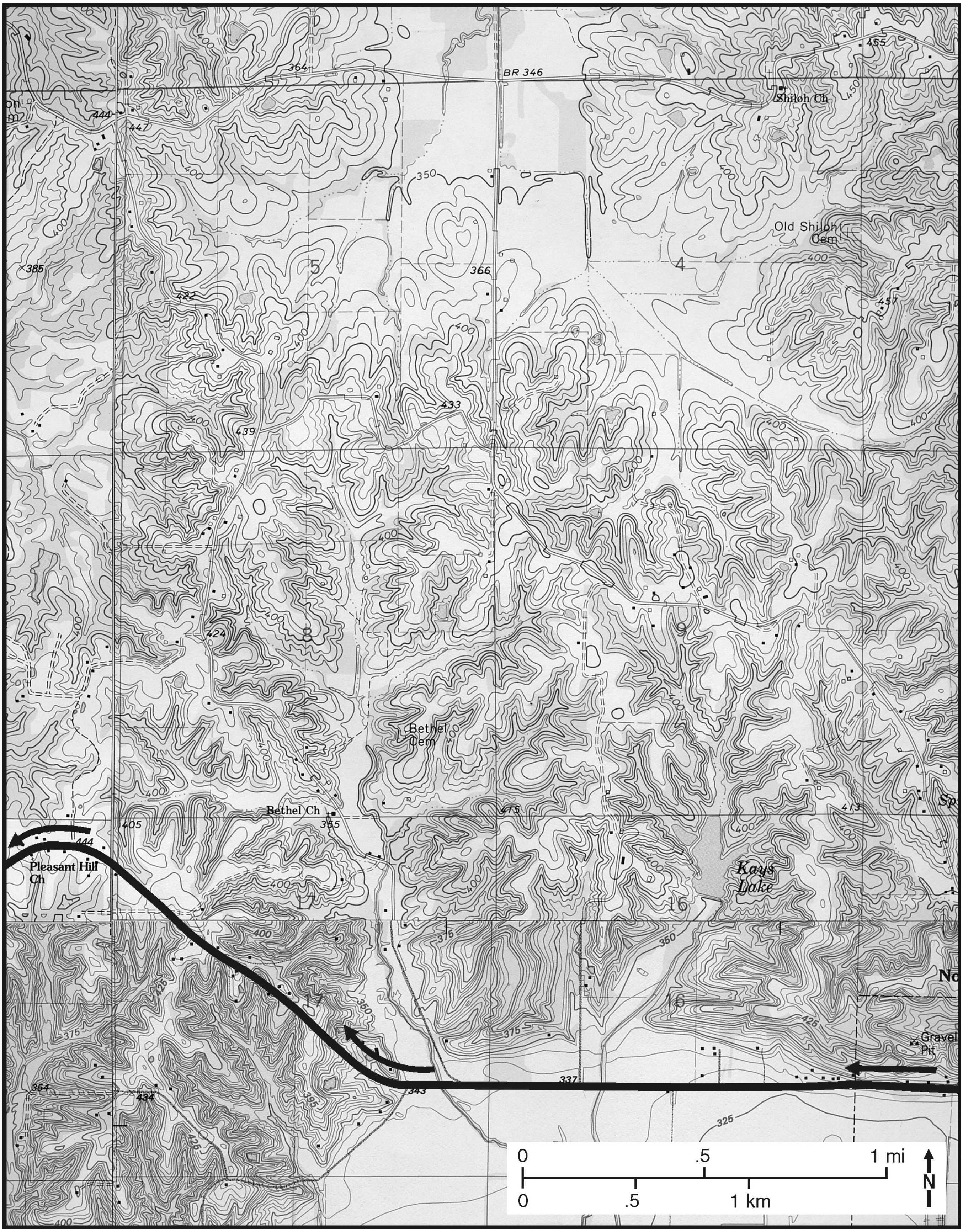

Creek
Hodges
Creek
NEW YORK
CENTRAL
BM 337
BR 339
BR 331
Macedonia Ch
PULASKI CO
ALLARD CO
T 15
T 16
0 .5 1 mi
0 .5 1 km
N

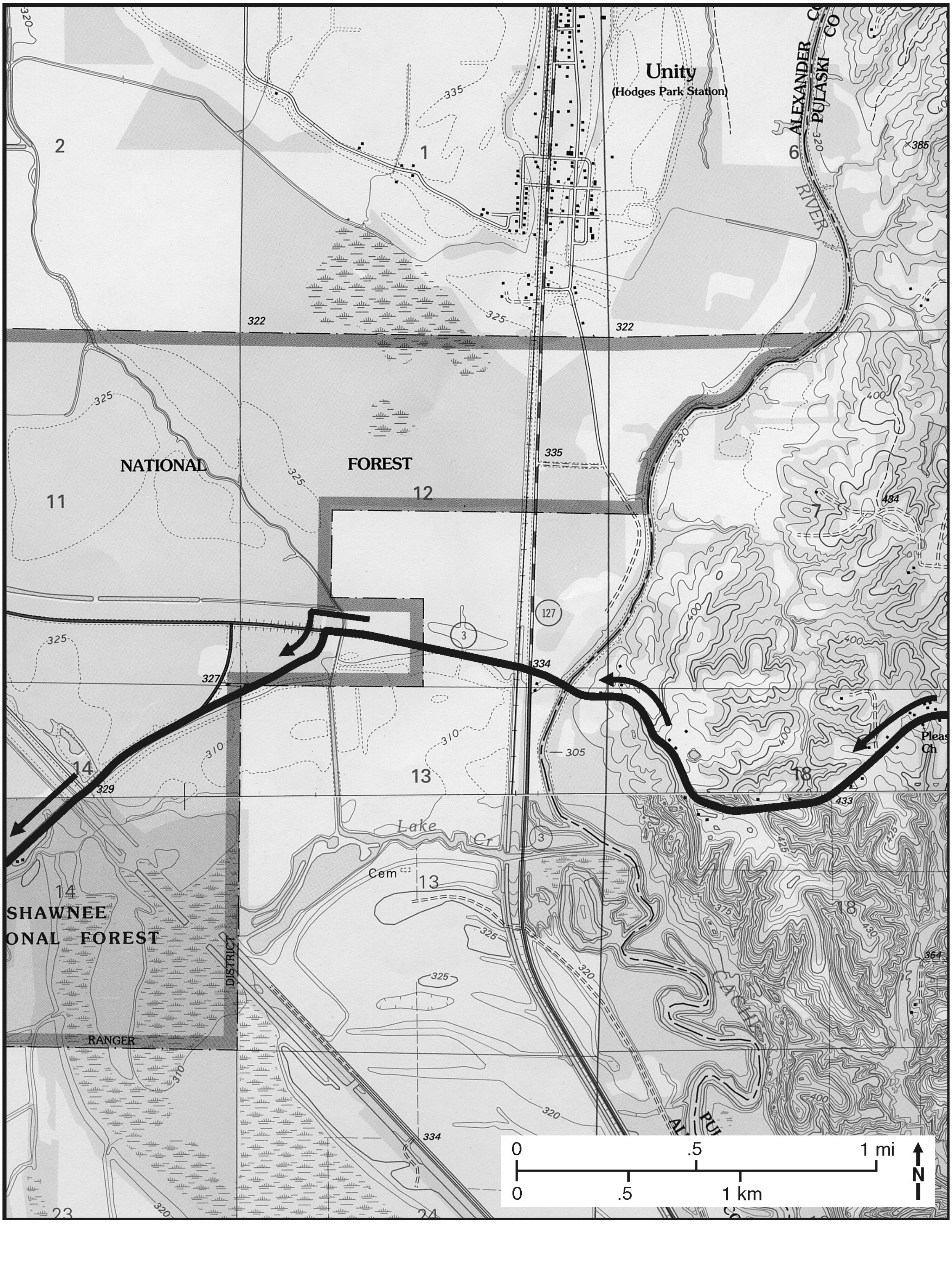


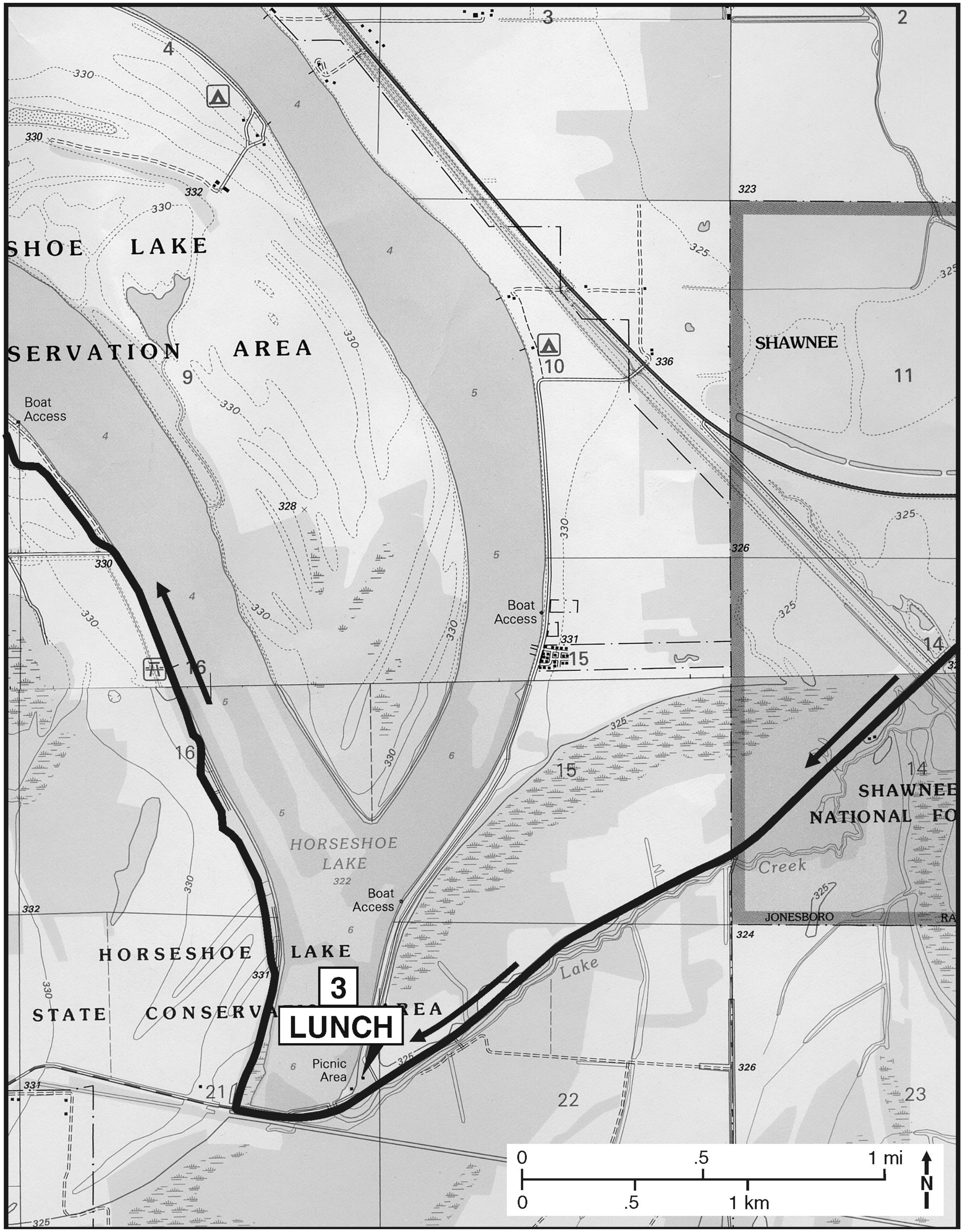
Hogendobler Cem
BM 448
36
31
32
BM 361
BM 440
6
5
BM 362
BM 347
3rd Principal Meridian
Macedonia Ch
King-McNeil Cem
12
7
8
Meridian High Sch
BM
337
336
349
387
377
350
339
2 LANE
1W
1E
0 .5 1 mi
0 .5 1 km
N

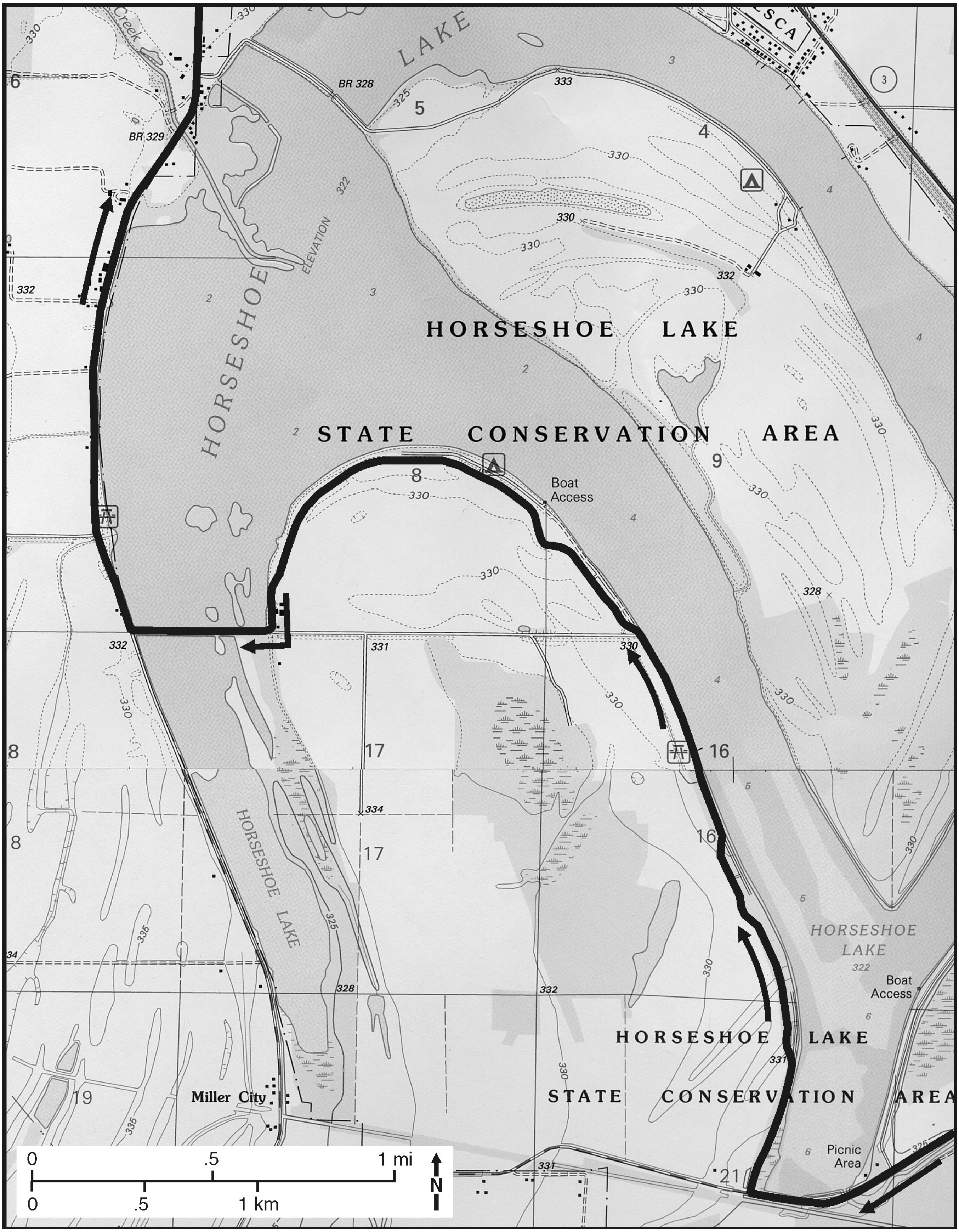


Shiloh Ch
Cairo City Cem
Mt Calvary Cem
BM 398
Old Shiloh Cem
CENTRAL
ILLINOIS
Egyptian Country Club
Cem
PROPOSED LOCATION
2 LANE
Lincoln Cem
BM 350
Spring
Spencer Heights
North Mounds
BM 425
Spencer Heights Memorial Cem
2
Gravel Pit
BM 369
St Marys Cem
Cem
Thistlewood Cemetery
Mounds
BM 324
0
.5
1 mi
1 km
N

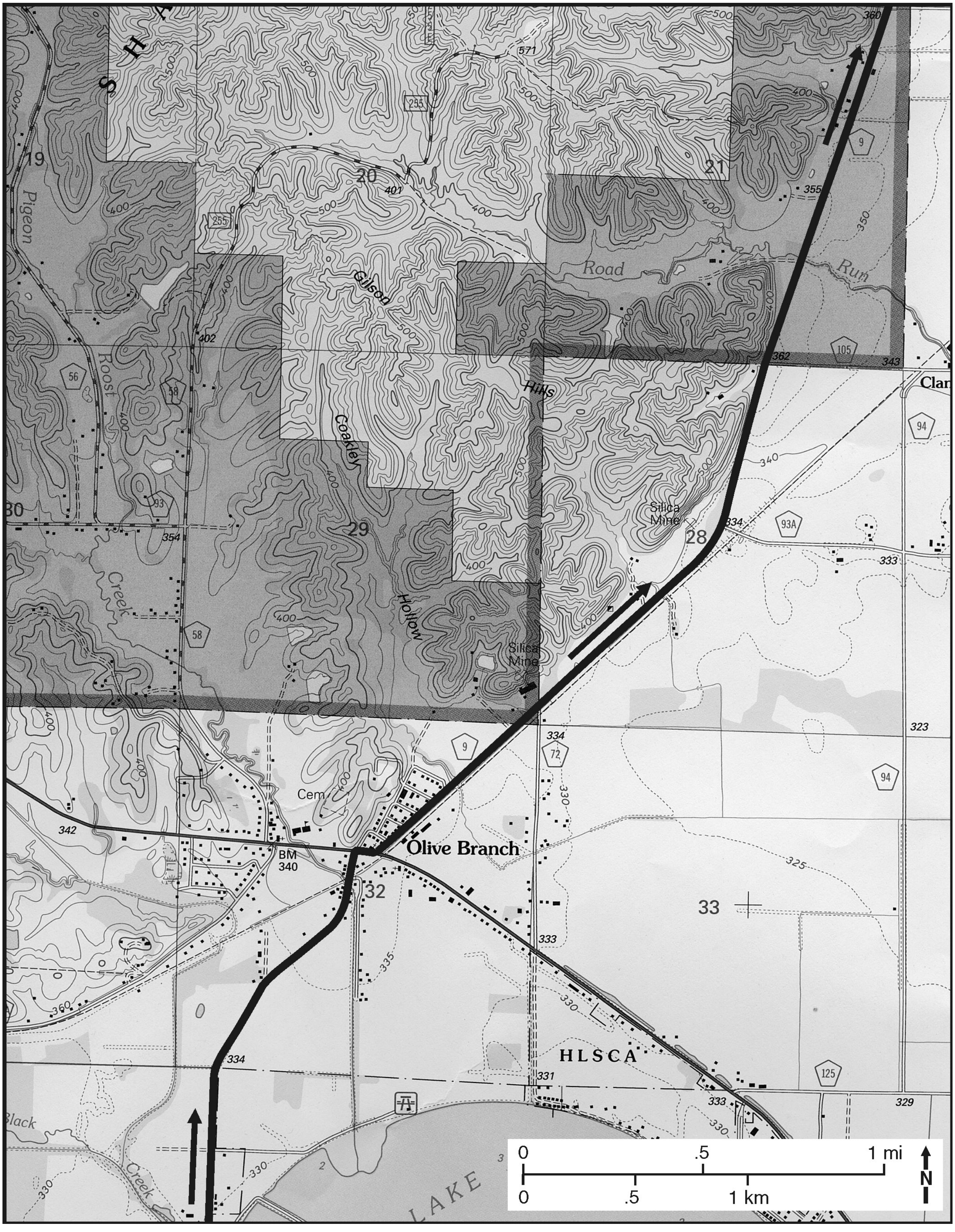

BR 346
Shiloh Ch
Old Shiloh Cem
Bethel Cem
Bethel Ch
Pleasant Hill Ch
Kays Lake
Gravel Pit
0 .5 1 mi
0 .5 1 km
N


Unity
(Hodges Park Station)
ALEXANDER CO
PULASKI CO
RIVER
NATIONAL
FOREST
SHAWNEE
ONAL FOREST
DISTRICT
RANGER
Lake Cr
Cem
Pleas Ch
0 .5 1 mi
0 .5 1 km
N

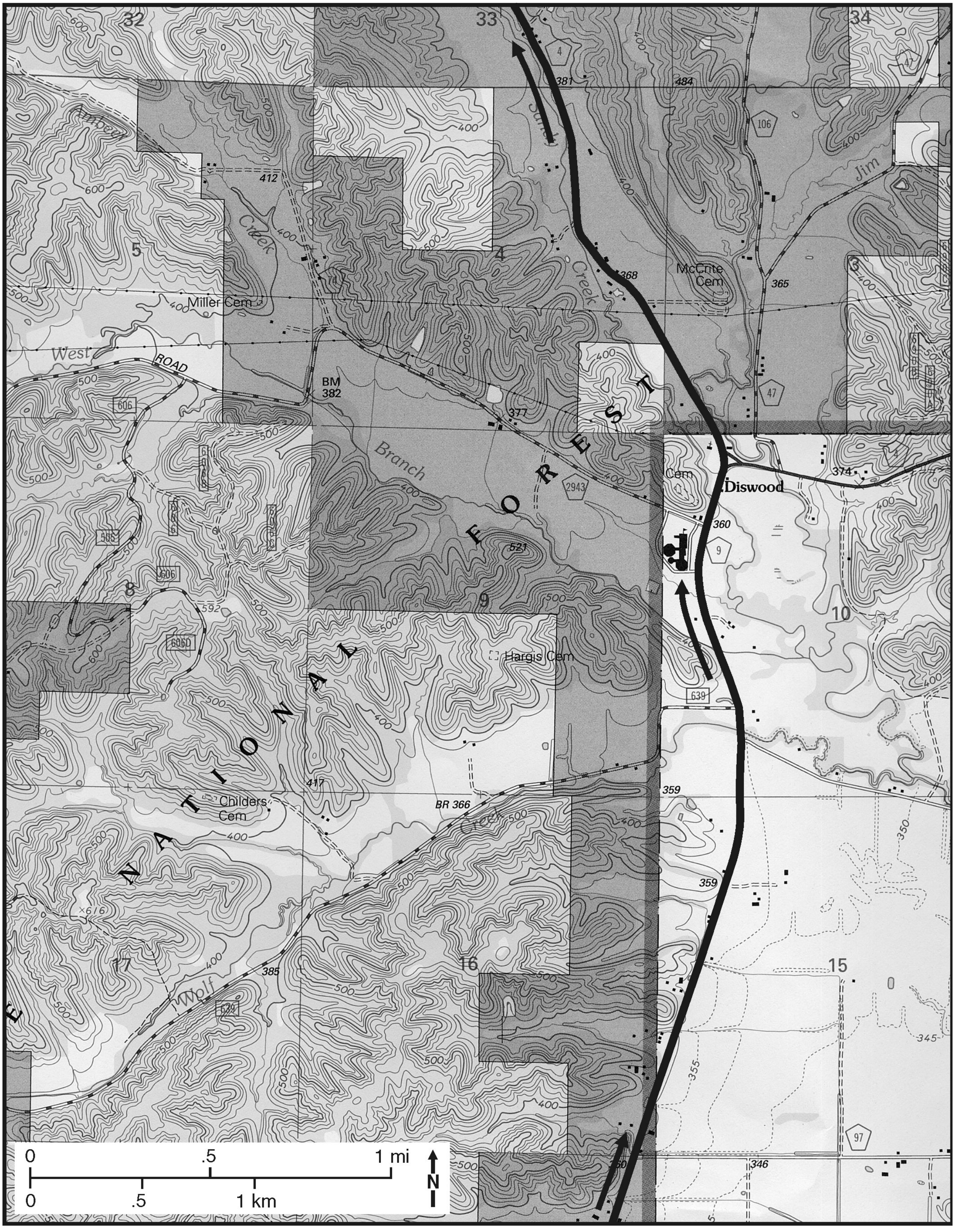

SHOE LAKE
SERVATION AREA
Boat Access
SHAWNEE
Boat Access
HORSESHOE LAKE
Boat Access
HORSESHOE LAKE
STATE CONSERVA REA
3
LUNCH
Picnic Area
SHAWNEE
NATIONAL FO
Creek
JONESBORO
Lake
0 .5 1 mi
0 .5 1 km
N



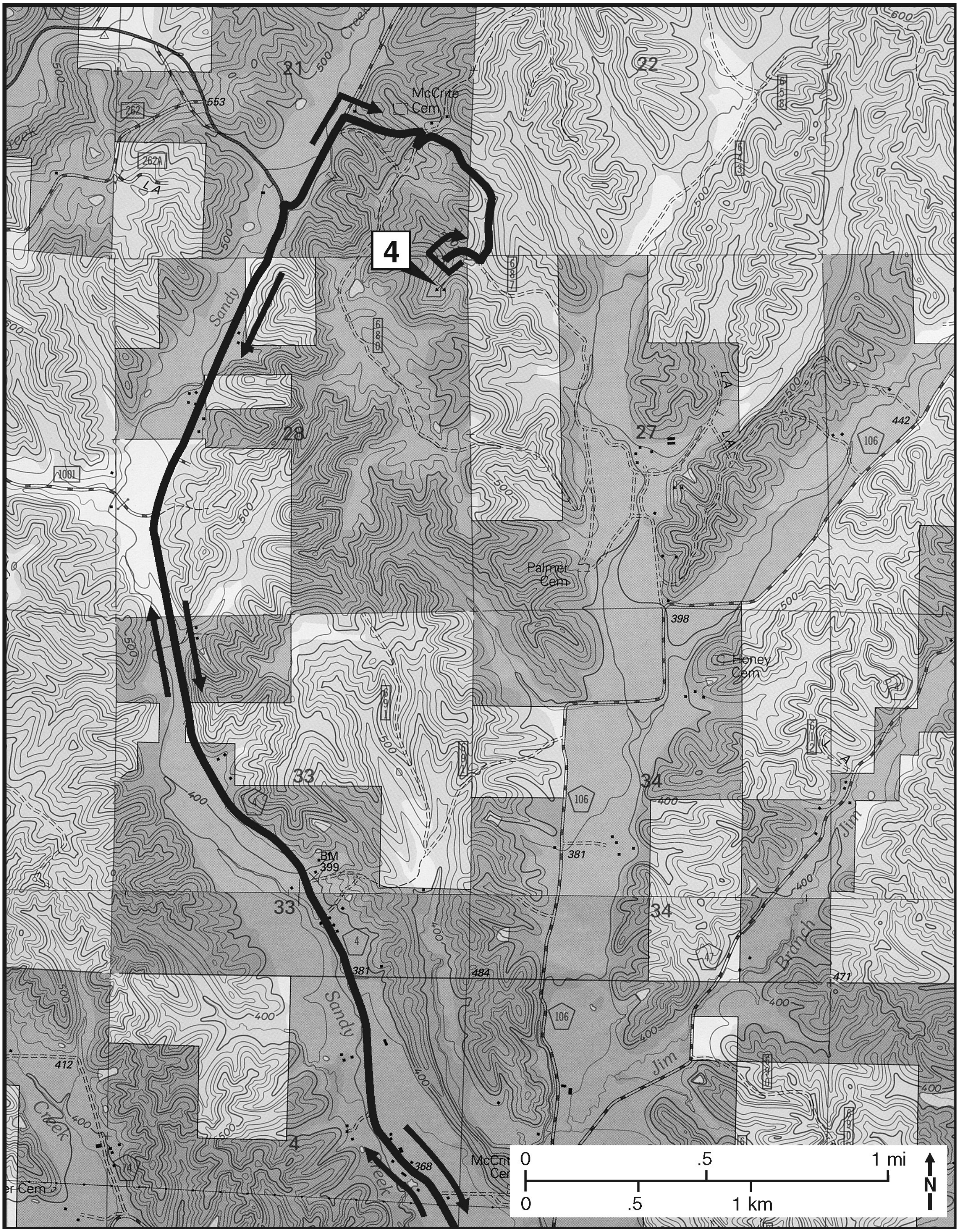
HORSESHOE LAKE
STATE CONSERVATION AREA
HORSESHOE
LAKE
BR 328
BR 329
ELEVATION
Boat Access
Picnic Area
Miller City
0 .5 1 mi
0 .5 1 km
N

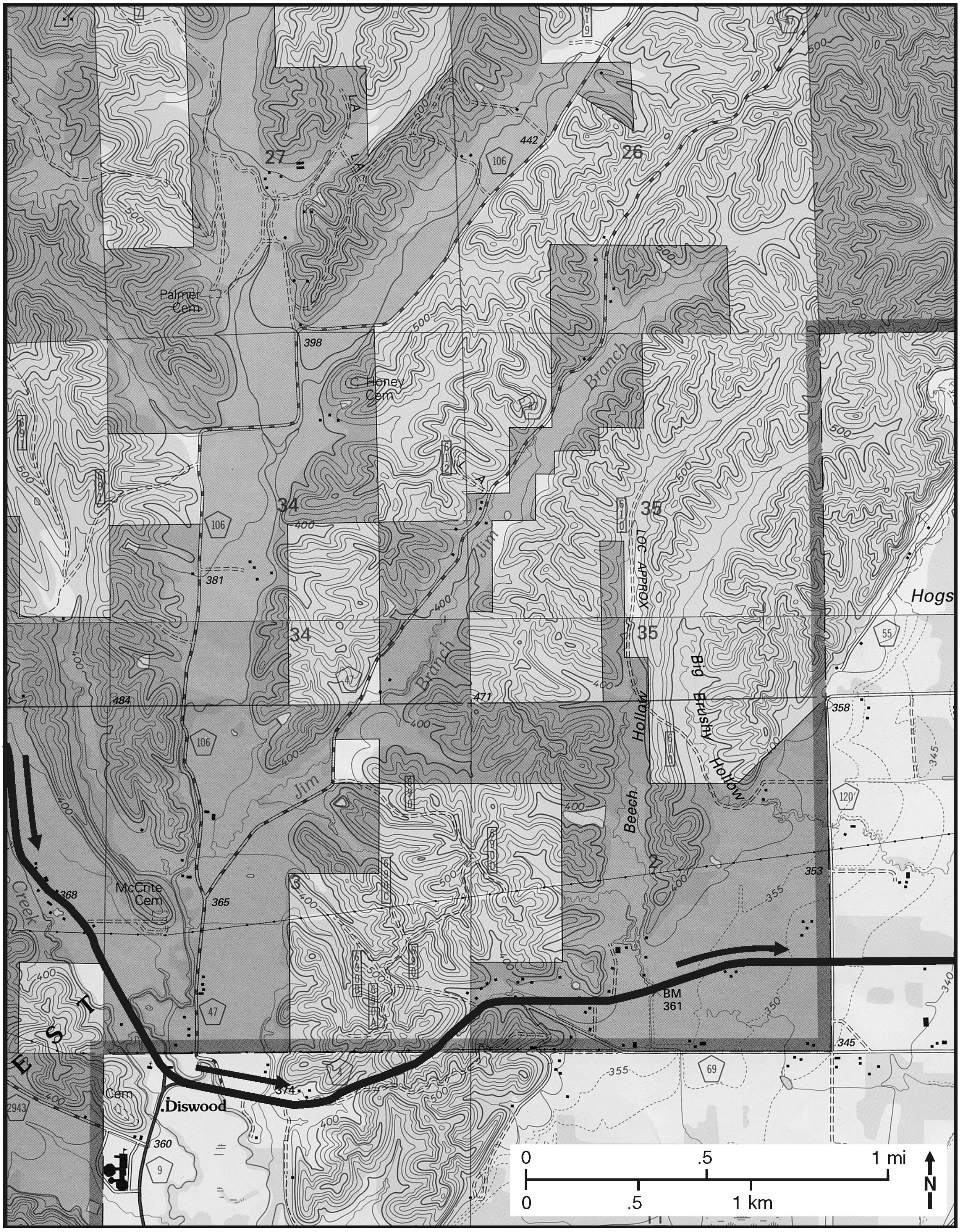


Olive Branch
HLSCA
LAKE
Silica Mine
Silica Mine
Cem
BM 340
Pigeon
Roost
Creek
Gilson
Coakley
Hollow
Hills
Road
Run
Black
Creek
19
20
21
28
29
30
32
33
0
.5
1 mi
0
.5
1 km
N

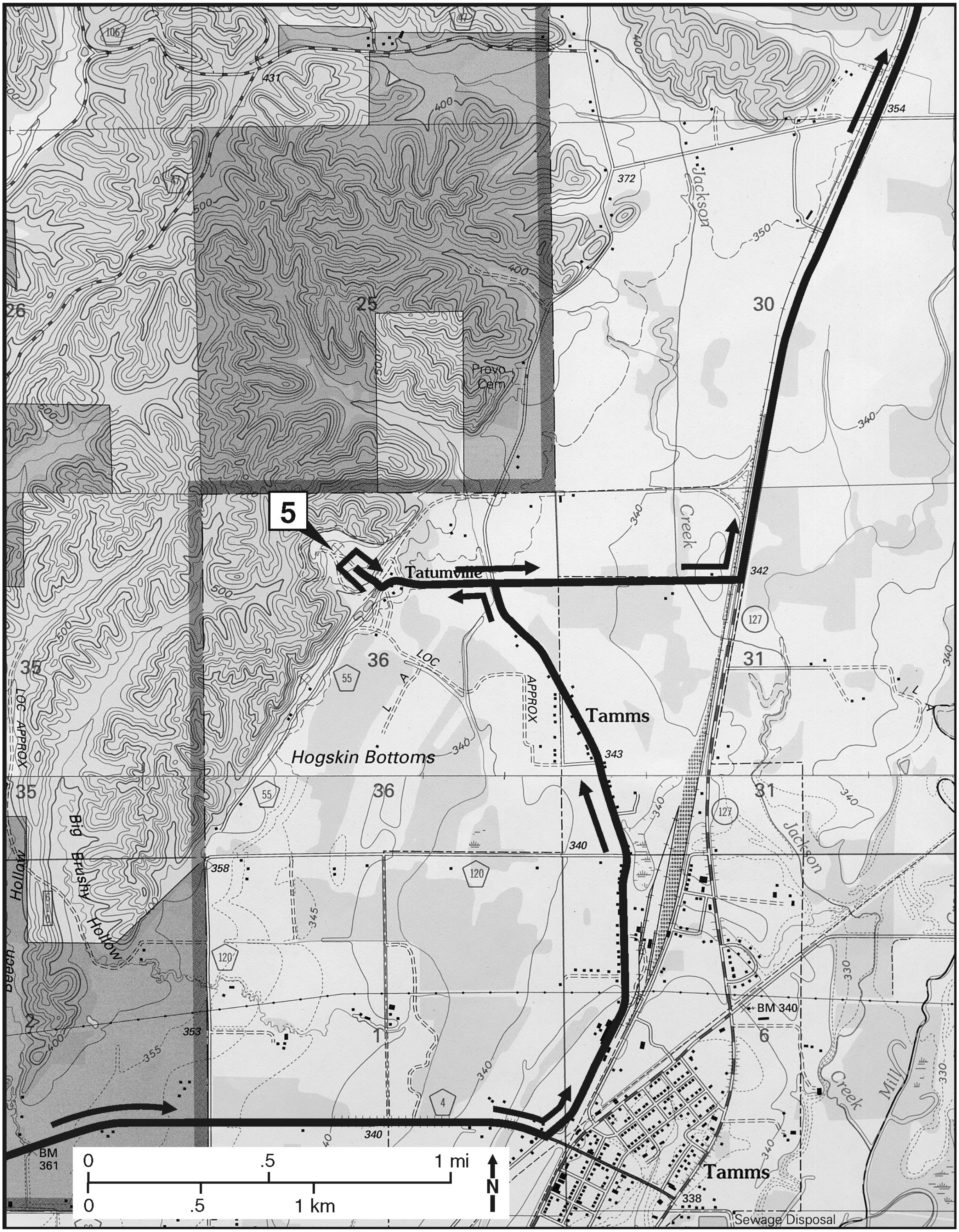


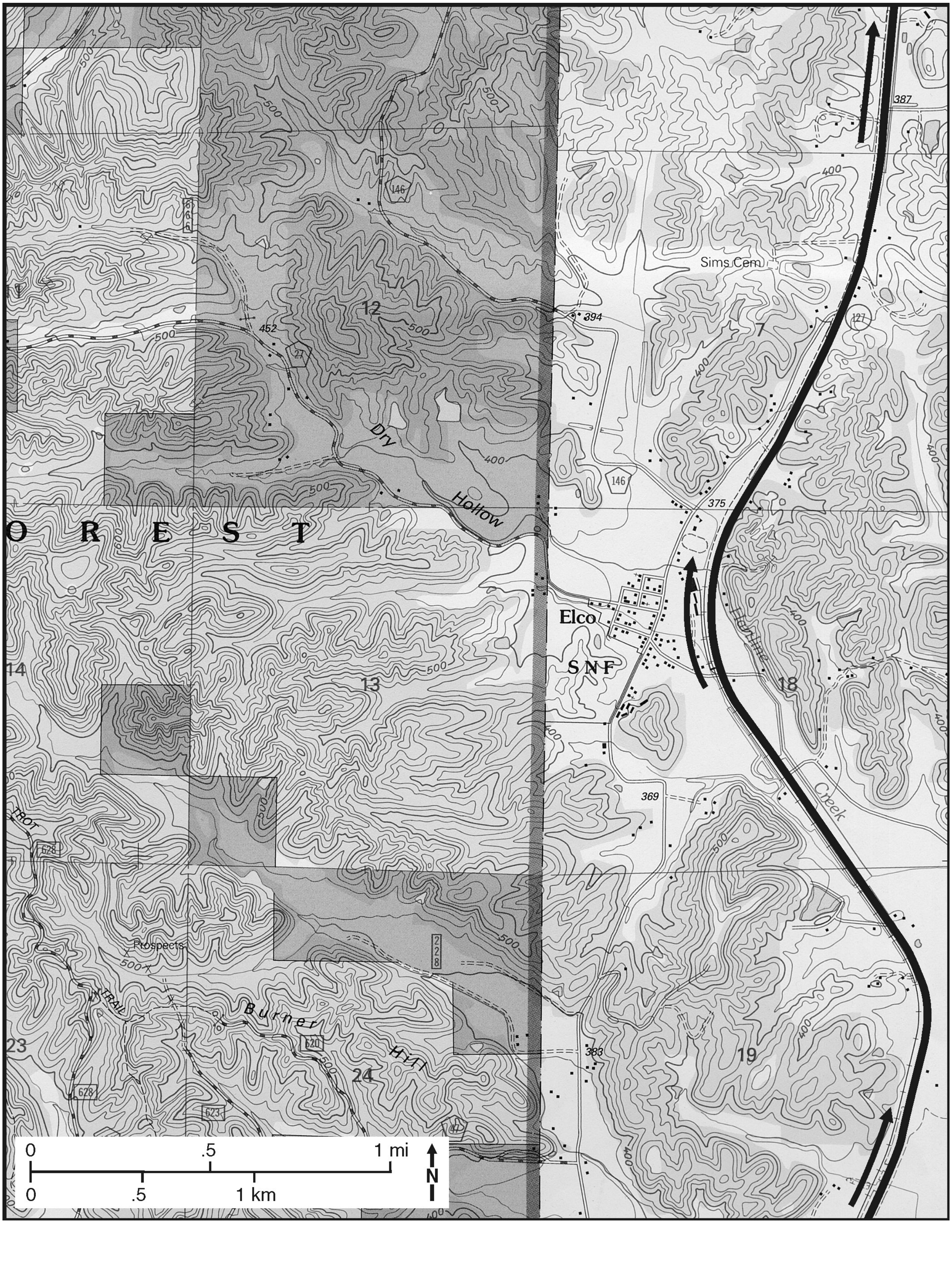
NATIONAL FOREST
Diswood
Miller Cem
McCrite Cem
Hargis Cem
Childers Cem
Cem
West
ROAD
Branch
Creek
Wolf
Jim
BM 382
BR 366
0 .5 1 mi
0 .5 1 km
N

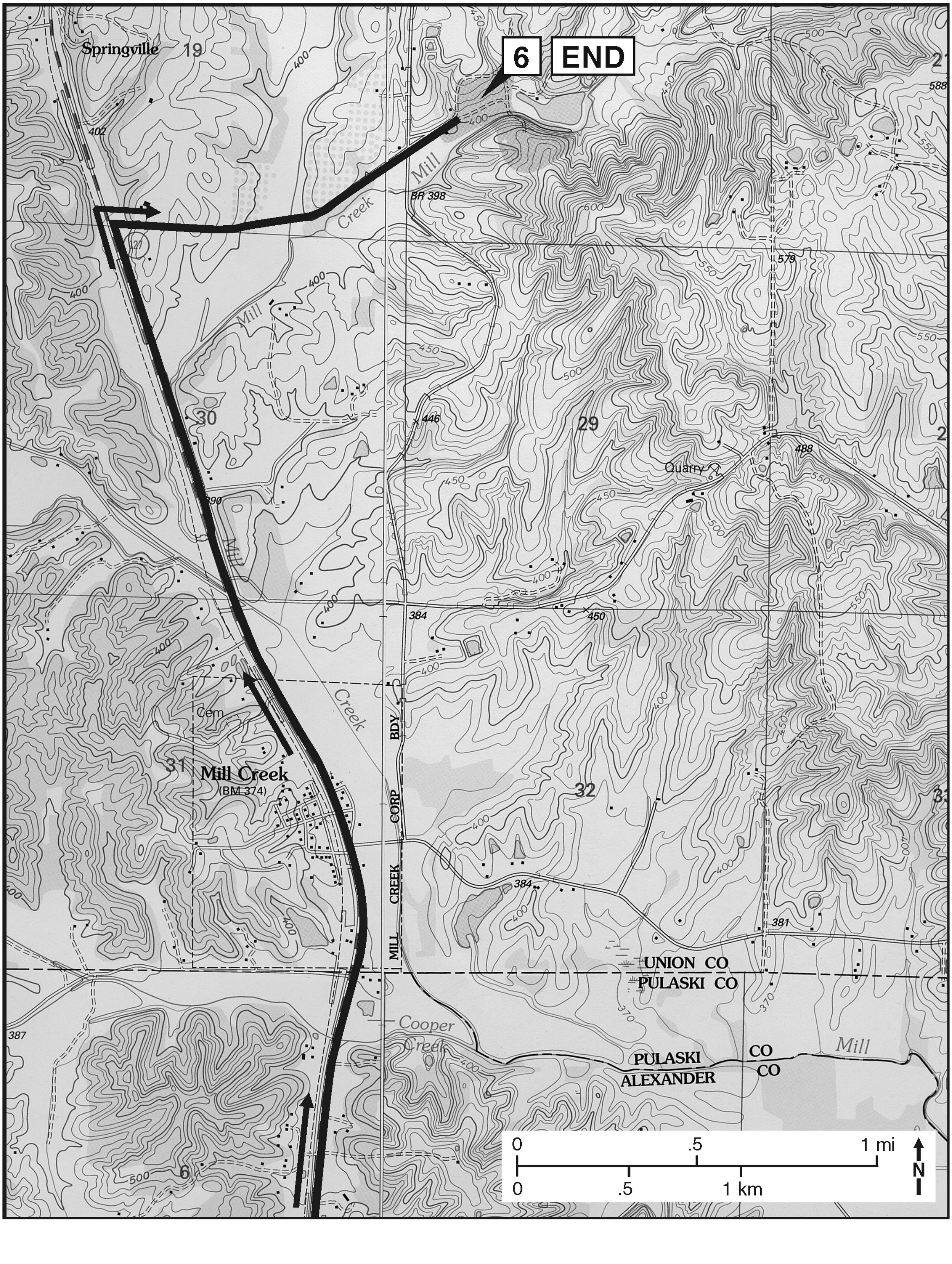

4
McCrite Cem
Palmer Cem
Honey Cem
Sandy
Creek
Jim Branch
21
22
27
28
33
34
0 .5 1 mi
0 .5 1 km
N



Palmer Cem
Honey Cem
McCrite Cem
Cem
Diswood
Jim Branch
Branch
Beech Hollow
Big Brushy Hollow
Hogs
Creek
LOC APPROX
E S T
BM 361
27
26
34
35
3
2
0 .5 1 mi
0 .5 1 km
N


5
Tatumville
Tamms
Tamms
Hogskin Bottoms
Provo Cem
Jackson
Creek
Jackson
Creek
Mill
Big Brushy Hollow
Beech Hollow
LOC APPROX
APPROX
LOC
25
26
30
31
31
35
35
36
36
1
2
6
BM 340
BM 361
338
340
342
343
353
354
358
372
431
Sewage Disposal
0
.5
1 mi
0
.5
1 km
N


O R E S T
12
Dry
Hollow
452
394
Sims Cem
7
127
146
387
375
Elco
SNF
Hunting
Creek
18
13
14
11
369
19
24
23
Burner
Hill
Prospects
TRAIL
TROT
383
628
623
620
228
0
.5
1 mi
1 km
N



6
END
Springville
19
30
29
31
32
Mill Creek
(BM 374)
Cem
Quarry
Mill Creek
Cooper Creek
MILL CREEK CORP BDY
UNION CO
PULASKI CO
PULASKI CO
ALEXANDER CO
0
.5
1 mi
0
.5
1 km
N

Figure 7 Confluence of the Mississippi River (on the right) and the Ohio River (on the left) from the Boatmen's Memorial at Fort Defiance State Park (photo by Wayne T. Frankie).

STOP DESCRIPTIONS

START: Fort Defiance State Park On the day of the field trip, we will start at the parking lot in front of the Boatmen's Memorial (NE, SW, SW, SW, Sec. 32, T17S, R1E, 3rd P.M., Wyatt 7.5-minute Quadrangle, Alexander County).

Located at the confluence of the Ohio and Mississippi Rivers (fig. 7), this area was originally know as Bird's Point and later as Cairo Point after the city of Cairo was established. This point is generally known as the southernmost part of Illinois. However, the actual southernmost tip of the state is on an island, Angelo Towhead, about 1.75 miles west and a little more than 0.5 miles south of this point in the SE 1/4 SE 1/4 SE 1/4 Sec. 31, T175, R1E, 3rd P.M., Alexander County, Wyatt 7.5-minute Quadrangle (see route map, page 26).

Fort Defiance State Park

Fort Defiance State Park was created in 1960. After 19.50 acres were acquired, the park was acclaimed “Cairo Point–Fort Defiance State Park. Other land acquisitions brought the total acreage to over 38 acres. Once called “the ugliest park in America” and “the park that no one wants” by the *Chicago Tribune* due to its state of deterioration, Fort Defiance became the park that the people saved. A grassroots organization of Cairo citizens, Operation Enterprise, leased the park from the state to renovate and maintain it. Ravaged by recurring floods, Fort Defiance has made a miraculous recovery from neglect through the efforts of the citizens of Cairo. Today, visitors can enjoy a picnic, stroll the grounds, or camp in one of 31 campsites within the historic park.

Fort Defiance, the Civil War post commanded by General Ulysses S. Grant, guarded this southernmost point of free territory and Union shipping and became the supply base for the western thrust into the Confederacy. Troops met in and near Cairo as they moved to and from the front lines. Over the past century, however, river changes have extended the point a mile south from the fort’s original site. Historically the encampments or forts located at or near this point have had several names including Villa Ridge, Camp McClernand, and Camp Defiance (also known as Fort Defiance).

The Ohio and Mississippi Rivers

In 1960, a Boatmen’s Memorial was dedicated to those who have lost their lives on the river. The memorial provides an awe-inspiring vantage point to overlook one of nature’s longest and most awesome battles, the constant meeting of the vast Ohio and Mississippi rivers (fig. 7). Refusing to merge although they flow down the same channel, the two rivers remain apart for about a mile downstream. The Ohio forms a rippling blue ribbon refusing to merge with the brown Mississippi currents. The demarcation between the two rivers is an ever-fascinating and changing phenomenon and the most significant convergence of two rivers in North America. The historical and military importance of this vantage point is unquestioned. From the Boatmen’s Memorial observation deck one can watch the captains of the large tows navigate the point as gulls wheel above the wakes produced by the small but mighty tugs. In the spring, the Mississippi may churn and grind with northern ice.

History of European Discovery and Settlement

Information from the historical marker on the Boatmen’s Memorial was incorporated into the following description:

The meeting of the rivers was long known to the Native Americans who used them as a highway for trade and warfare. This junction was first sited by Europeans when Frenchmen Jacques Marquette and Louis Joliet glided past in 1673. Ten years later, La Salle explored this area and established France’s claim to the Mississippi Valley. In 1721, Pierre Francois Xavier De Charlevoix, a French Jesuit, visited this area, and recorded the following in his journal: “The land at the confluence of the Mississippi and Ohio Rivers would be a strategic location for settlement and fortification.” From that time on, this confluence was recognized as a strategic site for settlement and fortification by all who followed. George Rodgers Clark, following the capture of Fort Kaskaski in 1778, stationed armed boats at this junction to guard against attacks on the Illinois Country by the British or Spanish. Here in April 1811, the *New Orleans*, first steamboat to navigate western waters, lay at anchor during the three nights of the New Madrid earthquake. In 1848, a cannon was installed at the confluence of the rivers to greet arriving riverboats. During the Civil War this cannon was aimed down the river to thwart any attacks from the South. A single track of the Illinois Central Railroad ran down the levee to the point.

Information from a historical sign located at the entrance to Fort Defiance, erected by the Illinois Department of Transportation and The Illinois State Historical Society on May 6, 1964, was incorporated into the following.

Cairo

In 1818, the Illinois territorial legislature incorporated the city and bank of Cairo. But Cairo was then only a city on paper, and plans for its development came to a standstill with the death of John Gleaves Comegys, the leading promoter of the incorporation. In the 1830s, the area's commercial potential again captured the imagination of Illinois leaders and eastern investors. The new city promoters incorporated the Cairo City and Canal Company and made elaborate plans for levees, canals, factories, and warehouses. The first levees failed to hold back the rampaging rivers, and financial difficulties slowed the boom. Company policy to lease, not sell, city lots also retarded expansion. With the first sale of lots in 1853 and the completion of the Illinois Central Railroad from Chicago to Cairo late in 1854, the city began to prosper.

When the Civil War began, strategists from both sides recognized the military importance of Cairo. Fort Defiance was established at the confluence to thwart Confederate invasion and blockade the trade to the South. On April 22, 1861, ten days after the bombardment of Fort Sumter, troops arrived to hold Cairo for the Union. They established camps on the land south of Cairo. The St. Charles Hotel in Cairo was the headquarters of General Prentiss, who had command of the federal armies here during the early 1860s. Upon hearing that the rebels had established a camp at Elliotts Mills, a point on the Kentucky side ten miles south of Cairo, he sent ten companies down there to dislodge them. When they arrived, the rebels had already fled.

Fort Prentiss was a noble fortification with a huge 64-pounder occupying the center of the fort, its muzzle threateningly pointed down the Mississippi. In front of this, the magazine was heaped over with earth, so well screened that no cannonball, shell, or any other missile of destruction could penetrate it. The fortifications were very simple earthworks, and not a stone was used.

Several Civil War camps were established along the Mississippi and Ohio Rivers near Cairo Point. Camp McAllister, on the Ohio bend of the levee, guarded Cairo Point from a surprise attack from upstream. Camp Smith, on the Mississippi bend of the levee, and Camp Houghtaling, three miles up the Mississippi, guarded against attack by way of the Mississippi River. Thus, within six months from the start of the Civil War, Cairo was one of the strong and important forts of the Union forces.

General Prentiss was succeeded in command at Cairo in September 1861 by General Ulysses S. Grant, who remained in command there until April 1862. The name of the fort was changed from Fort Prentiss to Fort Defiance.

Cairo flourished as a troop and supply center for the army of General Ulysses S. Grant. From here was launched General Grant's flanking movement up the Cumberland and Tennessee Rivers, which began at Fort Henry and ended at Vicksburg, giving the Union complete control of the Mississippi. Although the city bustled with wartime activity, non-military commerce was reoriented along east-west lines.

River Commerce

This locality affords an excellent opportunity to view the confluence of the Mississippi and Ohio Rivers and to see some of the barge traffic that moves on this important waterway.

Mississippi River

The Mississippi River system includes all main channels and all tributaries of the Mississippi, Illinois, Missouri, and Ohio Rivers. The Mississippi River itself is open to commerce for more than 1,830 miles—from Minneapolis, Minnesota, to the mouth of the river at Southwest Pass, Louisiana. More than 540 million tons of more than 100 different commodities are transported on the Mississippi River system.

Ohio River

The Ohio River comprises 204,000 square miles. The 981-mile-long river carries the largest volume of water of any of the Mississippi River tributaries. Starting in northeastern New York, the Ohio is formed by the junction of the Allegheny and Monongahela rivers at Pittsburgh, Pennsylvania, and empties into the Mississippi River at Cairo. Over 239 million tons of commodities, valued at nearly $45 billion, are transported by barge annually on the Ohio River.

Some of the more common commodities transported on the rivers for export include corn, wheat, soybeans, lignite, bituminous and anthracite coals, grain mill products, and basic chemicals and products. Imports include aluminum ore concentrates, crude petroleum, sugar, and iron and steel plates and sheets.

For comparison, the cargo capacity of one barge is 1,500 tons, which is equal to 15 jumbo hopper rail cars with a capacity of 100 tons each or 58 large semi trucks with a capacity of 25 tons each. A typical tow consists of 15 barges, which can carry 22,500 tons, the capacity of 870 trucks or 2.25 unit trains. A unit train consists of 100 jumbo hopper cars, each with a capacity of 100 tons. A single tow is 0.25 miles in length, 2.25 unit trains are 2.75 miles long, and 870 trucks, assuming 150 feet between trucks, are 34.5 miles long.

STOP 1: Oil-Dri Clay Pit Porters Creek and Clayton Formations, Paleocene, located northwest of Olmsted (SE, SE, SE Sec. 16, T15S, R1E, 3rd P.M., Olmsted 7.5-minute Quadrangle, Pulaski County). On the day of the field trip, park along the entrance road.

Clay mined at Oil-Dri Clay Pit is a special type that absorbs oils and greases (fig. 8). In Europe, the term "fuller's earth" was originally applied to clay used for fulling wool, that is, removing the natural oils and greases from sheep's wool. Later this clay was discovered to have the ability to remove basic colors from oils. Petroleum companies then used it for decolorizing various oils and eventually began mining the clay.

In 1920, Sinclair Refining Company mined fuller's earth at Olmsted. The first production of this clay in Illinois was for industrial purposes. Fuller's earth was mined near the Ohio River, and the mining employed a number of men as the overburden first had to be removed using mule teams. Shortly thereafter, Standard Oil Company of Indiana opened a mine and processing plant about a half-mile southwest of the Sinclair facility. For many years, this clay was used principally for clarifying and filtering animal, vegetable, and mineral oils, fats, and greases; in the manufacture of wallpaper pigments and talcum powder substitute; and for medicinal purposes.

These plants operated for years and contributed greatly to the development of the village. The Sinclair plant burned in 1921 but was rebuilt and enlarged, resuming operation in 1923. Standard Oil closed its plant in 1939, moving or selling all equipment and machinery. Ten years later, in

Figure 8 Oil-Dri Company clay pit, exposure of Porters Creek clay overlain by Mounds Gravel and loess at Stop 1.

August 1949, the Sinclair Refining Company shut down its plant. The closing of these mining operations was due to the discontinuation of the use of fuller's earth in the refining of oil by these companies. The Sinclair plant was later purchased by the American Charcoal Company of Detroit, Michigan. Their product was sold to the Floor Absorbent Trade to be used in removing oil from concrete floors.

In 1947, Lowe's, an early clay company located in Olmsted, discovered that this clay could be used as a cat box filler and developed their "Kitty Litter." In 1958, the original Sinclair plant was purchased by Lowe's Inc. and renovated. By 1960, the plant produced more than 10,000 tons of clay per year. Later on (date uncertain), the Olmsted plant was one of five operated by a company known as Southern Clay, Inc. whose five plants produced nearly a half-million tons of absorbent clay materials annually.

The last operation that produced absorbent clay in Olmsted was Golden Cat Corporation, which was owned by the Ralston Purina Company. The Olmsted facility was closed in 1997. The only company currently mining and producing absorbent clay in Illinois is the Oil-Dri Company. Their processing plant is located in Mounds was originally operated by American Colloid. Oil-Dri Company and others have used variations in the clay composition and in the amounts and types of deodorizers added to the clay to produce various private label brands for the Porters Creek clay.

Paleocene Porters Creek clay is trucked from the working pit to the plant in Mounds. There the clay is passed through crushers and screens to reduce the size of the material from large lumps down to granules. Raw clay from the pit contains 38 to 40% moisture, but, by passing the broken clay through the up to 100-feet long rotary kiln dryers, the moisture content is reduced to 4 to 6%. The clay may be heated up to 1,100°F. depending on its intended use. The absorption capacity of the clay is greatly increased when heated and hardened. Heat also prevents the clay from breaking down into a soft clayey mass when saturated with liquids. The litter is able to absorb its own weight in liquids.

The dried litter is stored in large bins from which it moves by conveyor belts to the computer-controlled bagging operation that ensures a uniform end product. The litter is sold through national food store chains and supermarkets in addition to many large independent grocers and pet stores. Packaged litter is loaded on both trucks and trains and shipped generally throughout the country.

Another product manufactured in Mounds absorbs oil and grease spills from garage and factory floors. This material has also been used as an inert carrier for agricultural chemicals that readily penetrate the heat-treated and hardened clay granules. This material promotes a more uniform distribution of the chemicals on a field. Sports turf, the red material used on the infields at most of the major league baseball stadiums, is produced by the Oil Dri Company at Mounds.

This fuller's earth deposit is a Coastal Plain sediment and part of the Paleocene Porters Creek Formation. This clay generally is very dark gray, but weathering at this location has lightened the clay to a light gray or tan. The lighter colors are more sought after, largely because they are also light in weight.

The geologic section (fig. 5) exposed in this pit includes Pleistocene loess (wind-blown silt) overlying the Pliocene-Pleistocene Mounds Gravel, which in turn rests upon the Paleocene Porters Creek clay. The Porters Creek is from 50 to 150 feet thick in southern Illinois, and north of the Cache Valley it is completely eroded. This formation is largely massive (bedding is not distinct), compact, and unbedded to weakly bedded, dark gray to nearly black clay with a blocky fracture. It is gray-tan to white where weathered and does not become plastic when wet, thus standing in steeper faces than most clays. This clay is more than 80% montmorillonite, which gives it the absorptive and filtering properties that make it quite useful in drilling muds, oil adsorption, and absorbent litter products. The Oil Dri company is the only company currently mining this absorbent clay. Microfossils (radiolaria, hystrichospheridae, and formaninifera) are common.

The company sometimes digs into the Clayton Formation just below the Porters Creek. The Clayton Formation is up to 20 feet in the area. The lower part contains macrofossils of various marine forms (shark teeth, ray teeth, crabs, snails, and clams) and is generally greenish gray silty clay interbedded with bioturbated glauconitic, micaceous fine to medium quartz sand and silty clay. The upper part of the Clayton is mainly dark greenish gray, sandy, glauconitic clay with some thin glauconitic sand beds. This fossil assemblage indicates that the paleoenvironment of the lower Paleocene sediments is very similar to that of the modern Gulf Coastal Plain deposits found today from Louisiana to Alabama.

In the area (but not likely to be exposed in this pit) below the Clayton are the Late Cretaceous Owl Creek and McNairy Formations. The Clayton occurs in erosional contact with these underlying Cretaceous formations.

The sediments and fossils in the Porters Creek (and the underlying Clayton) indicate that sea level rose during the Paleocene and that ocean waters spread inland across the Gulf Coastal Plain and Mississippi Embayment, extending into southern Illinois. How far this marine transgression extended into southern Illinois is unknown due to later erosion of those sediments north of the Cache River valley. The Mississippi Embayment is a structural trough in the form of a wedge-shaped inland extension of the Gulf Coastal Plain and is both a physiographic and structural feature. The northern limit of the Mississippi Embayment is marked mostly by the erosional limit of the Cretaceous and Tertiary age deposits. These late Cretaceous and Paleocene deposits represent the shoreline, open to marine sedimentation, when waters of the Gulf of Mexico reached inland to the southern tip of Illinois.

Previous research on the Cretaceous-Paleocene strata in southern Illinois have included two potassium-argon dates on the pelletal glauconite found above and below the Cretaceous-Tertiary boundary. The uppermost Owl Creek Formation (Cretaceous) was dated at 65.7 ± 1.4 million years B.P., and the lowermost Clayton Formation (Paleocene) was dated at 60.6 ± 1.3 million years B.P. (Reed et al. 1977).

STOP 2: Sam Moses' Pit Pliocene-Pleistocene Mounds Gravel, located at Mounds (center of NW, SW Sec. 15, T16S, R1W, 3rd P.M., Cairo 7.5-minute Quadrangle, Pulaski County). On the day of the field trip, follow the lead vehicle into the pit and obey ISGS staff directing traffic.

At Stop 2 (fig. 9), we will examine a pit where both Pleistocene Peoria Silt (Loess) (wind-blown silt) and Pliocene-Pleistocene gravels from the Mounds Gravel are being mined for local uses (fig. 5). This site is located on the south side of a prominent bluff that faces the Ohio River valley. Of interest is that a number of offsets that range from a few inches to 40 feet displace strata of the Eocene Wilcox Formation, Pliocene-Pleistocene Mounds Gravel, and the Pleistocene Loveland Silt, Roxana Silt, and Peoria Silt (Kolata et al. 1981). These offsets are aligned in an east-west direction parallel to the bluff, are largest toward the bluff, and become smaller and more abundant to the south toward the Ohio River valley. Although these offsets may or may not be visible the day we visit (they were not at the time of preparation of this guidebook), Kolata et al. (1981) drilled two holes (see section, pages 53–55) to determine how deep these offsets went. These drill holes confirmed the shallow nature of the offsets and that they are caused by landsliding down the bluff into the valley. They occurred within the last 10,000 years as evidenced by the fact that they offset the Peoria Silt. What caused this landslide is unknown, but evidence suggests that the Ohio River in the valley undercut the bluff (Kolata et al. 1981).

The Mounds Gravel is widely present and is exposed in numerous gravel pits and road cuts in the area south of the Cache Valley, such as this pit. This gravel is found in three terraces, an upper at an elevation of 580 to 620 feet, a middle one at 450 to 500 feet, and a lower terrace at 380 to 400 feet. This gravel is up to 40 feet thick in some areas but more often is less than 20 feet thick. At least 8 feet are exposed below the overlying Pleistocene loess at this pit. The formation is characterized by mostly medium to dark brown chert pebbles with a glossy surface in a matrix of coarse red sand to pebbly sand. Many of these pebbles are partly rounded to well-rounded and average 2 to 3 inches in diameter, but sometimes are even larger. Quartz pebbles, which are also well-rounded but typically smaller, are also common. Cross-bedding and heavy-mineral content indicate (Willman et al. 1975) that the Mounds Gravel in this area was largely deposited by streams flow-

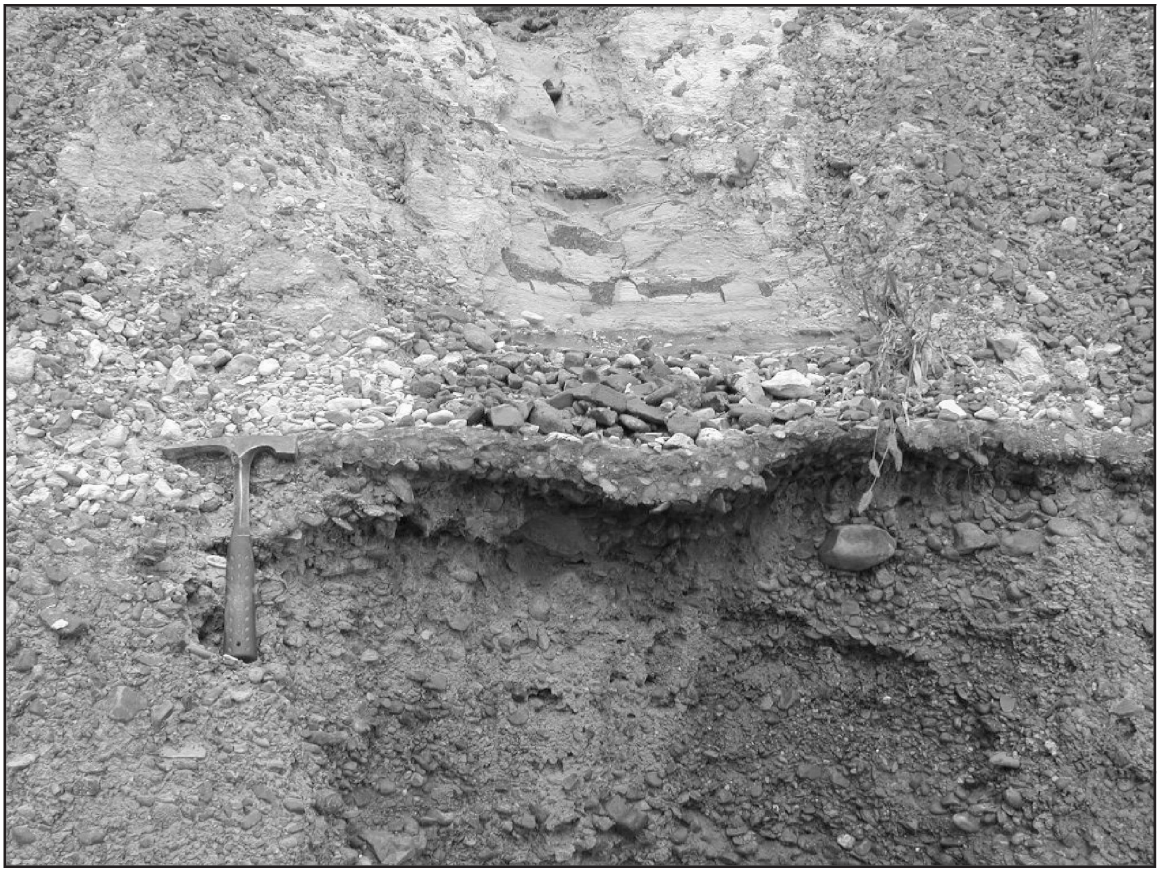


Figure 9 Sam Moses' Pit, exposure of Mounds Gravel with iron cemented conglomerate called "Peanut Brittle Rock" in middle (at the hammer's head) overlain by lens of silty clay at Stop 2 (photo by Wayne T. Frankie).

ing from the east or southeast, likely down the Tennessee River valley on the east side of the Mississippi Embayment. Some of the gravels in the Mounds found near the Mississippi River at the head of the embayment and on the west side of the embayment contain chert, agate, and purple quartzite pebbles that are characteristic of the Lake Superior region. The Mounds erodes underlying older Tertiary and Cretaceous sediments in the region and, in turn, has been highly dissected and weathered before the oldest Pleistocene deposit in the area, the Illinois Age Loveland Silt. In most cases these deposits are thought to be Pliocene in age; however there is evidence that deposits of the Mounds in the lower terrace surfaces may have been reworked from higher levels during the early Pleistocene. The Mounds does not contain the igneous and carbonate rocks or heavy minerals characteristic of the glacial deposits of the Upper Mississippi and Ohio Valleys.

At this stop we can see some lenses of channel fill reddish sand interbedded with the gravels. At least one clay-silt channel fill plug was found in the pit at the time of our visit to plan for this trip (fig. 9). A good description of the deposits at the pit (the upper part from exposures including some of the upper Wilcox Formation and the lower part from split spoon samples) was made by Kolata et al. (1981):

Quaternary System

Pleistocene Series

Wisconsin Age

Peoria Silt (Loess) (12 feet)

Silt, massive; Modern soil at top: light brown to light brownish gray with depth; nodular calcareous concretions in lower part.

Roxana Silt (7 feet)

Silt, massive; Farmdale Soil at top; light brownish to grayish red; clayey; becomes more brownish red at base, indicating a transition to the underlying silt.

Illinois Age

Loveland Silt (6 feet)

Silt, blocky; Sangamon Soil at top; reddish brown; clayey; dark brown clay skins coat the blocky fractures; scattered chert pebbles increase in abundance toward the base, indicating colluvial deposition that incorporates material from the underlying gravel.

Tertiary System

Pliocene-Pleistocene Series

Mounds Gravel (20 feet)

Gravel, pebbles are predominantly chert with some sandstone and siltstone, subangular to subrounded, dominantly coated with a glossy, moderate yellow-brown patina, most 0.75 to 1.5 inches in diameter; a few sandstone boulders occur, the largest observed was 3 feet in diameter; a few ellipsoidal to ovoidal milky quartz pebbles up to 0.75 inches in diameter are present; matrix is reddish brown to orangish brown silt and clay in various proportions; sand and silt lenses locally up to 4 feet thick near the top of the section, usually clayey, reddish brown, and some cross-bedding; a lens of light-gray clay up to 8 inches thick occurs in about the middle of the pit face over a distance of about 200 feet; iron hydroxides form Liesegang-like cemented zones in various places in the gravel and sand lenses; occasionally very low angle and broad cross-bedding can be recognized in the gravel; the contact with the underlying sand is erosional, as indicated by the abrupt change of material and the presence of reworked subangular to subrounded cobbles of iron hydroxide-cemented chert pebble conglomerate lying on the sharp contact.

Eocene Series

Wilcox Formation (40 feet)

Sand, fine-to coarse-grained; clean to moderately silty and clayey, often micaceous; in places, the top 6 feet is heavily iron-stained to reddish brown; generally, the sand is white, light gray to yellowish gray or pale yellow-orange; upper contact with Mounds is very irregular with up to 6 feet of relief in pit area; contains some iron concretions 1 to 2 inches in diameter, some elongated vertically and resembling fossil burrows; heavy minerals apparent in places up to 1%; generally horizontally bedded; some cross-bedded units average 6 inches thick; occasionally contains up to 10% pebbles, consisting of up to 0.5 inches in diameter ellipsoidal to ovoidal, milky to pink reddish brown, translucent quartz pebbles and up to 1 inch in diameter ellipsoidal to variably shaped, subangular, medium to dark gray, polished chert pebbles; grayish orange (bluff) clay balls up to 2 inches in diameter are also present; occasional clay beds range from minute laminae up to 6 feet thick locally within the pit area; they are very light yellowish to pinkish gray with some areas of stronger pinkish coloration.

Paleocene Series

Porters Creek Formation (100 feet)

Upper 10 feet consisting of clay, light olive to medium gray, mottled with yellowish orange areas; plastic; noncalcareous; underlying 50 feet consists of clay, massive; medium dark to dark gray; possibly bioturbated; firm; non-calcareous; slightly silty and micaceous; occasional sublaminar partings or lenses of silt as close as 0.25 to 0.5 inches apart; lower 40 feet contains scattered glauconite pellets, very thin lenses of very fine sand, and fine sand-sized disc-shaped amber crystals of siderite; clay is darker gray in lower 40 feet and has more abundant sublaminar mottle zones of slightly lighter gray.

Clayton Formation (16 feet)

Clay, very dark greenish gray; slightly silty and micaceous, especially in thin laminations and lighter-colored mottled areas; scattered glauconite pellets; moderately calcareous and fossiliferous; becomes sandy, more silty, and micaceous and non-calcareous with depth; clay becomes moderately light olive-gray with mottled patches of dusky yellow and some sand beds.

Cretaceous System

Gulfian Series

Owl Creek Formation (14 feet)

Clay and sand, alternating beds, dominantly clay; clay is dark gray, silty, sandy, micaceous, beds up to 1 inch thick; sand is clayey to clean, moderate gray to very light gray, micaceous, beds up to 0.5 inches thick; glauconite pellets occur in both clay and sand; non-calcareous.

STOP 3: Lunch, Horseshoe Lake (SE, SE, NE Sec. 21, T16S, R2W, 3rd P.M., Cache 7.5-minute Quadrangles, Alexander County) (fig. 10).

The following summary of the archaeology and history of Horseshoe Lake was modified from a paper by Koldehoff and Wagner (2002), who described Horseshoe Lake as the most prominent hydrologic feature in the complex area of floodplains and swamps between the converging channels of the Mississippi, Ohio, and Cache Rivers at the southern tip of Illinois. This oxbow lake, dating earlier than 3,000 B.C., is an unusual feature in geomorphic terms in that it still exists, albeit with some human intervention, as a definable lake and associated areas of swamp, when the vast majority of comparably aged features in active floodplains along the Mississippi have been infilled and have ceased to exist.

The Prehistoric Record of Horseshoe Lake

A record of human habitation ranges from the mid-Archaic cultural period, prior to 3,000 B.C., through the Mississippian cultural period (A.D. 900 to 1500). The importance of the lake area to local groups varied dramatically through time, being greater in the Archaic (8,000 B.C. to 500 B.C.) and Woodland (500 B.C. to A.D. 900) and declining noticeably during the Mississippian

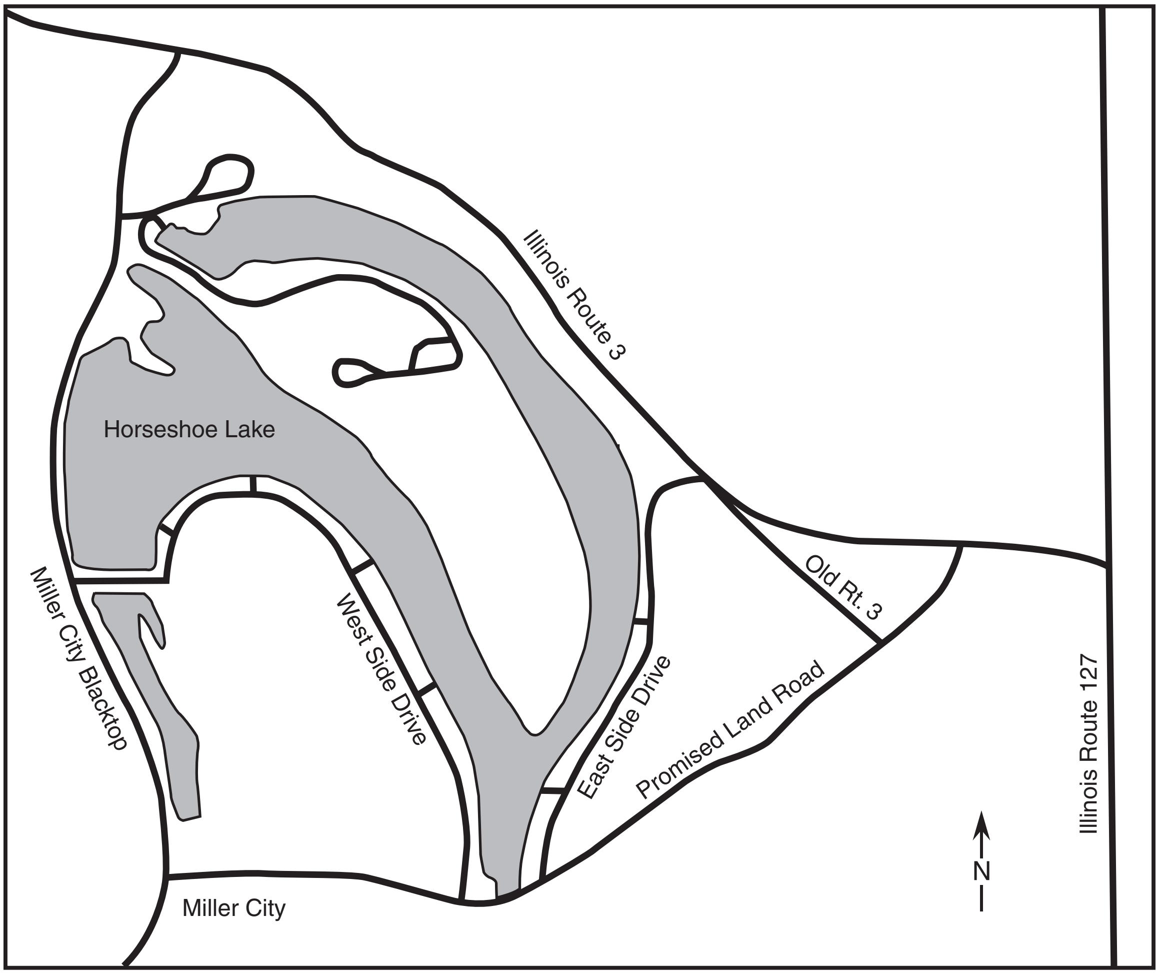


Figure 10 Horseshoe Lake Conservation Area, Stop 3.

period, when settlement was concentrated around the large mound center in the Dogtooth Bend meander to the southwest. Detailed analysis of the lithic artifacts and the chert sources used in the area reveals changing patterns of mobility and technological requirements that parallel the settlement record.

Surrounded by large areas of swamp and seasonally inundated woods, the lake was not an object of early Euro-American settlement directed at farming. Then, as now, the lake's aquatic resources, principally waterfowl, were the primary attraction. Logging and sawmilling operations in this area were minimal during early settlement, and only late in the nineteenth century had enough land been cleared and drained for widespread farming to commence. Concern over preservation of the lake feature and its wildlife resources ultimately led to the state's acquiring the land and designating it a conservation area.

Horseshoe Lake was formed around 4,000 B.C. and remains a scar on the Mississippi floodplain. A generalized model of the life cycle of Mississippi Valley oxbows can be divided into three stages with estimated date ranges: (1) the lake stage, 4,000 to 1,000 B.C.; (2) the swampy lake stage, 1,000 B.C. to A.D. 1000; and (3) the swamp stage, A.D. 1000 to 1929. These cycles are based on fundamental principles of wetland ecology, plant succession, and landscape. The swampy lake stage was the most productive in terms of human subsistence potential, and the most productive part of the lake during this stage was the interface between open water and the swampy ends of the lake's arms, which tend to fill with sediment and swamp more rapidly than the rest of the lake.

Geomorphology: The Evolution of Horseshoe Lake

In 1928, when the state of Illinois constructed a temporary dam at the south end of Horseshoe Lake, it ceased to be a natural feature. Before this construction, Horseshoe Lake was more swamp than lake, typically drying up in the summer. The areas of open water that currently exist are not natural features but are the result of logging early in the twentieth century and of artificial lake levels. No matter what actions are taken by the Illinois Department of Natural Resources, they will only be temporary remedies. The transformation of an oxbow lake into a swamp is a natural and inevitable process.

The life cycle of an abandoned Mississippi River channel begins when a meander loop is cut off from the main channel and an oxbow lake is formed. The cycle ends when the oxbow lake is filled with sediment and is completely transformed into a swamp or marsh, which eventually becomes dry land or is eroded by an advancing meander loop. The duration of a complete life cycle is highly variable because of local circumstances but probably involves at least several hundred years and apparently can be as long as several thousand years.

> The ultimate fate of an oxbow lake depends primarily on the behavior of the active river channel after cutoff takes place. If the river channel remains relatively nearby and there is an effective connection, the lake may fill completely and be characterized a dense swamp forest. Conversely, if the river meanders well away from the lake or occupies a new meander belt the lake may persist a long time as a relatively deep water body (Koldehoff and Wagner 2002).

After its cutoff, the Mississippi migrated to the west, never to return, except during floods, as in recent years.

Biotic Landscape

Once covered by rich bottomland forest interspersed with cypress swamps, the Horseshoe Lake Conservation Area, as is the case in much of the surrounding bottom lands of the Mississippi and Cache Rivers, is today denuded, drained, and cultivated. Much of this area, including Horseshoe Lake, was logged early in the twentieth century. Currently, the lake is ringed by bald cypress and tupelo gum (*Nyssa aquatica*) trees, occasionally in thick stands that reach from shoreline to shoreline. Merging with this zone but on higher ground along the lake bank are remnant slivers of bottomland forest.

The presettlement (pre-Euro-American) landscape was densely forested, and the distribution of plant species was closely tied to soil moisture, as dictated by annual flooding and the depth of the water table. Cypress-tupelo swamps covered the lowest areas. Willows, cottonwoods, and maples were common along the banks and sandbars of the Mississippi River and other waterways. These species, with ashes and elms, grew in and along swales and other low spots with sugarberry (*Celtis laevigata*) and sycamore (*Platanus occidentalis*). Natural levees, point-bar ridges, and other drier land forms supported mature growth, consisting of various species of oak and hickory (along with other tree species). These and similar species were common in the adjacent uplands, particularly in stream valleys and moist ravines. Numerous vines and understory plants thrived in all of these forested settings. Floating, submerged, and emergent plants grew in and along lakes, swamps, and streams. Many insect, mollusk, fish, amphibian, reptile, bird, and mammal species inhabited these ecosystems: some were permanent residents; others were periodic or seasonal visitors. From historic accounts, we know that migratory waterfowl—ducks, geese, and swans—were especially plentiful.

The swampy bottomland forest was described by Worthen (1882) in an early report on the geology of Alexander County:

> The bottom lands are generally flat, and are interspersed with Cypress ponds and marshes, and a portion of them are too wet for cultivation without a thorough system of drainage, and are subject to annual inundations from the floods of the adjacent rivers. The most elevated portion of these lands, however, has a light, rich, sandy sod, and is susceptible of a high state of cultivation. They are heavily timbered with white oak, swamp white oak, bur oak, Spanish oak, yellow poplar (tulip tree), shellbark and pig-nut hickory, ash, beech, and white and sugar maple, all of which are found on the highest bottoms, and indicate a soil sufficiently dry for cultivation. The swampy lands are characterized by the growth of the cypress, sweet gum, pecan, tupelo gum, cottonwood, willow, etc.

History of the Ohio River and the Cache Valley

The Cache Valley is one of the most impressive physiographic features in Illinois (fig.11), stretching east to west for nearly 45 miles from the Ohio River to the Mississippi River, across all or parts of Pope, Massac, Johnson, Union, Pulaski, and Alexander Counties. The Cache Valley is an abandoned segment of the trunk portion of a major drainage system and is one of the best exposed and most widely recognized landforms in Illinois.

Physiographically, the Cache Valley forms the northernmost edge of that part of the Coastal Plain Province known as the Mississippi Embayment (fig. 6). Here the embayment abuts against the Shawnee Hills section of the Interior Low Plateaus Province. The valley extends nearly 45 miles westward from its sharp angular junction with the Ohio River at Ropers Bluff (located about 5 miles south of Golconda). The relatively flat alluvial floor of the Cache Valley ranges from about 1.5 to nearly 4 miles wide.

Regional Setting

The general pattern of drainage across Illinois and the midwestern states was set millions of years ago (long before the Pleistocene glaciation) when this region was a lowland between the Appalachian and Rocky Mountains. For eons, rivers from the north, east, and west have met in this low-lying region of Illinois to begin their flow southward to the sea. Prior to the end of the Pleistocene Epoch, only a few thousand years ago, the courses of many of the ancient large rivers in the Midwest did not follow present-day drainage lines.

The Pleistocene glaciation changed ancient drainage courses of the Mississippi and Ohio Rivers north of the area where the present-day Mississippi River flows between Missouri and Kentucky. One glacier after another released immense quantities of meltwater that buried and diverted river valleys and eroded new channels across the region. The last glaciation led to the creation of the present-day drainage system.

The ancient drainage courses are based on a great deal of direct evidence. There are, for example, large valleys like the Cache that are too deep and wide to have been cut by the little streams they now contain. These large valleys were carved by large rivers that were diverted from them during the Pleistocene glaciation. More evidence comes from studies made of thousands of wells penetrating the thick deposits of mud, sand, and gravel covering the glaciated region. These show

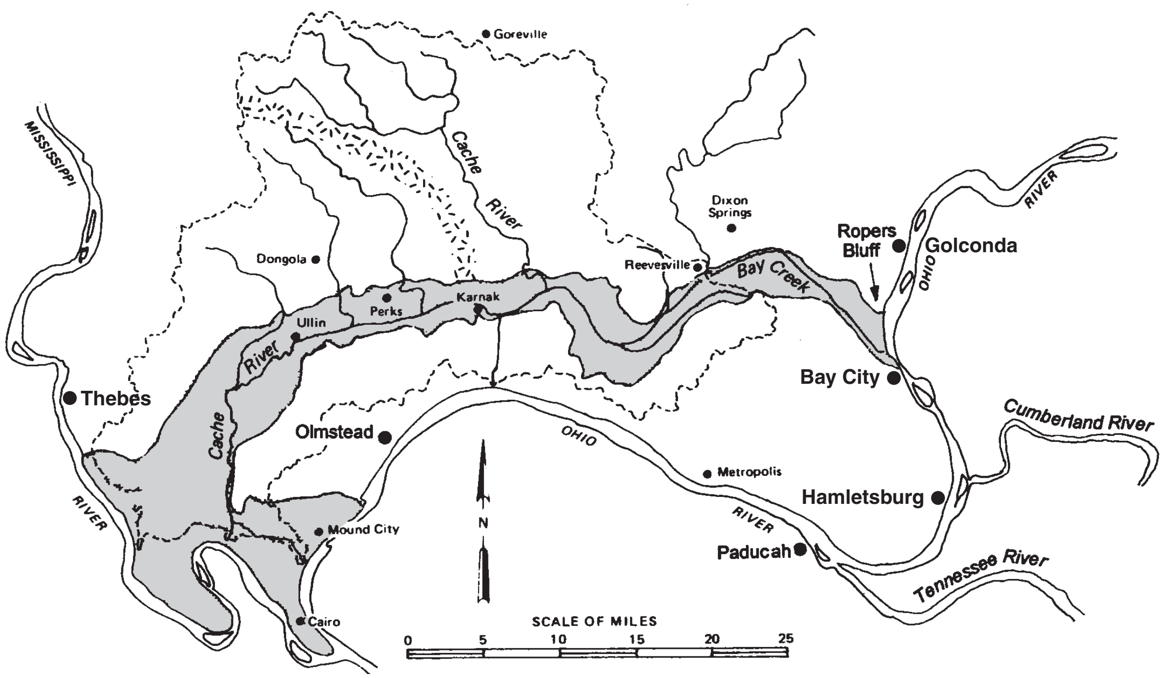


Figure 11 The Cache Valley (modified from Frankie et al. 1997).

that the underlying bedrock surface is not smooth but is channeled by ancient valleys, now buried beneath river and glacier deposits.

Origin of the Cache Valley

The origin of the Cache Valley and its history have remained matters for research and discussion for more than 60 years. For many geologists, the Cache Valley continues to be a topic of interest and a challenging puzzle to solve. Most agree that the valley served as the channel for the ancient Ohio River before it was diverted into the modern Ohio Valley.

Figure 11 shows the present drainage in extreme southern Illinois. The location of the Cache Valley is shown on the figure by the shaded area containing the lines representing the Cache River and Bay Creek, which flow through the valley.

The Cache is a broad, flat-bottomed valley, ranging in width from 1½ to 4 miles, averaging about 3. The north valley walls are 150 to 250 feet high. Generally, the valley follows the contact of the Cretaceous and Mississippian rocks across southern Illinois as far west as Cairo. Therefore, the north wall of the valley, which is cut in hard Paleozoic rock, is marked by cliffs and steep hills, whereas its south wall, cut through soft, unconsolidated Cretaceous and Tertiary sediments, is marked by gentle slopes.

Bay Creek, in the east end of the Cache Valley, flows eastward into the Ohio River above Bay City. The Cache River flows west into the Ohio just above Cairo. Both streams are small and sluggish—the Cache Valley has very little slope and has been channelized by manmade ditches in places. Seasonal floods from the Ohio back up into the Cache Valley and cover the floodplains of the streams. Hundred-year floods cover the slightly higher parts of the valley floor above these floodplains.

Most geologists think that the Ohio River flowed through the Cache Valley until it was diverted sometime during the Pleistocene Epoch. The most acceptable theory behind the cause of the diversion has been that outwash and meltwater filled the valley during times of glaciation and raised the river level until it overtopped a low divide, ran into an adjacent river, and abandoned the Cache Valley.

There are several lines of evidence and reasoning used to support these conclusions.

1. The streams now flowing in the Cache Valley and the present-day floods from the Ohio River could not have cut the Cache Valley. The streams are too small, high backwater floods are too infrequent, and both are too sluggish to have cut a valley as deep and wide as the Cache.

2. The Cache Valley appears to be an extension of the Ohio Valley. It is connected to and is in line with the Kentucky reach of the Ohio River above Bay City (see fig. 11) and is a more direct course westward than the present Ohio channel.

3. Valleys of the ancient Cumberland and ancient Tennessee Rivers and their tributaries could have served as channels for a diversion of the ancient Ohio River from the Cache Valley into the present-day Ohio Valley to the south.

4. The deep filling of stream-laid clay, silt, and sand beds in the large river valleys indicates enormous volumes of glacial meltwater and outwash that would have been sufficient to fill in the old channels and raise the rivers over low divides into their present courses. The floor of the Cache Valley, for instance, is filled in 140 to 180 feet above the original valley floor cut in bedrock.

Theories

There are several theories that explain how the ancient Ohio River drainage in this area looked and how the Ohio came to occupy its present course (fig. 11).

Theory 1 The ancient Cumberland River flowed northward to join the ancient Ohio River above Bay City at the east end of the Cache Valley. This theory considers the Ohio Valley between Bay City and Hamletsburg to have been the final reach of the ancient Cumberland River. The ancient Tennessee River followed its present course westward to Paducah, proceeding from there past Metropolis and Cairo in the valley now occupied by the Ohio River. The ancient Ohio and Tennessee Rivers join the ancient Mississippi River south of Cairo.

According to this theory, the modern drainage shown in figure 11 was established during a time of glaciation when the ancient Ohio and ancient Mississippi Valleys were brimming with glacial meltwater and sediments. High water in the ancient Ohio Valley is thought to have backed up into the Cumberland Valley and spilled over a low divide at Hamletsburg into the ancient Tennessee Valley. The Ohio then abandoned the Cache Valley and followed its present course.

The Mississippi River, under the same conditions, established its modern course by overtopping the divide at Thebes and joining the Ohio just south of Cairo.

Several workers have suggested that the diversions of the ancient Mississippi and ancient Ohio Rivers were caused by a particular high-water episode called the Kankakee Flood, which occurred late in the Pleistocene Epoch, about 14,000 to 15,000 years ago, during the Woodfordian Substage of the Wisconsin Glacial Episode.

Theory 2 Ross (1963) has suggested that the diversion across the divide at Hamletsburg could have been accomplished by faulting that lowered the divide. The region contains many faults, and some of those near the supposed diversion are parallel to the valley there.

Theory 3 Horberg (1950) theorized that only the ancient Ohio River flowed through the Cache Valley. The Cumberland, he thought, joined the Tennessee near Paducah and the Tennessee flowed on in the present Ohio Valley west of Paducah. According to Horberg's idea, the modern drainage was established in the latter half of the Pleistocene Epoch when glacial outwash filled the lower ancient Ohio and Mississippi Valleys and meltwater floods overtopped a drainage divide at Bay City, enabling the Ohio to flow southward into the Cumberland near Hamletsburg.

Theory 4 Other suggestions have been advanced to explain the existence of the Cache Valley. H.N. Fisk (Alexander and Prior 1968) proposed that both the ancient Tennessee and Cumberland Rivers flowed northwest and joined the ancient Ohio River at the entrance to the Cache Valley near Bay City. He thought that flooding backed up into the Cumberland and Tennessee Rivers and that high water in the Tennessee River cut a gap in a divide at Metropolis and fell into a west-flowing tributary of the ancient Ohio. This diversion, he thought, created the Ohio Valley between Paducah and a point below Cairo.

Several workers have suggested that after the Ohio had established its modern course from Bay City to Cairo, it continued to flow for a time through the Cache Valley. Similarly, Alexander and Prior (1968) have visualized the Ohio flowing in both the Cache Valley and its present valley past Metropolis but argued that the ancient Ohio River did not persistently occupy the Cache Valley. They think that the Cache Valley was just a spillway for high levels of meltwater from the Ohio near the end of the Wisconsin glaciation. The ancestral Bay Creek and Cache River, they think, cut the Cache Valley, which was later eroded by the Ohio's meltwater.

Current View

Some of the evidence needed to settle the points in dispute have been collected, and yet other questions about the origin of the Cache Valley remain to be answered. The following is a summary of the current and most acceptable conclusions on the development of the Cache Valley.

The valley walls are cut into resistant Paleozoic rocks in the eastern quarter, along the entire north side of the valley, and occasionally follow fault zones. Where resistant Paleozoic strata are exposed, the north valley walls are much steeper, 150 to 250 feet high and better defined than the south side, where all but the eastern quarter was eroded in softer, relatively unconsolidated Cretaceous and Tertiary sediments. The eastern part of the valley is now occupied by Bay Creek and the western part by the Cache River, both underfit streams too small to have eroded such an enormous valley. In the subsurface the deepest part of the valley is incised into Paleozoic strata throughout its extent.

The earliest *fluvial* system to occupy the position of the Cache Valley is unknown, but its beginning probably dates back to the Paleozoic/Mesozoic erosional unconformity. During part of that time, the Little Bear Soil was developed and the Cretaceous Tuscaloosa Formation gravel was deposited in the vicinity of the Cache Valley. The deposition of the Tuscaloosa chert gravel and the overlying fluvial-deltaic McNairy Formation reflect the northward extension of the Mississippi Embayment into southernmost Illinois (fig. 5).

During the early part of the late Cretaceous, the northern part of the Mississippi Embayment was on the north flank of an upland known as the Pascola Arch (fig. 2) and had possibly as much as

500 feet of relief. Streams heading in the upland flowed northeast and east across the embayment into a trunk stream that drained southward around the eastern periphery of the Pascola Arch. The Tuscaloosa gravel was deposited in part by this fluvial system. It is not known, for certain, if any part of these early streams occupied the position of the Cache Valley because no deposits of the Tuscaloosa have been identified there. However, the strong curvilinear alignment of the Cache Valley along the northeastern edge of the Mississippi Embayment and the position of the Cumberland and Tennessee River valleys suggest that its early origin may be related to the Cretaceous age fluvial system.

In the mid-Tertiary, the northeastern part of the Mississippi Embayment, including most of the area of the Cache Valley, was relatively near sea level in elevation, and the surrounding Paleozoic bedrock regions were also low and of subdued relief.

During the Pliocene, epeirogenic uplift initiated a new erosion cycle. Chert-rich residuum was eroded from the Paleozoic uplands and deposited (the Mounds Gravel) in the form of alluvial fans in the northeastern Mississippi Embayment by high-velocity braided streams. The ancestral Tennessee and Cumberland were the dominant rivers along the east side of the embayment, building their alluvial fans from the southeast toward the northwest where the Cumberland was joined by the relatively small, preglacial Ohio River near the present upstream (east) end of the Cache Valley.

These low-gradient alluvial fans apparently filled the northeastern part of the low-lying embayment and overlapped onto the east flank of the Paleozoic uplands. The fans were deposited on an erosional surface that is now at an elevation of 450 to 500 feet above mean sea level in the embayment area and that extends upward to 600 to 650 feet on the upland rim areas. Erosion has subsequently dissected the fans and underlying deposits. Northward progradation of these alluvial fans may well have forced the main Cumberland, Ohio, and probably the Tennessee River channels northward into the position of the Cache Valley. Erosion and redistribution of the chert gravels began in the Late Pliocene and probably continued into the early Pleistocene. Deep entrenchment of the major valleys in the midcontinent may well have begun with the onset of the Pliocene.

There are few, if any, deposits in the Cache Valley and vicinity to provide evidence of the effect of the pre-Illinois glacial episode and the following interglacial episode on the area. Although this area was not glaciated, the later Illinois Glacial Episode ice did extend southward to within about 25 mi (40 km) of the Cache Valley. Deep weathering and erosion appear to have progressed at variable rates during the early Pleistocene in this area. Early Pleistocene glaciation blocked other drainage systems from Indiana to Pennsylvania and eventually diverted them into the Ohio River. This large increase in the size of its drainage basin, coupled with the addition of vast quantities of meltwater, converted the Ohio into a major river. This conversion, accompanied by a worldwide lowering of sea level during each pre-Illinois glacial episode (at least two) and probably by uplift of the Earth's crust, ultimately resulted in the deep entrenchment of the ancestral Ohio River channel into bedrock beneath the Cache Valley. Thus, it seems most plausible that during the early Pleistocene, the Ohio, Cumberland, and Tennessee Rivers did meet near the sharp bend between Golconda and Bay City, Illinois, to flow westward, carving and entrenching the Cache Valley.

The absence of an equally deep channel in the present Ohio River valley between Paducah and Olmsted is also strong evidence that during the pre-Illinois glacial episode, the Ohio River did not flow through its present channel, but rather through the Cache Valley.

The present course of the Ohio River more likely formed in the late Wisconsin Glacial Episode. During a period of extremely high meltwater volume and alluviation of the valleys, a large slack water lake formed in the Tennessee River valley, backing up a tributary of the Tennessee toward Metropolis, Illinois. A low divide separating this northeast-flowing drainage from another steep-gradient system flowing south westward was eventually topped and rapidly cut down by the steep-gradient stream. The volume of meltwater was large enough and was sustained long enough to establish a permanent channel southwestward to a juncture with the Mississippi River. Both the Cache Valley channel and the new Ohio River channel were probably used by the Ohio River on into the Holocene, especially during times of exceptionally high flooding. However, by studying slack water lake deposits associated with the Cache Valley, Graham (1985) determined that the diversion of the Ohio was essentially completed by about 8,200 radiocarbon years B.P. Backwaters of the Ohio most recently spilled through the Cache Valley during the record flood of 1937.

In summary, the geologic history of the formation of the deeply entrenched Cache Valley extends back into the Cretaceous Period and is related to the origin of the northern part of the Mississippi Embayment. A stream flowing east to southeast may have occupied all or part of the location of the Cache Valley during the erosion of the Pascola Arch. Alternating subsidence and uplift in the embayment resulted in the deposition of shallow marine and fluvial-deltaic sediments in most of the area of the Cache Valley, followed by periods of erosion. Chert gravel deposition in the late Tertiary filled the northeastern portion of the embayment, concentrating the major west- to southwest-draining rivers of the time into the present location of the Cache Valley. The major deep entrenchment of the valley occurred during the Illinois Glacial Episode. With each glacial cycle, the Cache Valley was alternately scoured out and refilled with sediment to varying heights and thicknesses. The shallow sediments underlying the Cache Valley are mostly late Wisconsin and Holocene in age (12,600 to 8,200 years ago), bracketing the time of the diversion of the Ohio, Cumberland, and Tennessee rivers from the Cache Valley into the present Ohio Valley.

STOP 4: Birk-McCrite Quarry UNIMIN Specialty Minerals, Inc., Lower Devonian Clear Creek Chert, located northwest of Tamms (SE, SE Sec. 21 and NE, NE, NE, Sec. 28, T14S, R2W, 3rd P.M., Mill Creek 7.5-minute Quadrangle, Alexander County)(fig. 12). On the day of the field trip, park along the road. Follow directions of ISGS staff.

The UNIMIN quarry operates in the Lower Devonian Clear Creek Chert (fig. 1), which likely has been altered (leached of carbonates and silicified) by hot (hydrothermal) waters from an intrusive igneous rock in the Precambrian basement, indicated by prominent positive magnetic anomalies (Heigold 1976) in the Elco and Wolf Lake areas of these hills (Berg and Masters 1994). Bouguer Gravity maps (McGinnis et al. 1976) also support the presence of igneous bodies in the Elco and Wolf Lake areas, the body of igneous rock that geophysics indicates is likely to be a pluton with an uppermost extent of 5 miles below sea level in the Elco area (McGinnis et al. 1976).

The resultant microcrystalline silica, called tripoli, is utilized by UNIMIN in a variety of products. Tripoli has been mined for more than 80 years from deposits in both Alexander and Union Counties. It typically is used as a buffing and polishing compound and as a filler and extender in plastics, paints, and rubber. Iron oxide-stained tripoli is used as an ingredient in portland cement.

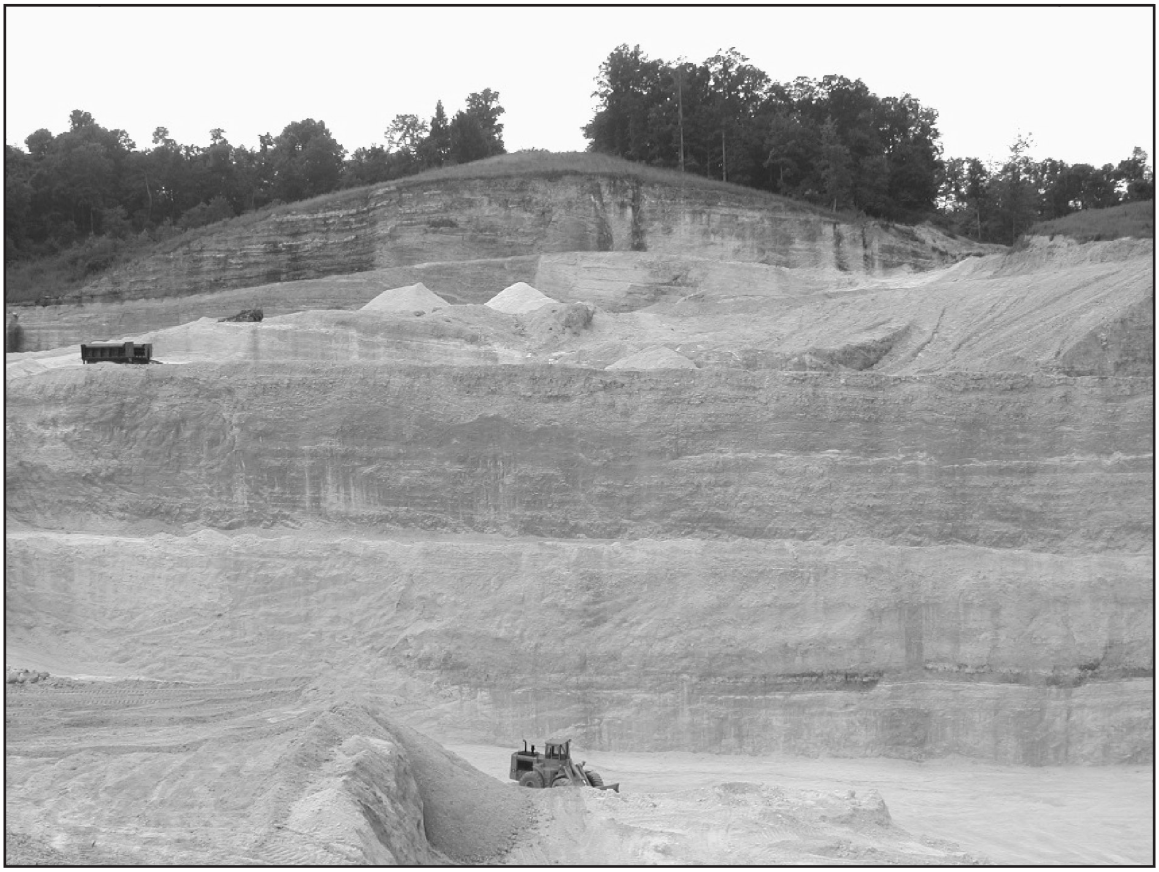


Figure 12 UNIMIN Speciality Minerals Inc., Birk-McCrite “Tripoli” Quarry, exposure of lower Devonian Clear Creek Chert at Stop 4 (photo by Wayne T. Frankie).

Most of the tripoli deposits are found in the Clear Creek, although the alteration has also affected the underlying Grassy Knob Chert and, to a lesser degree, the Bailey Limestone. According to Devera et al. (1995), four factors led to the original formation of this tripoli: (1) original biogenic silica in the form of sponge spicules, abundant in these lower Devonian host rocks; (2) abundant detrital quartz silt in the host rocks; (3) hydrothermal leaching and concentration of silica; and (4) near-surface weathering in the past (probably minor).

Devera et al. (1995) also note that the hydrothermal theory of alteration for tripoli formation suggests that metallic ores may be found in deposits near the surface. Local lore has it that pioneers mined lead along the Delta Fault (just west-northwest of this mine), but this lore cannot be confirmed. However, concentrations of limonite, goethite, and manganese oxides along this fault suggest metallic ores at depth. High concentrations of metals are also known from the Humble Pickle No. 1 oil test hole (Erickson et al. 1987), including the highest values in over 29 statewide wells for silver, arsenic, and lead and the second highest molybdenum values for any of these wells and third highest copper value. The silver value was highest, being six times that of any other of the 29 wells examined by Erickson et al. (1987).

The Birk Open Pit mine is located in an area of small faults striking N15° W to N40° W that are high angle and normal (Devera et al.1995) just to the east of the Delta Fault. Looking at the map by Devera et al. (1995), this complex of faults (some of which we can see in this mine) form a small down dropped block of lower Devonian rocks (or a graben). As a result of the downdropping of this graben, the overlying Dutch Creek Sandstone is preserved as a cap overlying the Clear Creek in this area.

A general stratigraphic description for the Devonian rocks in the area can be taken from Devera et al. (1995) and is reproduced here. The pit itself is largely in the Clear Creek, although the boundary between it and the underlying Grassy Knob is not clear. The Clear Creek appears to be very fossiliferous, and the Grassy Knob is not (Joe Devera 2003, personal communication); that difference makes for the best distinction.

Lower Devonian

Dutch Creek Sandstone (0 to 30 feet thick)

Sandstone, white weathering dark gray, fine- to medium-grained, well-sorted quartz arenite composed of rounded, frosted grains; molds of corals, brachiopods, and other fossils are locally abundant; much of this sandstone is an intraformational breccia cemented with silica and dark brown iron oxides. The lower contact is sharp and at least locally disconformable. Although this unit has been classified as Middle Devonian, the fossil content of the Dutch Creek more closely resembles that of the Clear Creek below, and, thus, may be Lower Devonian in age (Devera 2003, personal communication).

Clear Creek Chert (200 to 300 feet thick)

Chert, microcrystalline silica or tripoli, and minor limestone. Chert (largely silicified limestone) is a dull to semivitreous white with orange- and red-stained zones. Bedding is thin and wavy to tabular; red clay partings are common. The chert is mainly porous to microporous but some is dense. Brecciated chert occurs locally near tops of ridges. Ledge-forming chert occurs sporadically in the unit; its occurrence appears to be partially fault-controlled. Chert is gently folded and highly fractured in most places. Microcrystalline silica (such as at this mine) is white to very light gray, orange- and red-stained, and relatively soft and friable; it has indistinct thin layering and some clay partings. Limestone in the Clear Creek when present (likely not here as it was removed in this district by the hydrothermal altera tion) is grayish brown, thin-bedded lime mudstone. Fossils are abundant in the upper part of the unit, including trilobites *Dalmanites pratteni, Odontochile* sp., *Leonanaspis* sp., *Phacops cristata,* and *Cordania* sp., and the brachiopods *Eodevonaria arcuata, Strophostylus cancellatus,* and *Amphigenia curta* along with abundant spiriferid and strophenmenid brachiopods and pelmatozoans. Ichnofossils include burrows (typically vertical), borings in brachiopod shells, and large domichnia cavities. Gray chert containing abundant spiriferid brachiopods and crinoid columnals at the base of the unit may represent the Backbone Limestone. The lower contact is poorly exposed but appears conformable.

Grassy Knob Chert (200 to 250 feet thick)

Chert and microcrystalline silica (tripoli); white to very light gray with gray, yellow and orange stains. Typically, the Grassy Knob is dense, novaculitic, and medium- to thick-bedded. Fossils are rare and represent the best way to distinguish this unit from the overlying Clear Creek Chert. Brecciated chert occurs throughout the unit but is most common at the top. Below the upper breccia zone is an interval of very porous, popcorn-textured chert riddled with what appears to be horizontal burrows. The Grassy Knob contains less clay and more styolitic partings than does the Clear Creek. The lower contact is gradational. Microcrystalline silica (tripoli) is similar to that in the overlying Clear Creek, but generally occurs in thinner layers and contains a greater proportion of chert.

Bailey Limestone (300 to 325 feet thick)

Limestone, chert, minor shale, and microcrystalline silica (tripoli). Limestone is light brown to light yellowish gray, dolomitic, argillaceous lime mudstone; its thin wavy beds contain abundant gray chert nodules. The upper part of the unit, stained yellow to orange in some areas, includes chert with a “brain” texture interbedded with microcrystalline silica and dense, nodular chert. Sponge spicules increase in abundance upward. Fossils are common in the upper 100 feet; they include the trilobites *Huntonia palacea, Phacops* sp., and *Dalmanites* sp., crinoids, and the trace fossil *Zoophycos.* The lower part of the unit is relatively unfossiliferous. Near the base is greenish gray cherty limestone and bedded chert with interbeds of green shale. The lower contact is gradational.

STOP 5: Abandoned Novaculite Gravel Quarry Formerly operated by Markgraf Materials Co., Lower Devonian Grassy Knob Chert formation. Located north of Tamms at Tatumville (NE and SE of the NW, Sec. 36, T14S, R2W, 3rd P.M., Mill Creek 7.5-minute Quadrangle, Alexander County) (fig. 13).

The gravel from this area has been mined at least since the early 1920s. The 1923 edition of the Jonesboro 15-minute quadrangle map shows a spur from the Gulf Mobile and Ohio Railroad (GM &O) running to Tatumville, and two mines located in the area. ISGS survey reports mention that in 1927 railroad ballast material was taken from this locality by the GM & O Railroad (now the Illinois Central and Gulf Railroad). The 1947 edition of the Jonesboro 15-minute quadrangle map shows an active quarry at this stop. The chert from these early mining operations was possibly also used as road aggregate.

The material in recent years has been largely used for road construction purposes, and the broken pieces have sharp edges that are likely useful as aggregate in bituminous paving because they would provide a resistance to abrasion and scuffing, thus providing a skid-resistant surface. The last active mining operation by Markgraf Materials Co. halted sometime after 1981. The

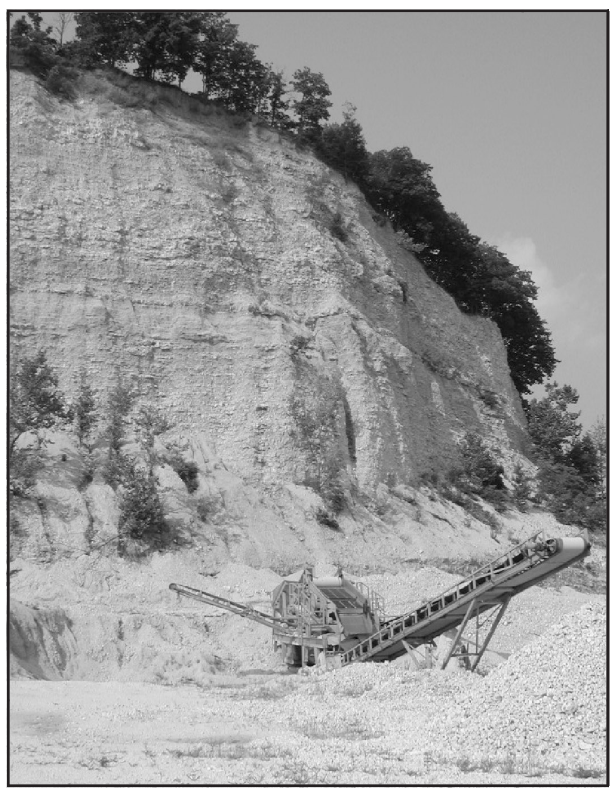


Figure 13 Abandoned novaculite gravel quarry, exposure of Lower Devonian Grassy Knob Chert at Stop 5 (photo by Wayne T. Frankie).

property is currently owned by an individual from the Marion area who uses it for roads on his property.

The Lower Devonian Grassy Knob Chert formation is exposed in this quarry. Approximately 185 feet of the formation is exposed in the quarry faces. The Grassy Knob Chert is highly fractured by open joints and contains some conspicuous beds of chert that are more resistant to weathering than most of the exposure. Some thin beds of clay are present. Iron staining is present close below the soil zone at the top and sides of the quarry face and where the face has been long exposed to weathering. A nearby well indicates that the formation may be somewhat more than 315 feet in thickness here. Locally it is difficult to differentiate the Grassy Knob from formations above and below but it differs from the underlying Bailey Limestone formation in being lighter colored and having more solid beds of chert. In this quarry and in the surrounding area, the Grassy Knob is overlain by the Clear Creek Chert, and the contact is difficult to recognize, but, as mentioned at the last stop, the presence of abundant fossils in the Clear Creek is the best way to determine the break with the Grassy Knob (Devera 2003, personal communication), which is largely unfossiliferous (fig. 1).

Lamar (1953) has noted that the terms "novaculite" and "novaculite gravel" have been applied to certain southern Illinois materials for a number of years. The term "novaculite" was typically applied to the dense white or nearly white chert that is found in relatively solid ledges of several feet in thickness without other interbedded materials. "Novaculite gravel" was more loosely applied to an angular chert gravel that is basically found in place with little or no transport. These terms were applied to these Illinois deposits because they resemble certain Arkansas novaculites.

STOP 6: Vulcan Materials Company, Jonesboro Quarry Mississippian Ullin Limestone, located south of Jonesboro (NW, NE, and SE of the SW, Sec. 20, T13S, R1W, 3rd P.M., Dongola 7.5-minute Quadrangle, Union County). On the day of the field trip, follow the lead vehicle into the quarry and obey ISGS staff directing traffic.

This quarry exposes the uppermost facies of the Ullin Limestone, probably deposited in relatively shallow water (fig. 14). The cross-bedded packstone-grainstone of the upper Ullin found here provides evidence of storm deposition. The high porosity of the Ullin makes it promising as a potential hydrocarbon reservoir, where permeable, deeper into the Illinois Basin.

The quarry consists of about 150 feet of the upper Ullin Limestone (fig. 1). This limestone is dominated by a very light gray, coarse to very coarse crinoid-bryozoan to bryozoan-crinoid grainstone. The rock is very well laminated and cross-laminated with alternating beds of very light gray, fine-grained bryozoan-rich hash and darker crinoid-rich sand. Graded bedding and hummocky cross-laminations are abundant throughout this unit. There is very little evidence of bioturbation in these rocks, but escape burrow structures are present in some beds. These features in the Ullin Limestone in this quarry tell a story of relatively rapid deposition, likely by storm currents. The top of the Ullin in this quarry contains some large-scale planar and trough cross-bedding that probably represent a more agitated environment, such as within the normal wave base, than in the rest of the Ullin (Lasemi et al. 1994).

The Harrodsburg Member (upper part of the Ullin Limestone) has some qualities that make it valuable for two main crushed stone uses, agricultural limestone (to neutralize the acidity and

Figure 14 Vulcan Materials Company, Jonesboro Quarry, Exposure of Mississippian Ullin Limestone. Cat front end loader filling Euclid haul truck from pile of broken stone created by blasting (photo by Wayne T. Frankie).

improve the texture of soils) and construction aggregates (Harvey 1994). At this quarry, the limestone tests typically greater than 96% calcium carbonate with a 3 to 4.5% water absorption and almost 2.4 g/cm^3 bulk density. These data indicate an average porosity of around 11%. The quality and implied softness make this stone at the Jonesboro quarry quite valuable as an agricultural limestone, which is about 40% of the quarry production.

Tests by the Illinois Department of Transportation to various grades of the crushed stone from this quarry confirm that Jonesboro Quarry products are too soft (average abrasion loss is 43%) and skid resistance too low for use as a portland cement for concrete pavements. However, the tests do qualify this stone for other road and construction materials where the specifications of abrasion are less stringent. Thus, about 10% of the production from this quarry is sold for road base materials, and the coarse aggregates are used on county roads.

Starting in about 1970, a new market for limestones and dolomites was developed that uses a calcined product (lime or magnesia derived from a heating process) as an absorbent of sulfur oxides (SO_2) from flue gases that are generated by combustion of coal. According to studies, the Harrodsburg Member is uniquely suited for the desulfurization process classified as wet limestone scrubbing (Harvey et al. 1974) and, to a lesser extent, for fluidized-bed combustion (Rostam-Abadi et al. 1989). The Harrodsburg Member gave the highest SO_2 reactivity of eleven carbonate rocks tested. Microscopic examination of the Harrodsburg show that it has high porosity and, hence, high reactivity. Also, highly reactive soluble salts (mostly NaCl) found as fluid inclusions in the Harrodsburg within crystals in crinoid fragments may figure in this high SO_2 reactivity. At present, about 50% of the production of the Jonesboro quarry is used for desulfurization purposes in scrubbers in two power plants, one in Sikeston, Missouri, and the second, the Southern Illinois Coop in Marion (Harvey 1994).

A description by ISGS geologists Zakaria Lasemi and Rodney D. Norby is given below in a modified and condensed format. The following section of the Ullin, described from top to bottom, includes the lower Ullin not totally exposed yet in this quarry:

Thickness (ft)	Top (ft)	Bottom (ft)	
			QUATERNARY
22.0	0	22.0	Unconsolidated sediments, not sampled during coring process.
			MISSISSIPPIAN
			Ullin Limestone (upper Ullin)
5.7	22.0	27.7	Limestone, grainstone, generally very light gray, with crinoidal grains, mostly very fine bryozoan-dominated hash, grains not visible with naked eye, scattered coarse to very coarse crinoid grains (10 to 20%) concentrated along laminae, some styolites. Remainder of unit is coarse to very coarse, dominated by crinoids (50 to 70%) and a few scattered brachiopods); some beds show low to moderate dips (0 up to 10 to 15 degrees); this interval has a general laminated appearance; relatively soft.
7.3	27.7	35.0	Limestone, grainstone, very light gray, finer grained, crinoids about 10 to 20%, few small brachiopods, starting at 32.1 feet down to 34.2 feet, crinoids increase to 20 to 30%; then from 34.2 to 35.0 feet crinoids increase to 60 to more than 80%, and the unit becomes coarse grained; bedding horizontal to some low angles (a few degrees); sharp break with lower unit.
37.6	35.0	72.6	Limestone, grainstone, very light gray to pale brown or yellowish gray, upper foot is fine- to medium-grained, enser, well-cemented with 5% crinoids, rest of unit consists of bryozoan-dominated zones alternating with zones containing up to 5 to 80% crinoidal fragments increasing to 60 to 90% in lower 2 feet that are medium to very coarse grained; slight to moderate bed inclinations from 5 to 20 degrees in crinoid-dominated interval, slight inclinations in bryozoan-dominated interval; stylolites scattered throughout.
37.9	72.6	110.5	Limestone, grainstone, very light gray, alternating beds of fine, denser bryozoan-rich material (5 to10% crinoids) with slightly coarser, bryozoan-rich (20 to 50% crinoids, a few up

			to 80%) intervals, color in lower half a little lighter; some inclined beds, a few scattered brachiopods; styolites common.
27.2	110.5	137.7	Limestone, grainstone, very light gray, interlaminated finer-grained, bryozoan-rich with coarser-grained crinoid-rich laminae; some fine-grained intervals with 5% crinoids; from 112.5 feet on predominantly bryozoan dominated overall with 10 to 60% crinoids; horizontally laminated to inclined beds of 10 to 15 degrees, occasional vertical fractures and a few scattered stylolites; no real break with unit above it.
83.8	137.7	221.5	Limestone, grainstone, very light gray (white), overall about equal amounts of bryozoans and crinoids in interlaminated layers; crinoid grains are still coarse from 5 to 50%; still laminated to cross-laminated; stylolites and fractures common; small scattered chert nodules; some brachiopods.
			Transitional to lower Ullin
11.8	221.5	233.3	Limestone, grainstone, subtle color change to light gray, grain size overall definitely a little finer (medium-grained crinoidal material), bryozoan-rich (crinoids 5 to 20%); fine shale partings common. Dark gray stylolites common. Laminated to faintly laminated, horizontal to slightly inclined beds, some beds may show slight disturbance (bioturbation?); some vertical fracturing.
30.3	233.3	263.0	Limestone, grainstone, very light gray to light gray, bryozoan-rich grainstone with varying amounts of crinoids (5 to 50% locally up to 95%, some of these concentrated around shale partings); fine to medium grained; common shale partings, scattered chert and styolites.

REFERENCES

Alexander, C.S., and J.C. Prior, 1968, The origin and function of the Cache Valley, southern Illinois, in The Quaternary of Illinois: Urbana, University of Illinois, College of Agriculture, Special Publication 14, p. 19–26.

Berg, R.B., and J.M. Masters, 1994, Geology of microcrystalline silica (tripoli) deposits, southernmost Illinois: Illinois State Geological Survey, Circular 555, 89 p.

Devera, J.A. W.J. Nelson, and J.M. Masters, 1995, Geologic map of the Mill Creek and McClure Quadrangles, Alexander and Union Counties, Illinois: Illinois State Geological Survey, IGQ 15, scale, 1:24,000, size, 45 × 33 inches.

Erickson, R.L., M.S. Erickson, B. Chazin, J.W. Baxter, J.M. Masters, and J.J. Eidel, 1987, Subsurface geochemical investigation in western and southern Illinois: Illinois State Geological Survey, Illinois Mineral Notes 98, 45 p.

Frankie, W.T., R.J. Jacobson, J.M. Masters, N.L. Rorick, A.K. Admiraal, M.R. Jeffords, S.M. Post, M.A. Phillips, and E. Jones, 1997, Guide to the geology of the Mississippi Embayment area, Johnson and Pulaski Counties, Illinois: Illinois State Geological Survey, Field Trip Guidebook 1997B, 86 p.

Graham, R.C., 1985, The Quaternary history of the upper Cache River Valley, southern Illinois [M.S. thesis]: Carbondale, Southern Illinois University, 123 p.

Harvey, R.D., 1994, Industrial uses of the Ullin Limestone (“Warsaw”) *in* Waulsortian Mounds and reservoir potential of the Ullin Limestone (“Warsaw”) in southern Illinois and adjacent areas in Kentucky: Illinois State Geological Survey, Guidebook 25, 65 p.

Harvey, R.D., R.R. Frost, and J. Thomas, Jr., 1974, Lake marls, chalks, and other carbonate rocks with high dissolution rates in SiO_2 —Scrubbing liquors, *in* Tenth Forum on Geology of Industrial Minerals: Ohio Geological Division Miscellaneous Report 1, p. 67–80. (Also Illinois State Geological Survey, Environmental Geology Notes 68.)

Heigold, P.C., 1976, An aeromagnetic survey of southwestern Illinois: Illinois State Geological Survey, Circular 495, 28 p.

Horberg, C.L., 1950, Bedrock topography of Illinois: Illinois State Geological Survey, Bulletin 73, 111 p.

Kolata, D.R., J.D. Treworgy, and J.M. Masters, 1981, Structural framework of the Mississippi Embayment of southern Illinois: Illinois State Geological Survey, Circular 516, 38 p.

Koldehoff, B., and M.J. Wagner, 2002, The archaeology and history of Horseshoe Lake, Alexander County, Illinois: Carbondale, Illinois, Center for Archaeological Investigations, Southern Illinois University, Research Paper 60,164 p.

Lamar, J.E.,1953, Siliceous materials of extreme southern Illinois—Silica, novaculite, ganister, Calico Rock, and chert gravels: Illinois State Geological Survey, Report of Investigations 166.

Lasemi, Z., J.D. Treworgy, R.D. Norby, J.P. Grube, and B.G. Huff, 1994, Waulsortian Mounds and reservoir potential of the Ullin Limestone ("Warsaw") in southern Illinois and adjacent areas in Kentucky: Illinois State Geological Survey, Guidebook 25, 65 p

Leighton, M.M., G.E. Ekblaw, and C.L. Horberg, 1948, Physiographic Divisions of Illinois: Illinois State Geological Survey, Report of Investigations 129, 19 p.

McGinnis, L.D., P.C. Heigold, C.P. Ervin, and M. Heidari, 1976, The gravity field and tectonics of Illinois: Illinois State Geological Survey, Circular 494, 28 p.

Nelson, W.J., J.A. Devera, and J.M. Masters, 1996, Geology of the Jonesboro 15-minute Quadrangle, southwestern Illinois—Jonesboro, Mill Creek, Ware, and McClure 7.5-minute Quadrangles: Illinois State Geological Survey, Bulletin 101, 57 p.

Reed, P.C., J.M. Masters, N.C. Hester, and H.D. Glass, 1977, Lithology and geochronology of the Cretaceous and Tertiary marine deposits in Illinois: Abstracts with programs, North-Central Section 11th Annual Meeting of the Geological Society of America, v. 9, no. 5, p 646.

Ross, C.A., 1963, Structural framework of southernmost Illinois: Illinois State Geological Survey, Circular 351, 28 p.

Rostam-Abadi, M., W.-T Chen, R.D. Harvey, and M.P. Cal, 1989, Sorbent evaluation for pressurized fluidized-bed combustors: Illinois State Geological Survey, Final Technical Report, 56 p.

Willman, H.B., E. Atherton, T.C. Buschbach, C. Collinson, J.C. Frye, M.E. Hopkins, J.A. Lineback, and J.A. Simon, 1975, Handbook of Illinois stratigraphy: Illinois State Geological Survey, Bulletin 95, 261 p.

Worthen, A.H., 1868, Geology of Alexander County, *in* Geology and palaeontology: Springfield, Illinois, Geological Survey of Illinois, Vol. III, p. 20–32.

Worthen, A.H., 1882 Alexander County, *in* Economical geology of Illinois: (Reprinted from the original reports of the Geological Survey, with additions and emendations, v. 1, by A.L. Worthen, p. 457–472: Springfield, Illinois, Illinois Geological Survey.

RELATED READINGS

Beadles, J.A., 1990, A history of southernmost Illinois: Des Peres, Missouri, Gateway Press.]

Botkir, E.A., ed., 1955, A treasury of Mississippi River folklore: New York, American Legacy.

Buschbach, T.C., and D.R. Kolata, 1991, Regional setting of the Illinois Basin, *in* M.W. Leighton, D.R. Kolata, D.F. Oltz, and J.J. Eidel, eds., Interior Cratonic Basins: Tulsa, Oklahoma, American Association of Petroleum Geologists, Memoir 51, p. 29–55.

Carroll, D.L., 1937 The 1937 flood in southern Illinois. Transactions of the Illinois State Academy of Science 30: 13–18.

Cashat, E.D, and C. J. Schuberth, 1977, Natural history tour to Horseshoe Lake and Shawnee National Forest: October 15–16, 1977: Springfield, Illinois, Illinois State Museum, Education Section.

Chrzastowski, M. J., M.M. Killey, R.A. Bauer, P.B Du Montelle, A.L. Erdmann, B.L. Herzog, J. M. Masters, and L.R. Smith, 1994. The great flood of 1993: Geologic perspectives on the flooding along the Mississippi River and its tributaries in Illinois: Illinois State Geological Survey, Special Report 2, 45 p.

Cote, W.E., 1978, Guide to the use of Illinois topographic maps, Revised by M.M. Killey, P.B. Du Montelle, and D.L. Reinertsen: Illinois State Geological Survey, 26 p.

Engelmann, H., 1866, Geology of Pulaski County, *in* A.H. Worthen, ed., Geology: Champaign, Illinois, Geological Survey of Illinois, v. I, p. 410–427.

Fisk, H.N., 1944, Geological investigation of the alluvial valley of the lower Mississippi River, *in* Mississippi River Commission publication 52: Washington, D.C., U.S. Army Corps of Engineers, War Department.

Hansel, A.K., and W.H. Johnson, 1996, Wedron and Mason Groups: Lithostratigraphic reclassification of deposits of the Wisconsin Episode, Lake Michigan Lobe Area: Illinois State Geological Survey, Bulletin 104, 116 p.

Hicken, V., (undated), Illinois camps, posts, and prisons, *in* Illinois Civil War sketches, no. 9: Springfield, Illinois, Illinois State Historical Library for the Civil War Centennial Commission of Illinois.

Killey, M.M., 1998, Illinois' Ice Age legacy: Illinois State Geological Survey, Geoscience Education Series 14, 66 p.

Lamar, J.E., 1959, Limestone resources of extreme southern Illinois: Illinois State Geological Survey, Report of Investigations 211, 81 p.

Leighton, M.M., G.E. Ekblaw, and L. Horberg, 1948, Physiographic Divisions of Illinois. Journal of Geology 56:16-M.

Leighton, M.M., D.R. Kolata, D.F. Oltz, and J.J. Eidel, eds., 1990, Interior cratonic basins: Tulsa, Oklahoma, American Association of Petroleum Geologists, Memoir 51.

Nelson, J.W., 1995, Structural features in Illinois: Illinois State Geological Survey, Bulletin 100, 144 p.

Pryor, W.A., and C.A. Ross, 1962, Geology of the Illinois parts of the Cairo, La Center, and Thebes Quadrangles: Illinois State Geological Survey, Circular 332, 39 p.

Raasch, G.0., 1948, Cairo area: Illinois State Geological Survey, Geological Science Field Trip Guide Leaflet 1948F, 8 p.

Reinertsen, D.L., J.M. Masters, and P.C. Reed, 1981, A guide to the geology of the Cairo area: Illinois State Geological Survey, Field Trip Guide Leaflet 1981A, 32 p.

WEB SITES

Roadside America - Illinois http://www.roadsideamerica.com/map/il.html

Illinois Periodicals Online - http://www.lib.niu.edu/ipo/index.html

Cairo, Illinois - http://www.angelfire.com/wi/wisconsin42nd/cairo.html

Southernmost Illinois History - http://www.southernmostillinoishistory.net/

Online Highways - Famous Illinoisans - http://www.ilohwy.com/f/famillin.htm

Online Highways - Illinois Historical Museums - http://www.ilohwy.com/h/histmuse.htm

Lewis and Clark - http://lewisclark.geog.missouri.edu/campsites/1804/nov14camp/

Mound City National Monument - http://www.cem.va.gov/pdf/moundcity.pdf

Illinois State Museum - http://www.museum.state.il.us/

Cache River - http://www.inhs.uiuc.edu/cwe/rra/site29.html

Illinois Natural History Survey - http://www.inhs.uiuc.edu/

National Scenic Byways Program - http://www.byways.org/index.html

Historic Scenes of Cairo - http://www.illinoishistory.com/cairoscenes.html

Iron Clads - http://www.missouricivilwarmuseum.org/1ironclads.htm

The Cairo Citizen newspaper -http://www.cairocitizen.com/history.htm

USN-US Mound City - http://www.history.navy.mil/photos/sh-usn/usnsh-m/md-cty.htm

GLOSSARY

The following definitions are adapted in total or in part from several sources. The principal source is R.L. Bates and J.A Jackson, eds., 1987, *Glossary of Geology*, 3rd ed.: Alexandria, Virginia, American Geological Institute, 788 p.

ablation Separation and removal of rock material and formation of deposits, especially by wind action or the washing away of loose and soluble materials.

accretion The gradual or imperceptible increase or extension of land by natural forces acting over a long period of time.

accretion-gley A gley soil built by accretion.

age An interval of geologic time; a division of an epoch.

aggraded Built up by deposition.

aggrading stream A stream that is actively depositing sediment in its channel or floodplain because it is being supplied with more load than it can transport.

alluviated valley One that has been at least partially filled with sand, silt, and mud by flowing water.

alluvium A general term for clay, silt, sand, gravel, or similar unconsolidated sorted or semisorted sediment deposited during comparatively recent time by a stream or other body of running water.

angular unconformity The name of the contact when the beds below the unconformity are tilted and eroded prior to deposition of overlying beds.

anticline A convex-upward rock fold in which strata have been bent into an arch; the strata on either side of the core of the arch are inclined in opposite directions away from the axis or crest; the core contains older rocks than does the perimeter of the structure.

anticlinorium A complex structure having smaller structures, such as domes, anticlines, and synclines superimposed on its broad upwarp.

aquifer A geologic formation that is water-bearing and that transmits water from one point to another.

arenite A relatively clean quartz sandstone that is well sorted and contains less than 10% argillaceous material.

argillaceous Said of rock or sediment that contains, or is composed of, clay-sized particles or clay minerals.

base level Lower limit of erosion of the land's surface by running water. Controlled locally and temporarily by the water level of stream mouths emptying into lakes, or more generally and semipermanently by the level of the ocean (mean sea level).

basement complex The suite of mostly crystalline igneous and/or metamorphic rocks that generally underlies the sedimentary rock sequence.

basin A topographic or structural low area that generally receives thicker deposits of sediments than adjacent areas; the low areas tend to sink more readily, partly because of the weight of the thicker sediments; the term also denotes an area of relatively deep water adjacent to shallow-water shelf areas.

bed A naturally occurring layer of earth material of relatively greater horizontal than vertical extent that is characterized by physical properties different from those of overlying and underlying materials. It also is the ground upon which any body of water rests or has rested, or the land covered by the waters of a stream, lake, or ocean; the bottom of a stream channel.

bedrock The solid rock (sedimentary, igneous, or metamorphic) that underlies the unconsolidated (non-indurated) surface materials (for example, soil, sand, gravel, glacial till).

bedrock valley A drainageway eroded into the solid bedrock beneath the surface materials. It may be completely filled with unconsolidated (non-indurated) materials and hidden from view.

biota All living organisms of an area; plants and animals considered together.

braided stream A low-gradient, low-volume stream flowing through an intricate network of interlacing shallow channels that repeatedly merge and divide and are separated from one another by branch islands or channel bars. Such a stream may be incapable of carrying all of its load. Most streams that receive more sediment load than they can carry become braided.

calcarenite Describes a limestone composed of more or less worn fragments of shells or pieces of older limestone. The particles are generally sand-sized.

calcareous Said of a rock containing some calcium carbonate ($CaCO_3$), but composed mostly of something else (synonym: limey).

calcining The heating of calcite or limestone to its temperature of dissociation so that it loses its carbon dioxide; also applied to the heating of gypsum to drive off its water of crystallization to make plaster of Paris.

calcite A common rock-forming mineral consisting of $CaCO_3$; it may be white, colorless, or pale shades of gray, yellow, and blue; it has perfect rhombohedral cleavage, appears vitreous, and has a hardness of 3 on the Mohs scale; it effervesces (fizzes) readily in cold dilute hydrochloric acid. It is the principal constituent of limestone.

cap rock The top layer of rock.

chert Silicon dioxide (SiO_2); a compact, massive rock composed of minute particles of quartz and/or chalcedony; it is similar to flint, but lighter in color.

clastic Said of rocks composed of particles of other rocks or minerals, including broken organic hard parts as well as rock substances of any sort, transported and deposited by wind, water, ice, or gravity.

claypan (soil) A heavy, dense subsurface soil layer that owes its hardness and relative imperviousness to higher clay content than that of the overlying material.

closure The difference in altitude between the crest of a dome or anticline and the lowest structural or elevation contour that completely surrounds it.

columnar section A graphic representation, in the form of one or more vertical columns, of the vertical succession and stratigraphic relations of rock units in a region.

conformable Said of strata deposited one upon another without interruption in accumulation of sediment; beds parallel.

cuesta A ridge with a gentle slope on one side and a steep slope on the other.

delta A low, nearly flat, alluvial land form deposited at or near the mouth of a river where it enters a body of standing water; commonly a triangular or fan-shaped plain extending beyond the general trend of a coastline.

detritus Loose rock and mineral material produced by mechanical disintegration and removed from its place of origin by wind, water, gravity, or ice; also, fine particles of organic matter, such as plant debris.

disconformity An unconformity marked by a distinct erosion-produced irregular, uneven surface of appreciable relief between parallel strata below and above the break; sometimes represents a considerable time interval of nondeposition.

dolomite A mineral, calcium-magnesium carbonate ($Ca,Mg(CO_3)_2$); also the name applied to sedimentary rocks composed largely of the mineral. It is white, colorless, or tinged yellow, brown, pink, or gray; has perfect rhombohedral cleavage; appears pearly to vitreous; and effervesces feebly in cold dilute hydrochloric acid.

dome A general term for any smoothly rounded landform or rock mass that roughtly resembles the dome of a building.

drift All rock material transported by a glacier and deposited either directly by the ice or reworked and deposited by meltwater streams and/or the wind.

driftless area A 10,000-square mile area in northeastern Iowa, southwestern Wisconsin, and northwestern Illinois where the absence of glacial drift suggests that the area may not have been glaciated.

earthquake Ground displacement associated with the sudden release of slowly accumulated stress in the lithosphere.

end moraine A ridge or series of ridges formed by accumulations of drift built up along the outer margin of an actively flowing glacier at any given time; a moraine that has been deposited at the lower or outer end of a glacier.

en echelon Said of geologic features that are in an overlying or staggered arrangement, for example, faults.

epoch An interval of geologic time; a division of a period (for example, Pleistocene Epoch).

era The unit of geologic time that is next in magnitude beneath an eon; it consists of two or more periods (for example, Paleozoic Era).

erratic A rock fragment carried by glacial ice and deposited far from its point of origin.

escarpment A long, more or less continuous cliff or steep slope facing in one general direction; it generally marks the outcrop of a resistant layer of rocks or the exposed plane of a fault that has moved recently.

esker An elongated ridge of sand and gravel that was deposited by a subglacial or englacial stream flowing between ice walls or in an ice tunnel and left behind by a melting glacier.

evaporite A nonclastic sedimentary rock composed primarily of minerals produced from a saline solution as a result of extensive or total evaporation of the solvent (for example, gypsum, anhydrite, rock salt, primary dolomite, and various nitrates and borates.

fault A fracture surface or zone of fractures in Earth materials along which there has been vertical and/or horizontal displacement or movement of the strata on opposite sides relative to one another.

flaggy Said of rock that tends to split into layers of suitable thickness for use as flagstone.

floodplain The surface or strip of relatively smooth land adjacent to a stream channel produced by the stream's erosion and deposition actions; the area covered with water when the stream overflows its banks at times of high water; it is built of alluvium carried by the stream during floods and deposited in the sluggish water beyond the influence of the swiftest current.

fluvial Of or pertaining to a river or rivers.

flux A substance used to remove impurities from steel. Flux combines with the impurities in the steel to form a compound that has a lower melting point and density than steel. This compound tends to float to the top and can be easily poured off and separated from the molten steel.

formation The basic rock unit, one distinctive enough to be readily recognizable in the field and widespread and thick enough to be plotted on a map. It describes the strata, such as limestone, sandstone, shale, or combinations of these and other rock types. Formations have formal names, such as Joliet Formation or St. Louis Limestone (Formation), generally derived from the geographic localities where the unit was first recognized and described.

fossil Any remains or traces of a once-living plant or animal preserved in rocks (arbitrarily excludes recent remains); any evidence of ancient life. Also used to refer to any object that existed in the geologic past and for which evidence remains (for example, a fossil waterfall)

fragipan A dense subsurface layer of soil whose hardness and relatively slow permeability to water are chiefly due to extreme compactness rather than to high clay content (as in claypan) or cementation (as in hardpan).

friable Said of a rock or mineral that crumbles naturally or is easily broken, pulverized, or reduced to powder, such as a soft and poorly cemented sandstone.

geest An alluvial material that is not of recent origin lying on the surface.

geology The study of the planet Earth that is concerned with its origin, composition, and form, its evolution and history, and the processes that acted (and act) upon the Earth to control its historic and present forms.

geophysics Study of the Earth with quantitative physical methods. Application of the principles of physics to the study of the Earth, especially its interior.

glaciation A collective term for the geologic processes of glacial activity, including erosion and deposition, and the resulting effects of such action on the Earth's surface.

glacier A large, slow-moving mass of ice formed on land by the compaction and recrystallization of snow.

gley horizon A soil developed under conditions of poor drainage that reduced iron and other elemental contents and results in gray to black, dense materials.

gob pile A heap of mine refuse left on the surface.

graben An elongate, relatively depressed crustal unit or block that is bounded by faults on its long sides.

gradient A part of a surface feature of the Earth that slopes upward or downward; the angle of slope, as of a stream channel or of a land surface, generally expressed by a ratio of height versus distance, a percentage or an angular measure from the horizontal.

gypsum A widely distributed mineral consisting of hydrous calcium sulfate ($CaSO_4 \cdot 2H_2O$). Gypsum is soft (hardness of 2 on the Mohs scale); white or colorless when pure but commonly has tints of gray, red, yellow, blue or brown. Gypsum is used as a retarder in portland cement and in making plaster of Paris.

hiatus A gap in the sedimentary record.

horst An elongate, relatively uplifted crustal unit or block that is bounded by faults on its long sides.

igneous Said of a rock or mineral that solidified from molten or partly molten material (that is, from magma).

indurated Said of compact rock or soil hardened by the action of pressure, cementation, and, especially, heat.

joint A fracture or crack in rocks along which there has been no movement of the opposing sides (*see also* fault).

karst Collective term for the land forms and subterranean features found in areas with relatively thin soils underlain by limestone or other soluble rocks; characterized by many sinkholes separated by steep ridges or irregular hills. Tunnels and caves formed by dissolution of the bedrock by groundwater honeycomb the subsurface. Named for the region around Karst in the Dinaric Alps of Croatia where such features were first recognized and described.

lacustrine Produced by or belonging to a lake.

Laurasia A protocontinent of the northern hemisphere, corresponding to Gondwana in the southern hemisphere, from which the present continents of the Northern Hemisphere have been derived by separation and continental displacement. The supercontinent from which both were derived is Pangea. Laurasia included most of North America, Greenland, and most of Eurasia, excluding India. The main zone of separation was in the North Atlantic, with a branch in Hudson Bay; geologic features on opposite sides of these zones are very similar.

lava Molten, fluid rock that is extruded onto the surface of the Earth through a volcano or fissure. Also the solid rock formed when the lava has cooled.

limestone A sedimentary rock consisting primarily of calcium carbonate (the mineral, calcite). Limestone is generally formed by accumulation, mostly in place or with only short transport, of the shells of marine animals, but it may also form by direct chemical precipitation from solution in hot springs or caves and, in some instances, in the ocean.

lithify To change to stone, or to petrify; especially to consolidate from a loose sediment to a solid rock.

lithology The description of rocks on the basis of their color, structure, mineral composition, and grain size; the physical character of a rock.

local relief The vertical difference in elevation between the highest and lowest points of a land surface within a specified horizontal distance or in a limited area.

loess A homogeneous, unstratified accumulation of silt-sized material deposited by the wind.

magma Naturally occurring molten rock material generated within Earth and capable of intrusion into surrounding rocks or extrusion onto the Earth's surface. When extruded on the surface it is called lava. The material from which igneous rocks form through cooling, crystallization, and related processes.

meander One of a series of somewhat regular, sharp, sinuous curves, bends, loops, or turns produced by a stream, particularly in its lower course where it swings from side to side across its valley bottom.

meander scars Crescent-shaped swales and gentle ridges along a river's floodplain that mark the positions of abandoned parts of a meandering river's channel. They are generally filled in with sediments and vegetation and are most easily seen in aerial photographs.

metamorphic rock Any rock derived from pre-existing rocks by mineralogical, chemical, and structural changes, essentially in the solid state, in response to marked changes in temperature, pressure, shearing stress, and chemical environment at depth in Earth's crust (for example, gneisses, schists, marbles, and quartzites)

mineral A naturally formed chemical element or compound having a definite chemical composition, an ordered internal arrangement of its atoms, and characteristic crystal form and physical properties.

monolith (a) A piece of unfractured bedrock, generally more than a few meters across. (b) A large upstanding mass of rock.

moraine A mound, ridge, or other distinct accumulation of glacial drift, predominantly till, deposited in a variety of topographic land forms that are independent of control by the surface on which the drift lies (*see also* end moraine).

morphology The scientific study of form and of the structures and development that influence form; term used in most sciences.

natural gamma log One of several kinds of measurements of rock characteristics taken by lowering instruments into cased or uncased, air- or water-filled boreholes. Elevated natural gamma radiation levels in a rock generally indicate the presence of clay minerals.

nickpoint A place with an abrupt inflection in a stream profile, generally formed by the presence of a rock layer resistant to erosion; also, a sharp angle cut by currents at base of a cliff.

nonconformity An unconformity resulting from deposition of sedimentary strata on massive crystalline rock.

nonlithified Said of unconsolidated materials.

normal fault A fault in which the hanging wall appears to have moved downward relative to the footwall.

outwash Stratified glacially derived sediment (clay, silt, sand, and gravel) deposited by meltwater streams in channels, deltas, outwash plains, glacial lakes, and on floodplains.

outwash plain The surface of a broad body of outwash formed in front of a glacier.

overburden The upper part of a sedimentary deposit, compressing and consolidating the material below.

oxbow lake A crescent-shaped lake in an abandoned bend of a river channel. A precursor of a meander scar.

paha A low, elongated, rounded glacial ridge or hill consisting mainly of drift, rock, or wind-blown sand, silt, or clay but capped with a thick cover of loess.

palisades A picturesque extended rock cliff or line of bold cliffs, rising precipitously from the margin of a stream or lake.

Pangea The supercontinent that existed from 300 to 200 million years ago. It combined most of the continental crust of the Earth, from which the present continents were derived by fragmentation and movement away from each other by means of plate tectonics. During an intermediate stage of the fragmentation, between the existence of Pangea and that of the present widely separated continents, Pangea was split into two large fragments, Laurasia on the north and Gondwana in the southern hemisphere.

ped Any naturally formed unit of soil structure (for example, granule, block, crumb, or aggregate).

peneplain A land surface of regional scope worn down by erosion to a nearly flat or broadly undulating plain.

perched groundwater Unconfined groundwater separated from an underlying body of groundwater by an unsaturated zone.

perched water table The water table of a body of perched groundwater.

period An interval of geologic time; a division of an era (for example, Cambrian, Jurassic, and Tertiary).

physiographic province (or division) (a) A region, all parts of which are similar in geologic structure and climate and which has consequently had a unified geologic history. (b) A region whose pattern of relief features or landforms differs significantly from that of adjacent regions.

physiography The study and classification of the surface features of Earth on the basis of similarities in geologic structure and the history of geologic changes.

point bar A low arcuate ridge of sand and gravel developed on the inside of a stream meander by accumulation of sediment as the stream channel migrates toward the outer bank.

radioactivity logs Any of several types of geophysical measurements taken in boreholes using either the natural radioactivity in the rocks or the effects of radiation on the rocks to determine the lithology or other characteristics of the rocks in the walls of the borehole (for example, natural gamma radiation log; neutron density log).

relief (a) A term used loosely for the actual physical shape, configuration, or general uneveness of a part of Earth's surface, considered with reference to variations of height and slope or to irregularities of the land surface; the elevations or differences in elevation, considered collectively, of a land surface (frequently confused with topography). (b) The vertical difference in elevation between the hilltops or mountain summits and the lowlands or valleys of a given regional extent. Formed in places where the forces of plate tectonics are beginning to split a continent (for example, East African Rift Valley).

rift (a) A narrow cleft, fissure, or other opening in rock made by cracking or splitting; (b) a long, narrow continental trough that is bounded by normal faults—a graben of regional extent.

riprap A layer of large, durable fragments of broken rock, specially selected and graded, thrown together irregularly or fitted together to prevent erosion by waves or currents and to preserve the shape of a surface, slope, or underlying structure.

rubble bars A loose mass of angular rock fragments, commonly overlying outcropping rock.

sediment Solid fragmental matter, either inorganic or organic, that originates from weathering of rocks and is transported and deposited by air, water, or ice or that is accumulated by other natural agents, such as chemical precipitation from solution or secretion from organisms. When deposited, sediment generally forms layers of loose, unconsolidated material (for example, sand, gravel, silt, mud, till, loess, and alluvium).

sedimentary rock A rock resulting from the consolidation of loose sediment that has accumulated in layers (for example, sandstone, siltstone, mudstone, and limestone).

shoaling Said of an ocean or lake bottom that becomes progressively shallower as a shoreline is approached. The shoaling of the ocean bottom causes waves to rise in height and break as they approach the shore.

silt A rock fragment or detrital particle smaller than a very fine sand grain and larger than coarse clay, having a diameter in the range of 4 to 62 microns; the upper size limit is approximately the smallest size that can be distinguished with the unaided eye.

sinkhole Any closed depression in the land surface formed as a result of the collapse of the underlying soil or bedrock into a cavity. Sinkholes are common in areas where bedrock is near the surface and susceptible to dissolution by infiltrating surface water. Sinkhole is synonymous with "doline," a term used extensively in Europe. The essential component of a hydrologically active sinkhole is a drain that allows any water that flows into the sinkhole to flow out the bottom into an underground conduit.

slip-off slope Long, low, gentle slope on the inside of a stream meander. The slope on which the sand that forms point bars is deposited.

stage, substage Geologic time-rock units; the strata formed during an age or subage, respectively. Generally applied to glacial episodes (for example, Woodfordian Substage of the Wisconsinan Stage).

strata Layers of sedimentary rock, visually separable from other layers above and below; beds.

stratigraphic unit A stratum or body of strata recognized as a unit in the classification of the rocks of Earth's crust with respect to any specific rock character, property, or attribute or for any purpose such as description, mapping, and correlation.

stratigraphy The study, definition, and description of major and minor natural divisions of rocks, particularly the study of their form, arrangement, geographic distribution, chronologic succession, naming or classification, correlation, and mutual relationships of rock strata.

stratum A tabular or sheet-like mass, or a single, distinct layer of material of any thickness, separable from other layers above and below by a discrete change in character of the material, a sharp physical break, or both. The term is generally applied to sedimentary rocks but could be applied to any tabular body of rock (*see also* bed).

subage A small interval of geologic time; a division of an age.

syncline A convex-downward fold in which the strata have been bent to form a trough; the strata on either side of the core of the trough are inclined in opposite directions toward the axis of the fold; the core area of the fold contains the youngest rocks (*see also* anticline).

system A fundamental geologic rock unit of worldwide significance; the strata of a system are those deposited during a period of geologic time (for example, rocks formed during the Pennsylvanian Period are included in the Pennsylvanian System).

tectonic Pertaining to the global forces that cause folding and faulting of the Earth's crust; also used to classify or describe features or structures formed by the action of those forces.

tectonics The branch of geology dealing with the broad architecture of the upper (outer) part of Earth; that is, the major structural or deformational features, their origins, historical evolution, and relations to one another. It is similar to structural geology, but generally deals with larger features such as whole mountain ranges or continents.

temperature-resistance log A borehole log, run only in water-filled boreholes, that measures the water temperature and the quality of groundwater in the well.

terrace An abandoned floodplain formed when a stream flowed at a level above the level of its present channel and floodplain.

till Nonlithified, nonsorted, unstratified drift deposited by and underneath a glacier and consisting of a heterogenous mixture of different sizes and kinds of rock fragments.

till plain The undulating surface of low relief in an area underlain by ground moraine.

topography The natural or physical surface features of a region, considered collectively as to form; the features revealed by the contour lines of a map.

unconformable Said of strata that do not succeed the underlying rocks in immediate order of age or in parallel position. A general term applied to any strata deposited directly upon older rocks after an interruption in sedimentation, with or without any deformation and/or erosion of the older rocks.

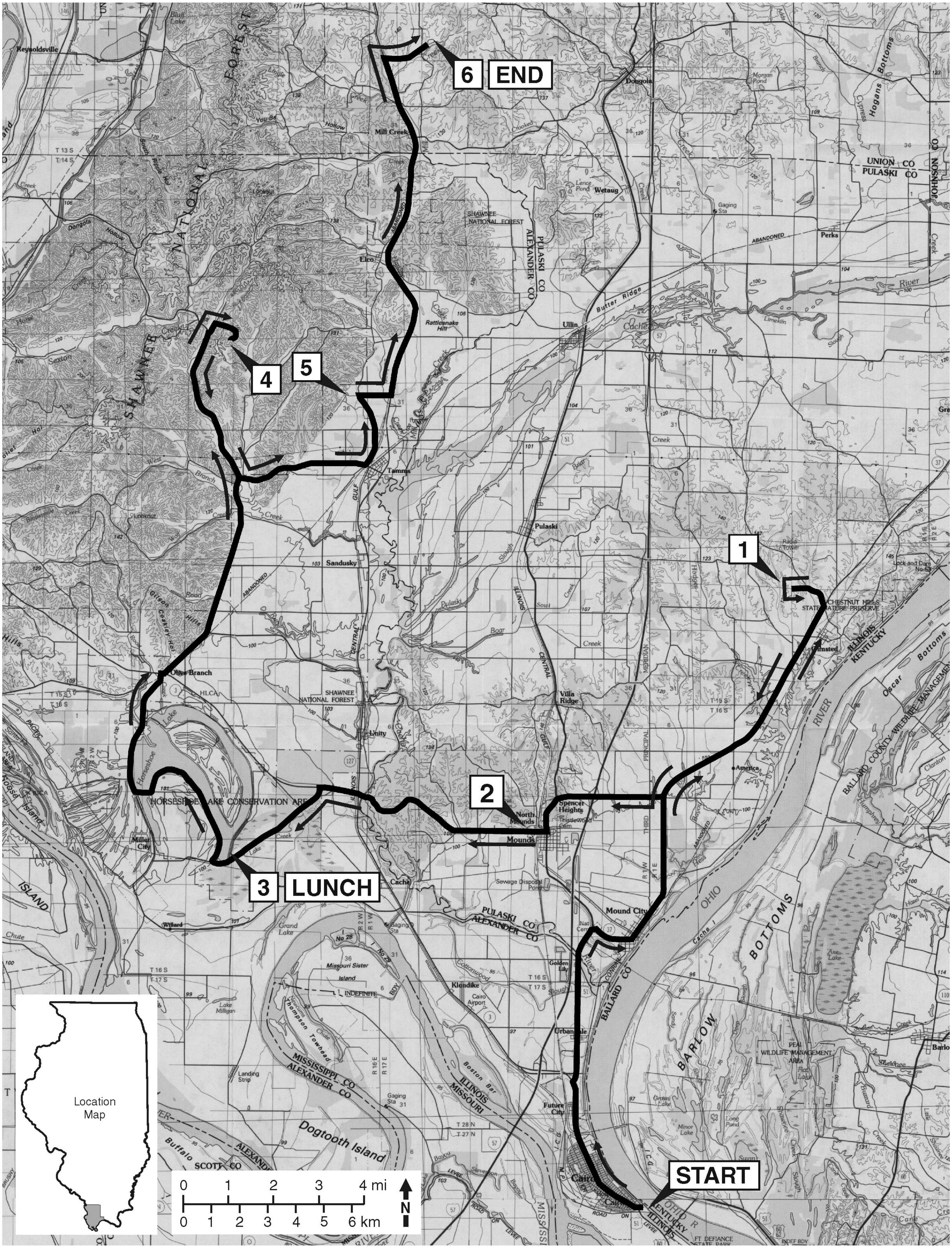
unconformity A substantial break or gap in the geologic record where a rock unit is overlain by another that is not next in stratigraphic successsion.

underfit stream A misfit stream that appears to be too small to have eroded the valley in which it flows. It is a common result of drainage changes effected by stream capture, by glaciers, or by climate variations.

valley train The accumulation of outwash deposited by rivers in their valleys downstream from a glacier.

water table The point in a well or opening in the Earth where groundwater begins. It generally marks the top of the zone where the pores in the surrounding rocks are fully saturated with water.

weathering The group of processes, both chemical and physical, whereby rocks exposed to the weather change in character and decay and finally crumble into soil.



START
1
2
3
LUNCH
4
5
6
END
Location Map
0 1 2 3 4 mi
0 1 2 3 4 5 6 km
N
SHAWNEE NATIONAL FOREST
Mill Creek
Dongola
Wetaug
Elco
Ullin
Tamms
Pulaski
Sandusky
Olive Branch
Unity
Villa Ridge
North Mounds
Mounds
Spencer Heights
Mound City
Olmsted
HORSESHOE LAKE CONSERVATION AREA
Miller City
Cache
Urbandale
Future City
Cairo
Klondike
CHESTNUT HILLS STATE NATURE PRESERVE
UNION CO
PULASKI CO
PULASKI CO
ALEXANDER CO
ILLINOIS
KENTUCKY
OHIO
BALLARD CO
BARLOW
BOTTOMS
Dogtooth Island
MISSISSIPPI CO
ALEXANDER CO
ILLINOIS
MISSOURI
Willard