Guide to the Geology of the Joliet Area Including the Midewin National Tallgrass Prairie and the Des Plaines and Mazonia/ Braidwood State Fish and Wildlife Areas, Will and Portions of Grundy and Kankakee Counties, Illinois

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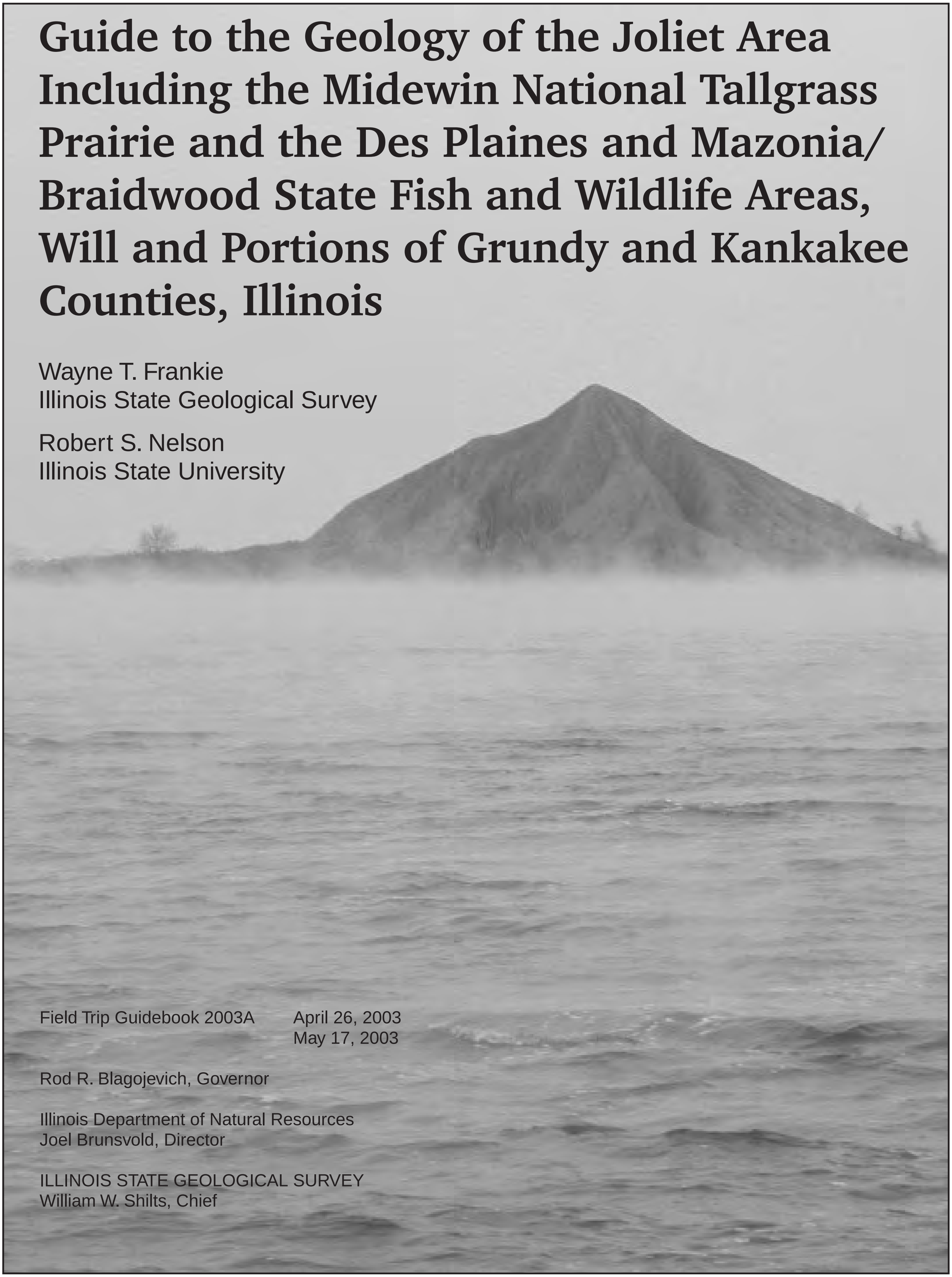

Field Trip Guidebook 2003A   April 26, 2003
May 17, 2003

Rod R. Blagojevich, Governor

Illinois Department of Natural Resources
Joel Brunsvold, Director

ILLINOIS STATE GEOLOGICAL SURVEY
William W. Shilts, Chief

Cover photo: *A large abandoned gob pile at the Mazonia/Braidwood Fish and Wildlife Area, Will County (photo by W. T. Frankie).*

Geological Science Field Trips The Illinois State Geological Survey (ISGS) conducts four free 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 must be accompanied by a parent or guardian. High school science classes should be supervised by at least one adult for each ten students.

A list of guidebooks of earlier field trips for planning class tours and private outings may be obtained by contacting the Geoscience Education and Outreach Section, Illinois State Geological Survey, Natural Resources Building, 615 East Peabody Drive, Champaign, IL 61820-6964. Telephone: 217-244-2427 or 217-333-4747. This information is on the ISGS home page: http://www.isgs.uiuc.edu.

Seven USGS 7.5-Minute Quadrangle maps (Elwood, Essex, Channahon, Gardner, Joliet, Symerton, and Wilmington) 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 Illinois and in particular Will County and the area south of Joliet, Illinois. The second section is a road log for the trip, and the third section provides detailed stop descriptions. The final section is an appendix that includes supplementary materials that are important to the field trip area. Special gratitude is expressed to Mike Knapp for his laborious task of preparing this guidebook for publication and to Cheryl Nimz for editing.

ILLINOIS DEPARTMENT OF NATURAL RESOURCES

ISGS Illinois State Geological Survey

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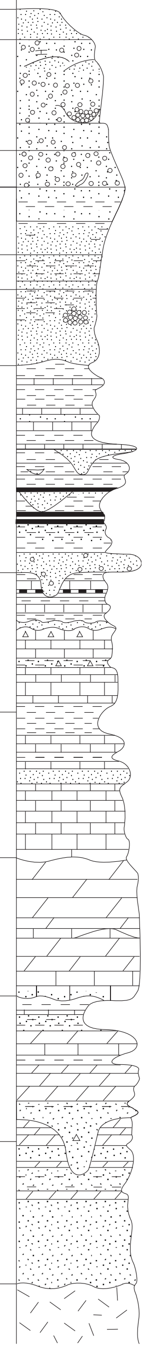
CONTENTS

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	Chert gravel, present in northern, southern and western Illinois
			Eocene	33.7 m 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

The city of Joliet, the Midewin National Tallgrass Prairie, and the Des Plaines and Mazonia/Braidwood State Fish and Wildlife Areas are located in the northeastern portion of Illinois in Will, Grundy, and Kankakee Counties. The area of the field trip is centered around the confluence of the Des Plaines and Kankakee Rivers, where the Illinois River is formed.

The bedrock in the northern part of the field trip area consists of Silurian *sedimentary strata* consisting primarily of *dolomite*, and the bedrock in the southern part of the field trip area consists of Pennsylvanian strata consisting primarily of shale, siltstone, sandstone, and coal. Ordovician strata are exposed along the Kankakee River valley near the middle part of the field trip area (see generalized geologic column on facing page). This geological science field trip will acquaint you with the *geology*[1], landscape, and mineral resources for part of Will, Grundy, and Kankakee Counties.

Joliet, with a population of 106,221, is the largest city within the field trip area. Joliet is 46 miles southeast of Chicago, approximately 161 miles northeast of Springfield, 257 miles northeast of East St. Louis, and 352 miles north of Cairo.

GEOLOGIC FRAMEWORK

Precambrian Era (3.8 BY to 543 MY)

Through several billion years of geologic time, the area surrounding Joliet, like the rest of present-day Illinois, has undergone many changes. The oldest rocks beneath the field trip area belong to the ancient Precambrian *basement complex*. We know relatively little about these rocks from direct observations because they are not exposed at the surface anywhere in Illinois. Only about 35 drill holes have reached deep enough for geologists to collect samples from the Precambrian rocks of Illinois. The depth to the Precambrian rocks in Will and Grundy Counties ranges from 4,000 to 4,500 feet. In southern Illinois, the depth to the Precambrian rocks is greater than 20,000 feet in the deepest part of the Illinois *Basin*. From these samples, however, we know that these ancient rocks consist mostly of granitic and rhyolitic (*igneous rocks)* and possibly *metamorphic*, crystalline rocks formed about 1.5 to 1.0 billion years ago. From about 1 billion to about 0.6 billion years ago, these Precambrian rocks were exposed at the surface. During this long period, the rocks were deeply weathered and eroded and formed a barren landscape that was probably quite similar to the topography of the present Missouri Ozarks. There is no rock record (sediments) in Illinois that represents the long interval of *weathering* and erosion that lasted from the time the Precambrian rocks were formed until the first Cambrian-age sediments accumulated on the eroded Precambrian rocks. This interval of weathering and erosion is almost as long as the time from the beginning of the Cambrian *Period* to the present.

Because geologists cannot see the Precambrian basement rocks in Illinois except as cuttings and cores from boreholes, other various techniques, such as measurements of Earth's gravitational and magnetic fields and seismic exploration, are used to map out the regional characteristics of the basement complex. The evidence collected from these various exploratory techniques indicates that southernmost Illinois, near what is now the historic Kentucky–Illinois Fluorspar Mining District, consisted of *rift* valleys similar to those in eastern Africa. These Illinois Basin rift valleys formed as movement of crustal plates (plate *tectonics*) began to rip apart the Precambrian North

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[1] Words 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.

American continent. These rift valleys have been named the Rough Creek Graben and the Reelfoot Rift (fig. 1).

Paleozoic Era (543 MY to 248 MY)

After the beginning of the Paleozoic Era, about 520 million years ago in the late Cambrian Period, the rifting stopped, and 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 following 270 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, located in the Rough Creek Graben and Reelfoot Rift areas of southeastern Illinois and western Kentucky. At various times during this era, the seas withdrew and deposits were weathered and eroded. As a result, there are gaps (called a *hiatus)* in the sedimentary record in Illinois.

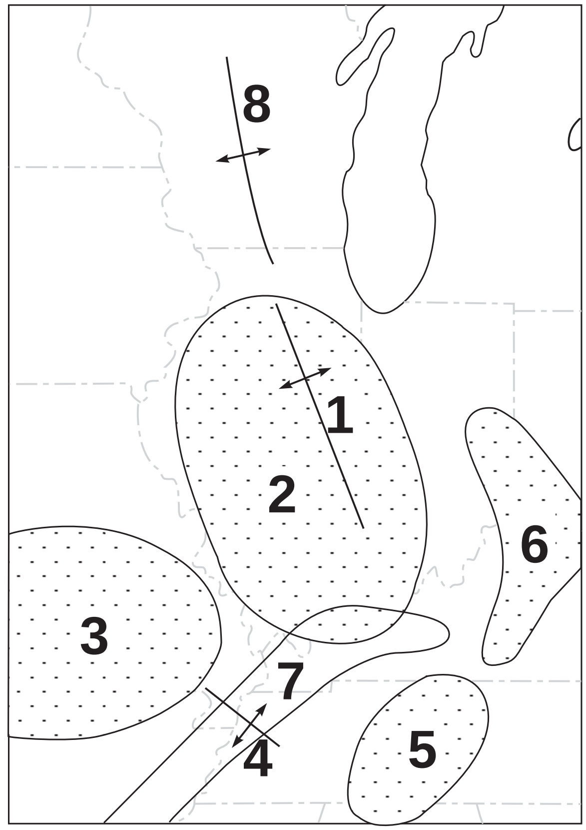


Figure 1 Location of some of the major structures in the Illinois region: (1) La Salle Anticlinorium, (2) Illinois Basin, (3) Ozark Dome, (4) Pascola Arch, (5) Nashville Dome, (6) Cincinnati Arch, (7) Rough Creek Graben–Reelfoot Rift, and (8) Wisconsin Arch.

These sediments, when compacted and hardened (*indurated*), constitute the bedrock succession. Bedrock refers to the indurated or *lithified* rock units that underlie the soils or other relatively loose, crumbly, materials near Earth's surface. In the field trip area, *bedrock* strata range in age from more than 520 million years (the Cambrian Period) to less than 320 million years old (the Pennsylvanian Period). The field trip area is underlain by as much as 4,500 feet of Paleozoic sedimentary strata. Figure 2 shows the succession of rock strata a drill bit would penetrate in this area if the rock record were complete and all the *formations* were present. The oldest Paleozoic rocks exposed in the area are Ordovician in age. These rocks formed from sediments that accumulated from about 490 up to 443 million years ago in an ancient shallow sea that covered Illinois and adjacent states.

DEPOSITIONAL HISTORY

Paleozoic Era (543 MY to 248 MY)

As noted previously, the Rough Creek Graben and the Reelfoot Rift (figs. 1 and 3) were formed by tectonic activity that began in the latter part of the Precambrian *Era* and continued until the Late Cambrian. Toward the end of the Cambrian, rifting ended, and the whole region began to subside, allowing shallow seas to cover the land.

These inland seas connected with an open ocean to the south during much of the Paleozoic, and the area that is now southern Illinois was an embayment. The southern part of Illinois and adjacent

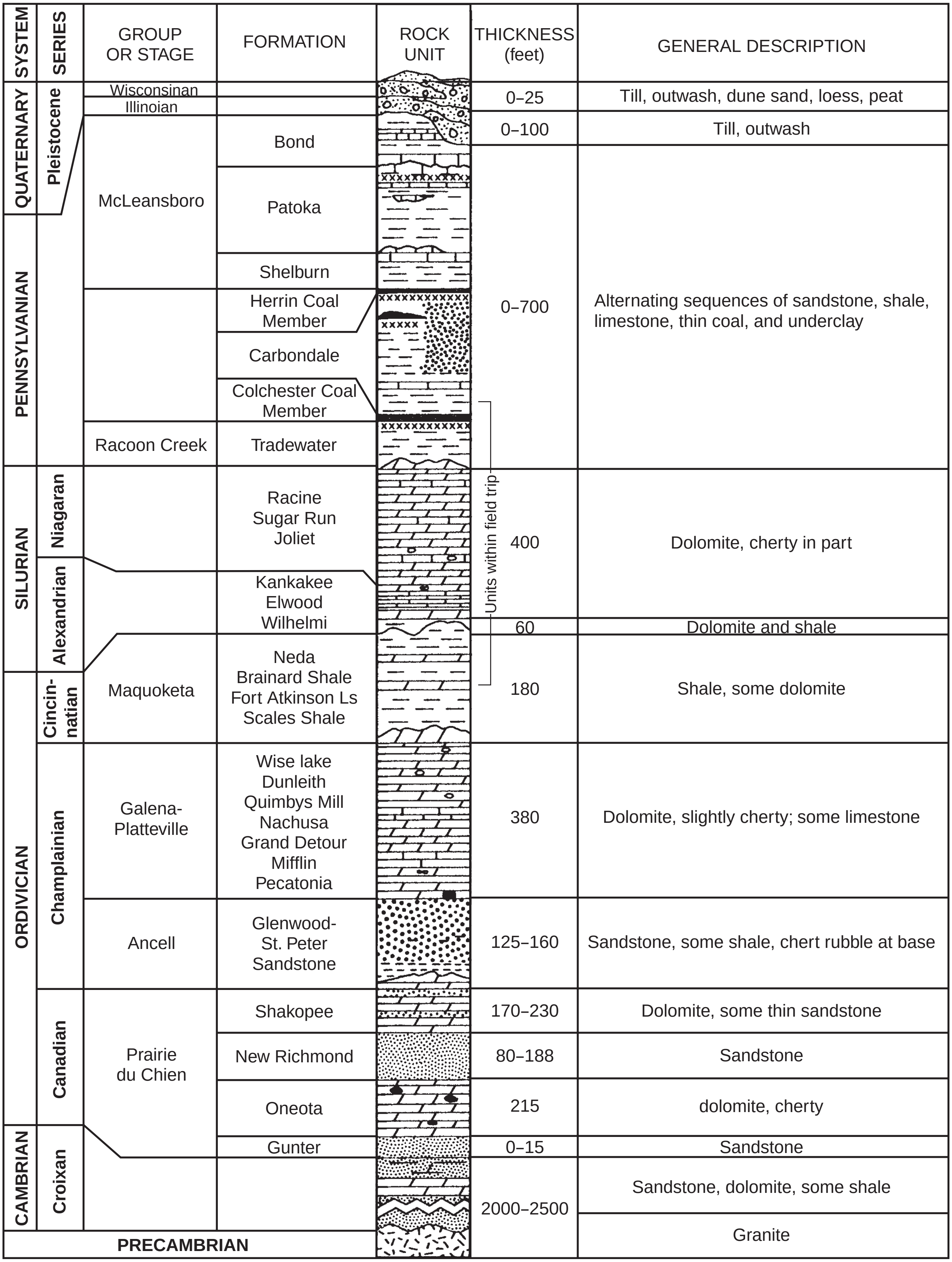


Figure 2 Generalized stratigraphic column of the upper rock formations in the field trip area (modified from Reinertsen and Smith 1990).

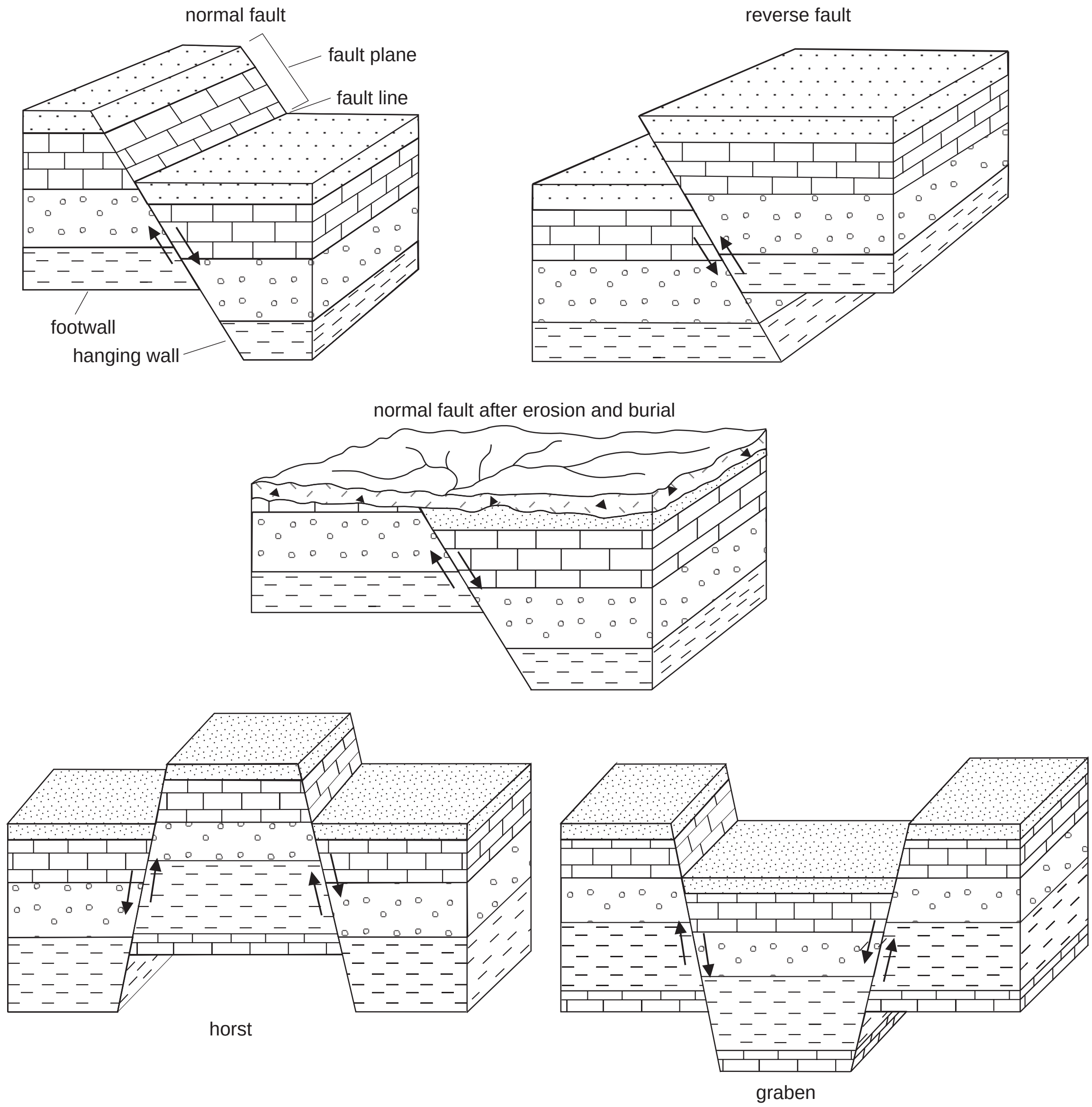


Figure 3 Diagrammatic illustrations of fault types that may be present in the field trip area. A fault is a fracture in the Earth's crust along which there has been relative movement of the opposing blocks. A fault is usually an inclined plane, and when the hanging wall (the block above the plane) has moved up relative to the footwall (the block below the fracture), the fault is a reverse fault. When the hanging wall has moved down relative to the footwall, the fault is a normal fault.

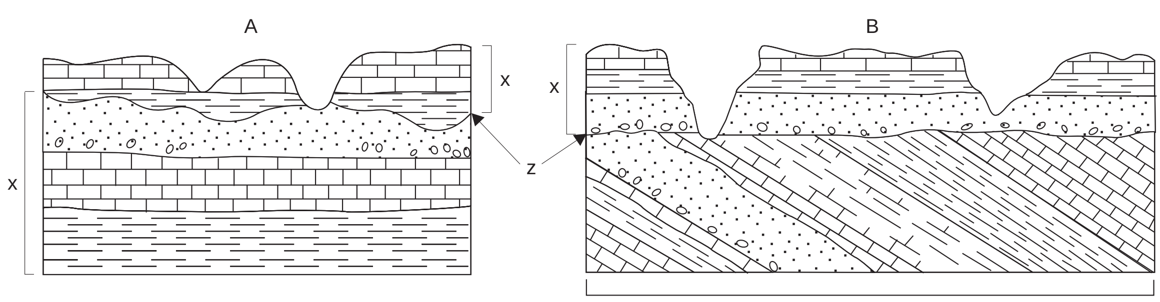


Figure 4 Schematic drawings of (A) a disconformity and (B) an angular unconformity (x represents the conformable rock sequence, and z is the plane of unconformity).

parts of Indiana and Kentucky sank more rapidly than the areas to the north, allowing more sediment to accumulate. During the Paleozoic and Mesozoic Eras, the Earth's thin crust was periodically flexed and warped in places as stresses built up in response to the tectonic forces associated with the collision of continental and oceanic plates and mountain building. These movements caused repeated invasions and withdrawals of the seas across the region. The former sea floors were thus periodically exposed to erosion, which removed some sediments from the rock record.

Stratigraphic Units and Contacts Sedimentary rock, such as limestone, sandstone, shale, or combinations of these and other rock types, commonly occur in units called formations. A formation is a body of rock that has a distinctive lithology, or set of characteristics, and easily recognizable top and bottom boundaries. It is also thick enough to be readily traceable in the field and sufficiently widespread to be represented on a map. Most formation names contain modifiers, such as St. Peter Sandstone or Scales Shale, which are usually derived from geographic names and predominant rock types. In cases where no single rock type is characteristic, the word "Formation" becomes a part of the name (for example, Joliet Formation). A group, such as the Galena Group or the Maquoketa Group, is a vertical lumping together of adjacent formations having many similarities. A member, or *bed*, is a subdivision of a formation that is too thin to be classified as a formation or that has minor characteristics setting it apart from the rest of the formation.

Many of the sedimentary units called formations have conformable contacts—that is, no significant interruption in deposition occurred as one formation was succeeded by another (figs. 2 and 4). In some instances, even though the composition and appearance of the rocks change significantly at the contact between two formations, the *fossils* in the rocks and the relationships between the rocks at the contact indicate that deposition was virtually continuous. In contrast, in other places, the top of the lower formation was at least partially eroded before the next formation began to be deposited. In these instances, fossils and other evidence within or at the boundary between the two formations indicate a significant age difference between the lower unit and the overlying unit. This type of contact is called an *unconformity* (fig. 4). If the *beds* above and below an unconformity are parallel, the unconformity is called a *disconformity*. However, if the lower beds were tilted and eroded prior to deposition of overlying beds, the contact is called an *angular unconformity*. Unconformities occur throughout the Paleozoic rock record and are shown as wavy lines in the generalized stratigraphic column (fig. 2). Each unconformity represents an extended interval of time for which there is no rock record.

Near the close of the Mississippian Period, gentle arching of the rocks in eastern Illinois initiated the development of the La Salle Anticlinorium (figs. 1 and 5). This complex structure has smaller structures such as domes, *anticlines,* and *synclines* superimposed on the broad upwarp of the anticlinorium. Further gradual arching continued through the Pennsylvanian Period. Because the youngest Pennsylvanian strata are absent from the area of the anticlinorium (either because they were not deposited or because they were eroded), we cannot determine just when folding ceased—perhaps by the end of the Pennsylvanian or during the Permian Period a little later, near the close of the Paleozoic Era.

Mesozoic Era (248 MY to 65 MY)

During the Mesozoic Era, the rise of the Pascola Arch (figs. 1 and 5) in southeastern Missouri, northeastern Arkansas, and western Tennessee produced a structural barrier that helped form the current shape of the Illinois Basin by closing off the embayment and separating it from the open sea to the south. The Illinois Basin is a broad, subsided region covering much of Illinois, southwestern Indiana, and western Kentucky (fig. 1). Development of the Pascola Arch, in conjunction

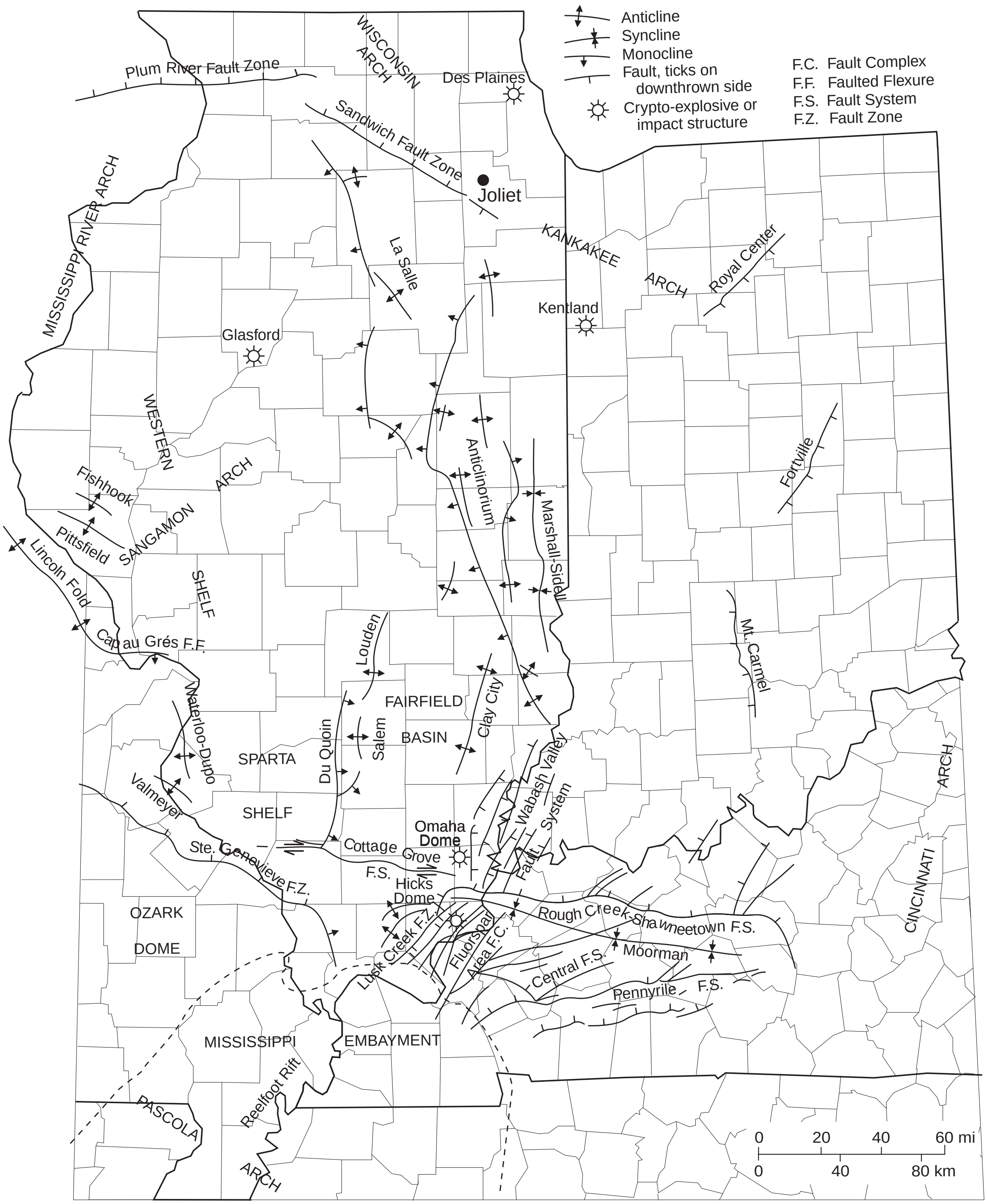


Figure 5 Structural features of Illinois (modified from Buschbach and Kolata 1991).

with the earlier sinking of the deeper portion of the basin north of the Pascola Arch in southern Illinois, gave the basin its present asymmetrical, spoon-shaped configuration (fig. 6). The geologic map (fig. 7) shows the distribution of the rock *systems* of the various geologic time periods as they would appear if all the glacial, windblown, and unconsolidated or non-lithified surface materials were removed.

Younger rocks of the latest Pennsylvanian and perhaps the Permian (the youngest rock systems of the Paleozoic) may have at one time covered the southern and northern portions of Illinois. Mesozoic and Cenozoic rocks (see the generalized geologic column at the front of the guidebook) might also have been present here. Indirect evidence, based on the stage of development (rank) of coal deposits and the generation and maturation of petroleum from source rocks (Damberger 1971), indicates that perhaps as much as 1.5 miles (7,920 feet) of latest Pennsylvanian and younger rocks once covered southern Illinois.

During the more than 240 million years since the end of the Paleozoic Era (and before the onset of *glaciation* 1 to 2 million years ago), several thousands of feet of strata may have been eroded. Nearly all traces of any post-Pennsylvanian bedrock that may have been present in Illinois were removed. During this extended period of erosion, deep valleys were carved into the gently tilted bedrock formations (fig. 8).

Later, during the Ice Age, the topographic *relief* was reduced by repeated advances and melting back of continental *glaciers* that scoured and scraped the bedrock surface. This glacial erosion modified all of the bedrock surfaces in Illinois. The final melting of the glaciers left behind the non-lithified deposits in which our modern Holocene soil has developed.

ANCIENT ENVIRONMENTAL HISTORY

The sediments that form the bedrock that underlies northeastern Illinois were laid down in a warm, tropical sea that covered the Midwest approximately 490 to 417 million years ago during the Ordovician and Silurian Periods. The environment was probably similar to that in the present Bahama Islands. The nearest land was situated about 500 miles to the north in Canada. During the Ordovician time, North America straddled the equator, and northern Illinois was positioned at about 25° S latitude. The prevailing wind direction during the Ordovician was out of the southeast (southeast trade winds), in contrast to the present prevailing wind direction from the west. Occasionally, winds would carry clouds of fine ash into the area from explosive volcanic eruptions that occurred in the region of what is now Alabama and Georgia. Those eruptions constituted some of the largest volcanic eruptions known on Earth. Two- to three-inch-thick volcanic ash beds can be seen in several rock quarries in northern Illinois.

The flat, featureless sea floor was teeming with invertebrate animals and algae. Shells of animals including trilobites, brachiopods, bryozoans, crinoids, snails, and clams accumulated on the sea floor along with mud formed from very fine calcium carbonate crystals secreted by algae. The carbonate mud and shells were slowly buried and, with time, began to solidify, producing beds of limestone. After several million years, numerous limestone beds were formed and stacked one on another. Evidence suggests that perhaps as much as a mile of sedimentary rocks (limestone, shale, and sandstone) was deposited in the region after the limestones formed. Hot groundwater containing dissolved salts and metals began to move slowly through the deeply buried limestone altering the rock to the mineral dolomite.

Later fluid migration, approximately 270 million years ago during the Permian Period, formed the galena (lead ore) and sphalerite (zinc ore) deposits in northwestern Illinois and southwestern

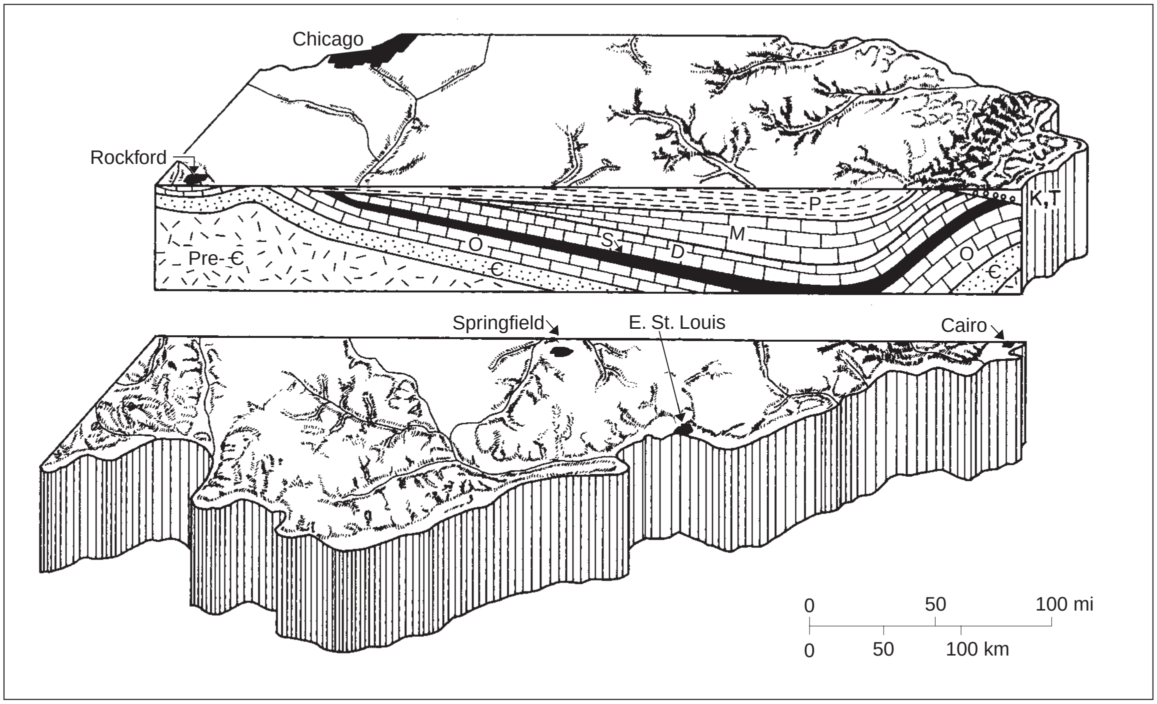


Figure 6 Stylized north-south cross section shows the structure of the Illinois Basin. To show detail, the thickness of the sedimentary rocks has been greatly exaggerated and younger, unconsolidated surface deposits have been eliminated. The oldest rocks are Precambrian (Pre-Є) granites. They form a depression filled with layers of sedimentary rocks of various ages: Cambrian (Є), Ordovician (O), Silurian (S), Devonian (D), Mississippian (M), Pennsylvanian (P), Cretaceous (K), and Tertiary (T). Scale is approximate.

Wisconsin. The galena deposits in northwestern Illinois have been radioisotope dated at 270 million years, the same date as the fluorspar deposits of southeastern Illinois. The fluid migration path, which formed the galena and sphalerite deposits, was from the north to the south (D. Kolata and S. Nelson, personal communication, 2002). Hot brines found their way through fractures in the limestone and dolomite, rose to the surface, cooled, and precipitated sulfide minerals, including galena (PbS) and sphalerite (ZnS).

At about 250 million years ago, the seas withdrew from the region, and a long period of erosion began that continues today. The mile thick layer of sedimentary rocks slowly eroded away exposing the ancient and now petrified sea floor with its abundant fossils. Outstanding specimens of trilobites, crinoids, starfish, and other rare fossils have been collected from the bedrock in northern Illinois.

STRATIGRAPHY

Bedrock Names

Ordovician Period The upper Ordovician dolomite bedrock in northeastern Illinois is about 800 feet thick. It is divided into numerous formations based mainly on the relative amount of shale, presence or absence of chert, and fossil content (fig. 2). Knowledge of the individual formations is useful in locating and producing crushed stone products, siting large construction sites such as bridges, dams, and power plants, and identifying potentially fossiliferous exposures of bedrock. The upper Ordovician dolomites are underlain by the Glenwood Formation and the St. Peter Sandstone of the Ancell Group and are unconformably overlain by the Maquoketa Shale Group (fig. 2).

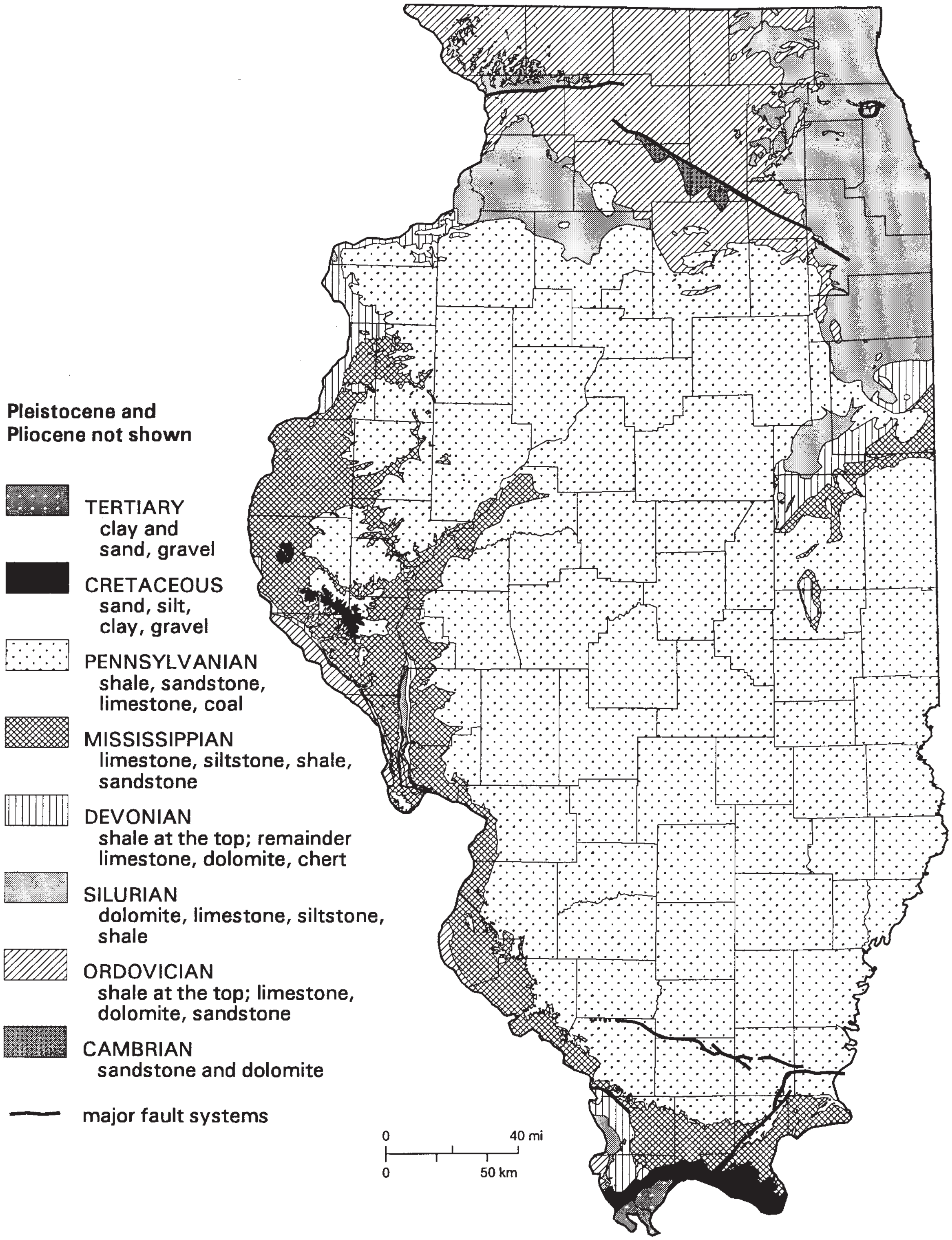


Figure 7 Bedrock geology beneath the surficial deposits in Illinois.

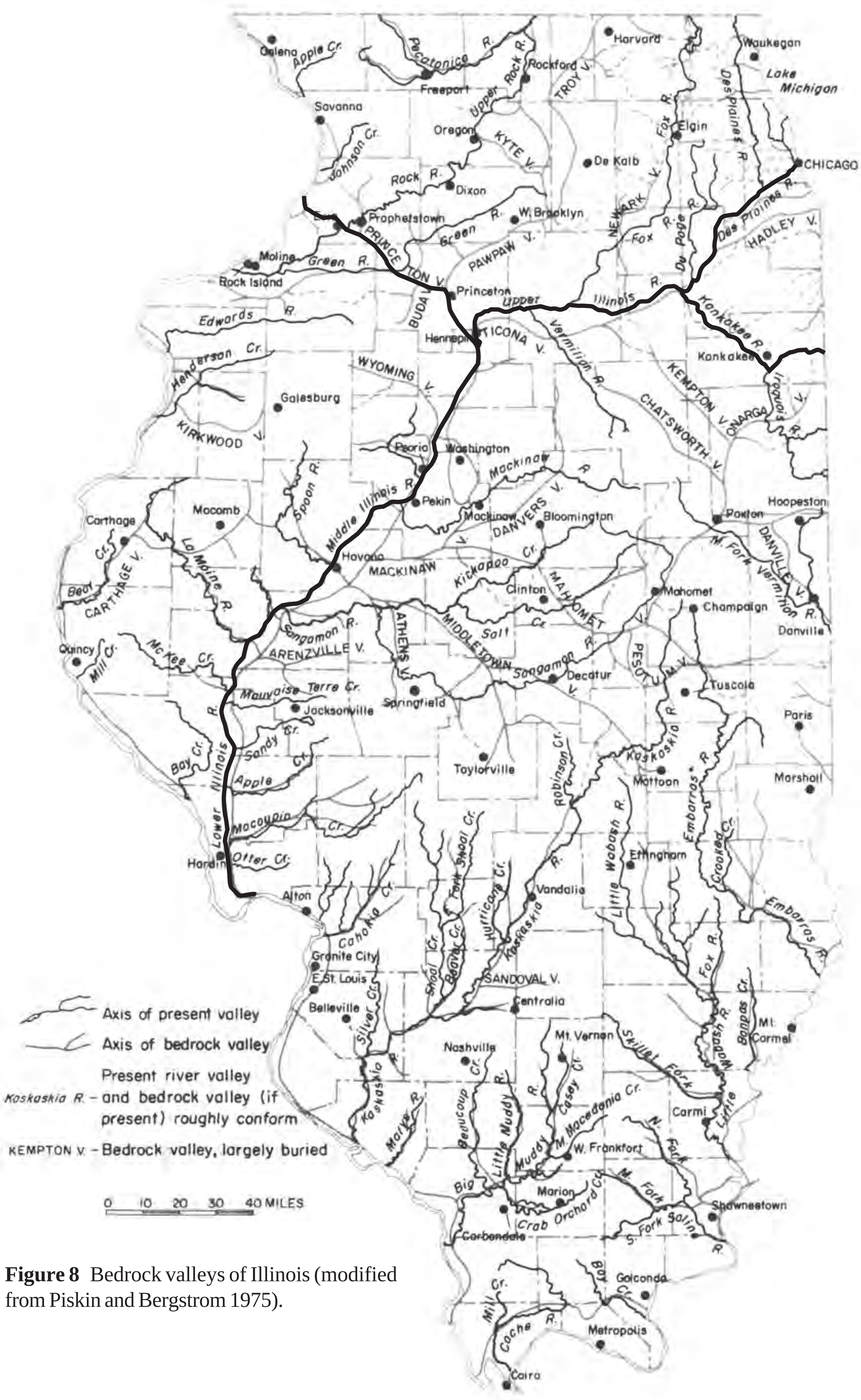


Figure 8 Bedrock valleys of Illinois (modified from Piskin and Bergstrom 1975).

The mud that produced the Maquoketa Shale was flushed into shallow areas from nearby low-lying land areas. These shales are the youngest Ordovician rocks and are about 180 feet thick. The Ordovician rocks in the field trip area are exposed along the Kankakee River and in the lowermost units within the Joliet Quarry.

Silurian Period The oldest rock exposed in the northern part of the field trip area is the Silurian dolomite of the Racine, Sugar Run, Joliet, Kankakee, Elwood, and Wilhelmi Formations (fig. 2). These rocks formed from sediments deposited in the embayment that encompassed present-day Illinois about 420 million years ago. Most of the Silurian strata are dolomite (calcium magnesium carbonate, $CaMg(CO_3)_2$) that was originally deposited as limestone ($CaCO_3$) in the shallow seas of the embayment that covered what is now Illinois and adjoining states. The limestone was later altered to dolomite. Except for a small amount of limestone and thin shale layers, the Silurian rocks consists of dolomite. In general these dolomites are crystalline, coarse grained, and porous; they weather into exceedingly rough, irregular forms. Hand specimens show small cavities, many of which are lined with dolomite or calcite crystals. When exposed, the dolomite weathers into a coarse yellow dolomite sand. The Silurian bedrock is crisscrossed with numerous joints and crevices. At nearly all places where these rocks are exposed, they are broken by cracks that cross the strata at all possible angles and trend in various directions.

During the Silurian, the nearby low-lying lands generally did not contribute much sediment to the seas covering the region from 443 to about 417 million years ago. Most of the sediment deposited during this period consisted of limestone formed primarily from the shells of living organisms, both animals and plants. Silurian dolomite in northeastern Illinois reaches a thickness of about 460 feet and is approximately 200 feet thick within the field trip area. A greater thickness of Silurian strata may have been present across the area, but subsequent erosion has removed it. Furthermore, still younger rocks may also have been present, but long periods of erosion may have removed them as well. The underlying Ordovician Maquoketa Shale was partially eroded before early Silurian sediments accumulated in shallow seas. The contact between the underlying Maquoketa Shale is marked by an erosional unconformity (fig. 2).

Pennsylvanian Period The oldest rocks exposed in the southern part of the field trip area are the lower Pennsylvanian rocks of the Carbondale Formation. This area is of historical economic importance. In the early 1900s, surface mining began in northern Illinois in the Colchester (No. 2) Coal Member, the lowermost member of the Pennsylvanian Carbondale Formation (fig. 2). (See Jacobson 2000.) In this vicinity, the Colchester Coal averaged about 3 feet thick, whereas in most other parts of Illinois it was 24 to 30 inches thick. The Colchester Coal is overlain by the Francis Creek Shale, which is about 35 feet thick in this area. The Pennsylvanian strata are unconformably overlain by the Wisconsin Episode glacial deposits of the Wedron Formation and Parkland Sand.

STRUCTURAL SETTING AND TECTONIC HISTORY

The field trip area is located on the northeast edge of the Illinois Basin along the southwestern flank of the regional, broad, and gently sloping Kankakee Arch (figs. 1 and 5). The Silurian Paleozoic bedrock strata in the field trip area have a slight dip to the east.

Wisconsin Arch

The Wisconsin Arch is a broad, positive area that separates the Michigan Basin on the east from the Forest City Basin on the west (figs. 1 and 5). The northern end of the Wisconsin Arch is termed the Wisconsin Dome, a region where Precambrian rocks outcrop in northern Wisconsin. The rest of the arch is overlapped by Cambrian, Ordovician, and Silurian sedimentary rocks.

The southeast end of the Wisconsin Arch connects with the Kankakee Arch, which separates the Michigan and Illinois Basins (Nelson 1995). The Illinois Basin is the major structural depression between the Ozark Dome to the west, the Cincinnati Arch to the east, and the Kankakee Arch to the north.

The Wisconsin Arch apparently began to emerge late in the St. Croixan Epoch (Cambrian) and was well established by the middle of the Ordovician Period. The Wisconsin Arch may have been covered by seas in the late Ordovician through middle Silurian time, but rose again in late Silurian or Devonian time (Nelson 1995).

Kankakee Arch

The Kankakee Arch, located in northeastern Illinois and north-central Indiana, is a broad, gently sloping arch that connects the Wisconsin Arch to the northwest with the Cincinnati Arch to the southeast (fig. 5). Joliet is situated on the Arch. This structural feature separates the present-day Michigan Basin on its northeast flank from the Illinois Basin on its southwest flank (fig. 5). The limits of the Kankakee Arch are not precisely defined because dips on its flanks are extremely gentle.

The Kankakee Arch first came into being late in the Canadian Epoch of the Ordovician Period. The Prairie du Chien Group is arched and truncated by erosion beneath the St. Peter Sandstone. The St. Peter thins across the arch and nearly pinches out. The overlying Platteville Group also thins. The Ordovician Kankakee Arch laid slightly northeast of the current arch. During the Silurian Period, the arch became the scene of reef development between the deeper seas to the north and south. By the Middle Devonian Epoch, the division between the Illinois and Michigan Basins became almost complete; *evaporites* were deposited in the latter. Not much is known about subsequent development because post-Devonian rocks have been eroded from the arch. Mississippian and Pennsylvanian sediments at least partially overlapped the Kankakee Arch, as shown by the presence of rocks of that age in the Des Plaines Disturbance, which lies on the north flank of the arch (Nelson 1995).

Rocks of the Silurian System (fig. 2) occur at or just below the surface over most of the field trip area. Because the Silurian strata have a slight dip eastward, successively older formations are exposed at the surface toward the west. Silurian rocks are rarely exposed at the surface east of the quarries near Joliet, Lockport, and Lemont, because they are overlain by Wisconsin Episode glacial deposits.

The following section on the tectonic history of the Joliet area was modified from Reinertsen and Smith (1990).

Sandwich Fault Zone

Southwestward from Joliet, Ordovician rocks of the Maquoketa Group are found near Channahon. Here the southeastern extension of the Sandwich Fault Zone parallels the crest of the Kankakee Arch. Some of the Sandwich faults can be seen at Channahon Mound where the Ordovician Fort Atkinson Limestone and every Silurian formation of northeastern Illinois can be recognized in the fault zone complex.

Because Mesozoic and most Cenozoic rocks are absent from the stratigraphic record of northern Illinois, the details of the tectonic history (the history of the Earth's crustal movements) of the region during the last 300 million years is only partially known and must be inferred from evidence in other places. A great deal is known, however, about the tectonic history of the Paleozoic Era.

A minor unconformity separates the Cambrian (Croixan) and Lower Ordovician (Canadian) rocks in northeastern Illinois (fig. 2). After the Lower Ordovician sediments were deposited, the tectonic (vertical or tilting) movements that disturbed major areas in the eastern part of the continent caused uplift, warping, and erosion here. As a result, the basal Middle Ordovician (Champlainian) St. Peter Sandstone was deposited over the truncated ends of the upwarped and eroded Lower Ordovician rocks. Just north of the Joliet area, the Lower Ordovician rocks are completely eroded away and the St. Peter Sandstone directly overlies Cambrian rocks. Willman (1971) notes that Lower Ordovician rocks are again present north of the Chicago area. He suggests that this "extra" erosion in the Joliet area may indicate an early movement along the Kankakee Arch (fig. 5). A widespread minor unconformity occurs at the base of the Upper Ordovician (Cincinnatian) rocks, but the surface of the unconformity is almost flat, only slightly truncating the Middle Ordovician strata. The end of Ordovician time, however, was marked by uplift and the erosion of valleys as much as 150 feet deep in the Upper Ordovician Maquoketa Shale Group. These valleys were filled with early Silurian sediments, but there is only slight evidence of unconformity in the sediments that occur between the valleys.

Silurian and Lower Devonian strata appear to be in conformable contact in northeastern Illinois, and deposition of these sediments seems also to have been continuous southward in the area of the Illinois Basin. However, as a result of tectonic movements in the Appalachian region that caused tilting, uplift, and erosion in parts of Illinois, Middle Devonian sediments were deposited across the truncated ends of Lower Devonian, Upper Silurian, and some of the Middle Silurian rocks north of central Illinois.

In areas where this pre-Middle Devonian erosion surface was especially deeply eroded, the Lower Devonian and Silurian rocks are completely absent, and Middle Devonian rocks rest directly on Upper Ordovician strata. Although Middle Devonian strata occur both north and south of the Chicago area, these rocks are not present in the Chicago/Joliet area. However, remnants of Upper Devonian black shale have been found in scattered pockets on top of the Silurian throughout the area, and rocks of Upper Devonian and Mississippian age rest directly on Silurian strata in fault blocks of the Des Plaines Disturbance. The absence of Middle Devonian strata in the Chicago-Joliet region can be explained by either of two hypotheses: (1) the Chicago area remained above sea level following the pre-Middle Devonian uplift and no Middle Devonian rocks were ever deposited, or (2) Middle Devonian rocks were deposited and then eroded away before or during Upper Devonian time. Available evidence does not allow us to eliminate either hypothesis. In either case, the observed relationships indicate uplift of the Kankakee Arch around Middle to Late Devonian time.

Although the unconformity between Middle and Upper Devonian strata is significant here in northeastern Illinois, in most of the state there was essentially continuous deposition from Devonian into Mississippian time. However, the contact between the Mississippian System and the overlying Pennsylvanian System is recognized as one of the major unconformities in the state. This sub-Pennsylvanian unconformity resulted from regional uplift and upward warping of the Kankakee Arch and other anticlinal structures in Illinois.

These movements continued into early Pennsylvanian time and caused deep erosion, during which older rocks were removed from wide areas in the northern part of the state. Later subsidence of the area of the present Illinois Basin resulted in on-lapping deposition of successively younger Pennsylvanian sediments across the upturned edges of the Mississippian, Devonian, Silurian, and part of the Ordovician rocks around the northern rim of the Illinois Basin (fig. 6). South of Joliet, Pennsylvanian rocks directly overlie Ordovician and Silurian strata, but elsewhere in the field trip area Pennsylvanian rocks generally have been eroded away. Although no major unconformities occur within the Pennsylvanian System in Illinois, the oldest Pennsylvanian rocks were deposited only in southern Illinois.

At the end of the Paleozoic Era, the Chicago-Joliet area was uplifted and warped during the major tectonic events that folded and faulted the formations in the Appalachian Mountains. The Kankakee Arch was again uplifted, and the Pennsylvanian strata, possibly exceeding 3,000 feet in total thickness, were eroded from most of this area. There is no evidence that any younger sediments accumulated during the long time interval between the deposition of the latest Pennsylvanian rocks and the deposition of the Pleistocene glacial drift. This "sub-Pleistocene unconformity," the bedrock surface in Illinois, truncates all the Tertiary, Cretaceous, and Paleozoic rocks down to the Upper Cambrian rocks exposed at the bedrock surface.

Because the Joliet area is close to the crest of the broad, gently warped Kankakee Arch, the bedrock appears to be nearly horizontal or to have only a slight eastward dip. The broad regional movements that formed the Kankakee Arch were also accompanied by minor local warps and faults. Faults with vertical displacements of a few feet to as much as 20 feet are fairly common across the region, but there is no evidence that these faults have been active for hundreds of thousands of years.

Major faults occur not only in the Des Plaines Disturbance, noted previously, but also in the Sandwich Fault Zone located in the northeastern part of the field trip area between Elwood and Joliet (see fig. 5 and the route maps). This major fault zone extends from near Oregon in Ogle County southeastward for a distance of about 80 miles to the vicinity of Manhattan, about 10 miles south-southeast of Joliet. We know that the faults that make up the Sandwich Fault Zone are younger than Silurian age because Silurian rocks are broken by them. Although Pennsylvanian strata have been completely eroded from the vicinity of the Sandwich Fault Zone, major folding and faulting west and south of the Chicago-Joliet area involved Pennsylvanian rocks. The Sandwich Fault Zone, therefore, is likely to be post-Pennsylvanian in age and related to the major tectonic disturbance at the end of the Paleozoic Era.

PREGLACIAL HISTORY OF NORTHEASTERN ILLINOIS

The topography of northeastern Illinois has had a long history of development. Since the last Paleozoic sea withdrew from the midcontinent at the end of the Pennsylvanian Period some 286 million years ago, or possibly as late as the end of the Permian Period nearly 245 million years ago, this region was uplifted and has remained a land area. During this long interval of erosion, many hundreds of feet of Paleozoic strata have been stripped away.

Prior to glaciation, an extensive system of *bedrock valleys* was deeply entrenched in the bedrock surface of the Illinois Basin (fig. 8). As glaciation began, streams probably changed from erosion to aggradation; that is, their channels began to build up and fill in because the streams did not have sufficient volumes of water to carry and move the increased volumes of sediment. To date, no evidence indicates that the early deposition of sediments filling in these preglacial valleys were ever completely flushed out of their channels by succeeding deglaciation meltwater torrents.

GLACIAL HISTORY OF ILLINOIS

Pleistocene Epoch

In the past 1.6 million to 2 million years, during the Pleistocene *Epoch* of the Quaternary Period (also known as the Ice Age), much of northern North America was repeatedly covered by huge

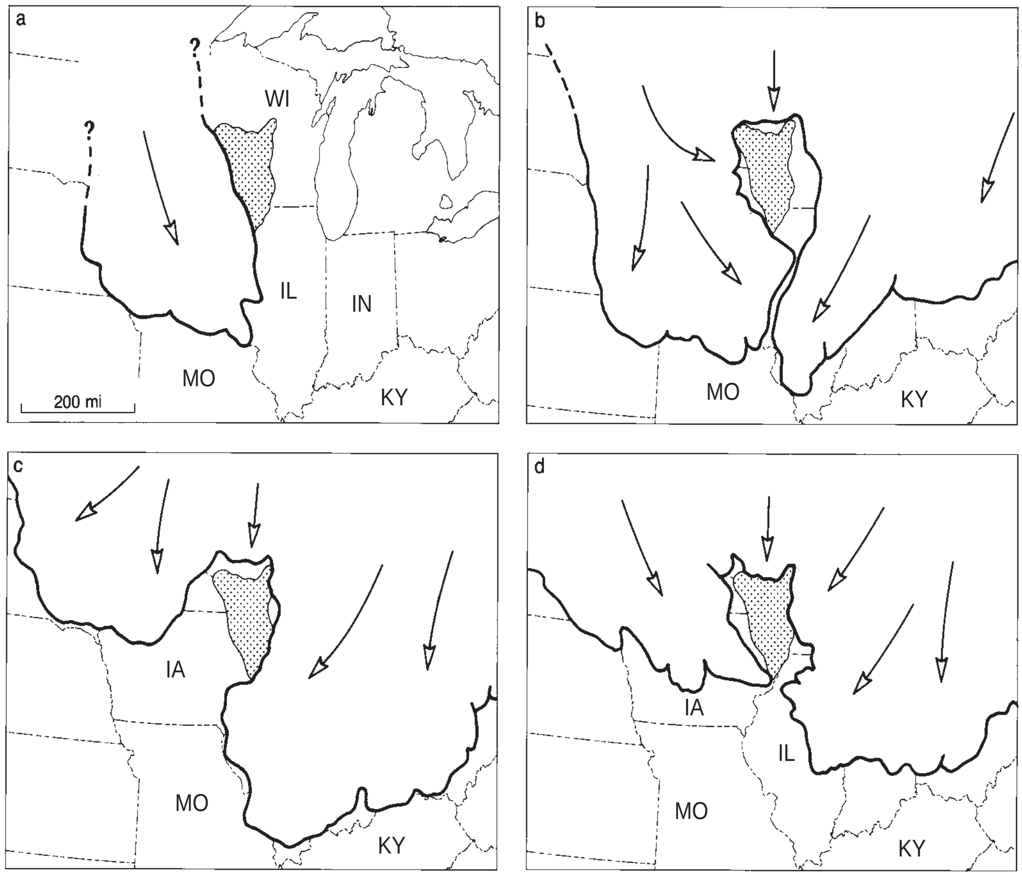


Figure 9 Maximum extent of (a) early pre-Illinois glacial episode (1,000,000 ± years ago); Driftless Area shown by stippled pattern; arrow indicates direction of ice movement; (b) late pre-Illinois glacial episode (600,000 ± years ago); (c) Illinois Glacial Episode (250,000 ± years ago); (d) late Wisconsin Glacial Episode (22,000 years ago).

glaciers (see fig. 9). These continent-size masses of ice formed in eastern and central Canada as a result of climate cooling. Their advances into the central lowland of the United States altered the landscape across much of the Midwest.

The present *topography* of Illinois is significantly different from the topography of the preglacial bedrock surface. The topography of the bedrock surface throughout much of Illinois is largely hidden from view by glacial deposits except along the major streams and in the driftless areas of northwestern and southern Illinois (fig. 10). In many areas, the glacial drift is thick enough to completely mask the underlying bedrock surface. Studies of mine shafts, water-well logs, and other drill-hole information in addition to scattered bedrock exposures in some stream valleys and road cuts show that the present land surface of the glaciated areas of Illinois does not reflect the underlying bedrock surface. The topography of the preglacial bedrock surface has been significantly modified by glacial erosion and is subdued by glacial deposits.

During an early part of the Pleistocene Epoch, glaciers advanced out of the centers of ice accumulation both east and west of the Hudson Bay area in Canada (fig. 9). These centers are referred to in this guidebook as northeastern and northwestern source areas because Illinois lies to the south of and between these centers of accumulation. Glaciers flowing out of these centers into

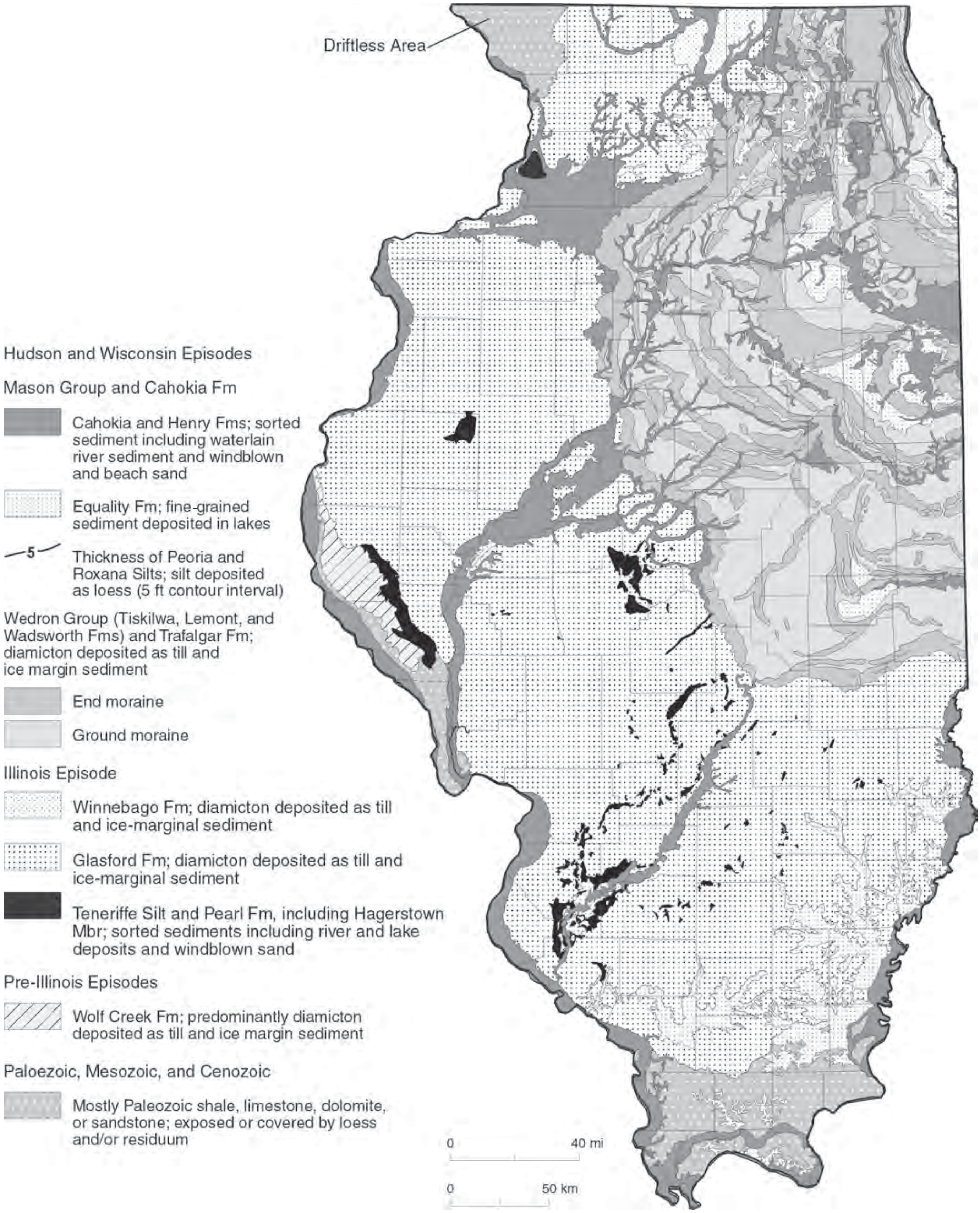


Figure 10 Generalized map of the glacial deposits in Illinois (modified from Willman and Frye 1970).

Illinois transported rock debris incorporated into the ice as they advanced; the material was dropped out (deposited) as the ice melted. The number and timing of these early episodes of glaciation in Illinois are uncertain at present and are therefore unnamed, but, because they precede the first named episode (the Illinois Episode; Hansel and Johnson 1996) of glaciation, they are called simply pre-Illinois glacial episodes (figs. 9a and b, 11, and 12). The pre-Illinois glacial episodes ended about 425,000 years ago.

A long interglacial episode, called the Yarmouth, followed the last of the pre-Illinois glacial advances (figs. 11 and 12). The Yarmouth interglacial episode is estimated to have lasted approximately 125,000 years, and deep soil formation took place during that long interval (Yarmouth Geosol). On the parts of the landscape that were generally poorly drained, fine silts and clays slowly accumulated (accreted) in shallow, wet depressions formed what are called *accretion-gleys*, which are characterized by dark gray to black, massive, and dense gleyed clays.

Approximately 300,000 years ago, the Illinois Episode of glaciation began. It lasted for about 175,000 years, and during this interval the ice advanced three times out of the northeastern center of accumulation (figs. 9c, 11, and 12). During the Illinois Episode, North American continental glaciers reached their southernmost position in the northern part of Johnson County (fig. 10). During the first of these advances, ice of this episode reached westward across Illinois and into Iowa, south of the Driftless Area (fig. 9c).

Another long interglacial episode, called the Sangamon (figs.11and 12), followed the Illinois Episode and lasted about 50,000 years. Although shorter than the Yarmouth, the length of this interglacial interval was sufficient for another major soil, the Sangamon Geosol, to develop. The Sangamon Geosol exhibits both well-drained and poorly drained soil profiles; although accretion-gleys are not as pronounced as they are in the Yarmouth Soil, their occurrence is common across the Sangamon landscape, and they are easily identified by the same characteristics as the Yarmouth accretion-gleys.

About 75,000 years ago, the Wisconsin Episode of glaciation began (figs. 9d, 11, and 12). Ice from the early and middle parts of this episode did not reach into Illinois. Although late Wisconsin ice did advance across northeastern Illinois beginning about 25,000 years ago, it did not reach southern or western Illinois (figs. 9d and 10). The maximum thickness of the later Wisconsin Episode glaciers was about 2,000 feet in the Lake Michigan Basin, but only about 700 feet over most of the Illinois land surface (Clark et al. 1988). The last of these glaciers melted from northeastern Illinois about 13,500 years B.P.

In general, the glacial deposits in the field trip area consist primarily of (1) *till* —pebbly clay, silt, and sand, deposited directly from melting glaciers; (2) *outwash*—mostly sand and gravel, deposited by the rapidly flowing meltwater rivers; (3) *lacustrine deposits—silt* and clay that settled out in quiet-water lakes and ponds; and (4) *loess* (pronounced "luss")—windblown sand and silt.

Wisconsin Episode moraines were deposited in Illinois from approximately 25,000 to 13,500 years ago (figs. 10 and 13). Although Illinois Episode glaciers probably built morainic ridges similar to those of the later Wisconsin Episode glaciers, the Illinois Episode moraines apparently were not as numerous and have been exposed to weathering and erosion for approximately 280,000 years longer than their younger Wisconsin Episode counterparts. For these reasons, Illinois Episode glacial features generally are not as conspicuous as the younger Wisconsin Episode features.

Outwash deposits of silt, sand, and gravel were dumped along the major river valleys. When these deposits dried out during the winters, strong prevailing winds from the west (the westerlies) winnowed

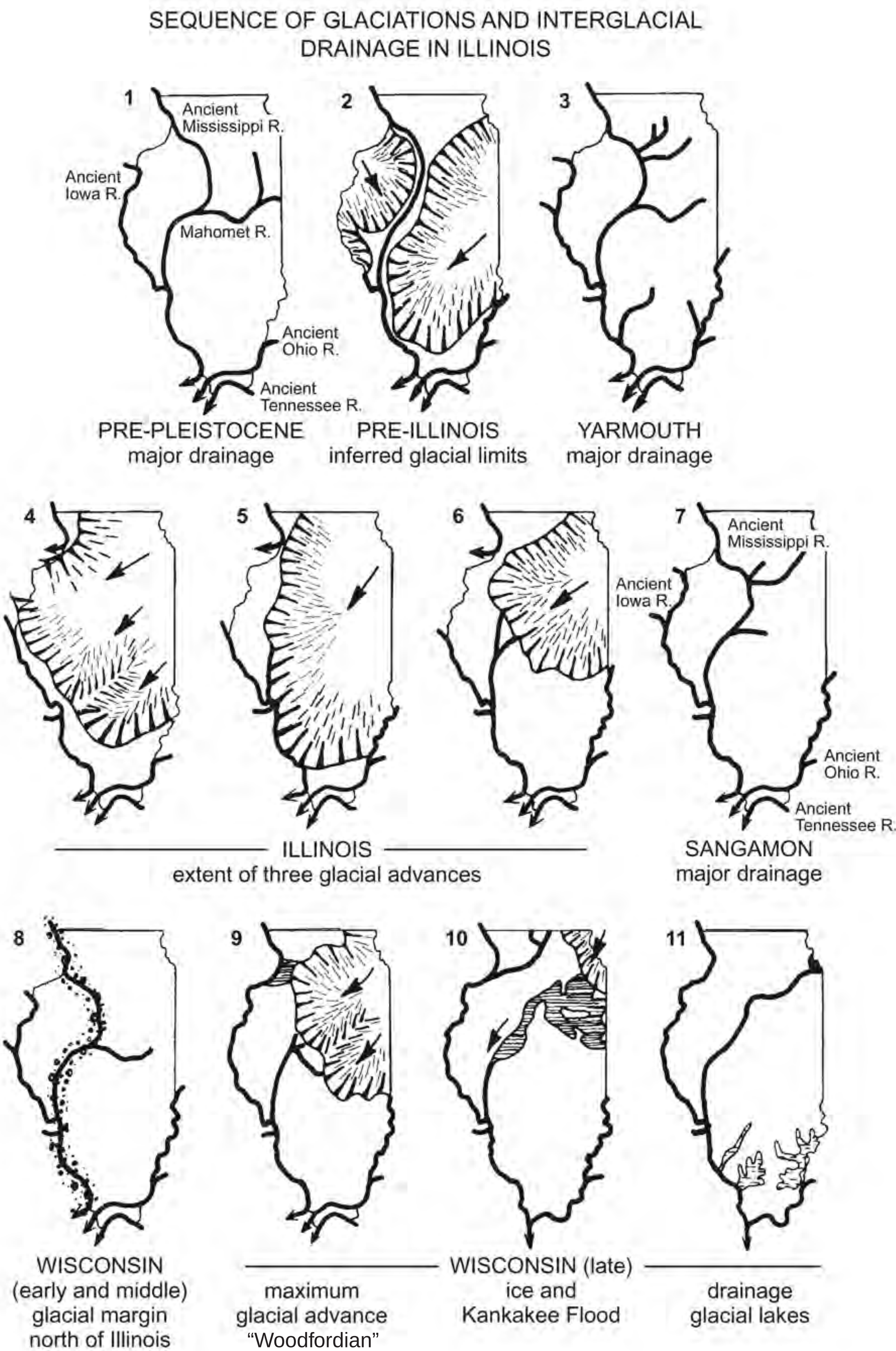


Figure 11 The sequence of glaciations and interglacial drainage in Illinois.

Years before present	Time-distance diagram Interglacial and glacial episodes	Sediment record	Dominant climate conditions Dominant land forming and soil forming events
HOLOCENE	interglacial episode	River, lake, wind, and slope deposits.	Warm; stable landscape conditions. Formation of modern soil; running water, lake, wind, and slope processes.
PLEISTOCENE EPOCH (not to scale) 10,000	WISCONSIN (late) glacial episode; glacial ice	Till and ice-marginal deposits; outwash and glacial lake deposits; loess. **6**	Cold; unstable landscape conditions. Glacial deposition, erosion, and landforming processes (e.g., formation of end moraines, outwash plains, valley trains, proglacial lakes, kettles), plus running water, lake, wind, and slope processes.
25,000	WISCONSIN (early and middle) glacial margin north of Illinois	Loess; river, lake, and slope deposits. **5**	Cool; stable. Weathering, soil formation (Farmdale Soil and minor soils); wind and running water processes.
75,000	SANGAMON interglacial episode	River, lake, wind, and slope deposits. **4**	Warm; stable. Weathering, soil formation (Sangamon Geosol); running water, lake, wind, and slope processes.
125,000	ILLINOIS glacial episode	Till and ice-marginal deposits; outwash and glacial lake deposits; loess. **3**	Cold; unstable. Glacial deposition, erosion, and landforming processes, plus proglacial running water, lake, wind, and slope processes; possible minor soil formation.
300,000	YARMOUTH interglacial episode	River, lake, wind, and slope deposits. **2**	Warm; stable. Long weathering interval with deep soil formation (Yarmouth Geosol); running water, lake, wind, and slope processes.
425,000 – 1,600,000 and older	? PRE-ILLINOIS glacial and ? interglacial episodes	Till and ice-marginal deposits; outwash and glacial lake deposits; loess plus nonglacial river, lake, wind, and slope deposits. **1**	Alternating stable and unstable intervals of uncertain duration. Glacial deposition, erosion, and landforming processes, plus proglacial and interglacial running water, lake, wind, and slope processes; interglacial weathering and soil formation.

Figure 12 Timetable illustrating the glacial and interglacial events, sediment record, and dominant climate conditions of the Ice Age in Illinois (modified from Killey 1998).

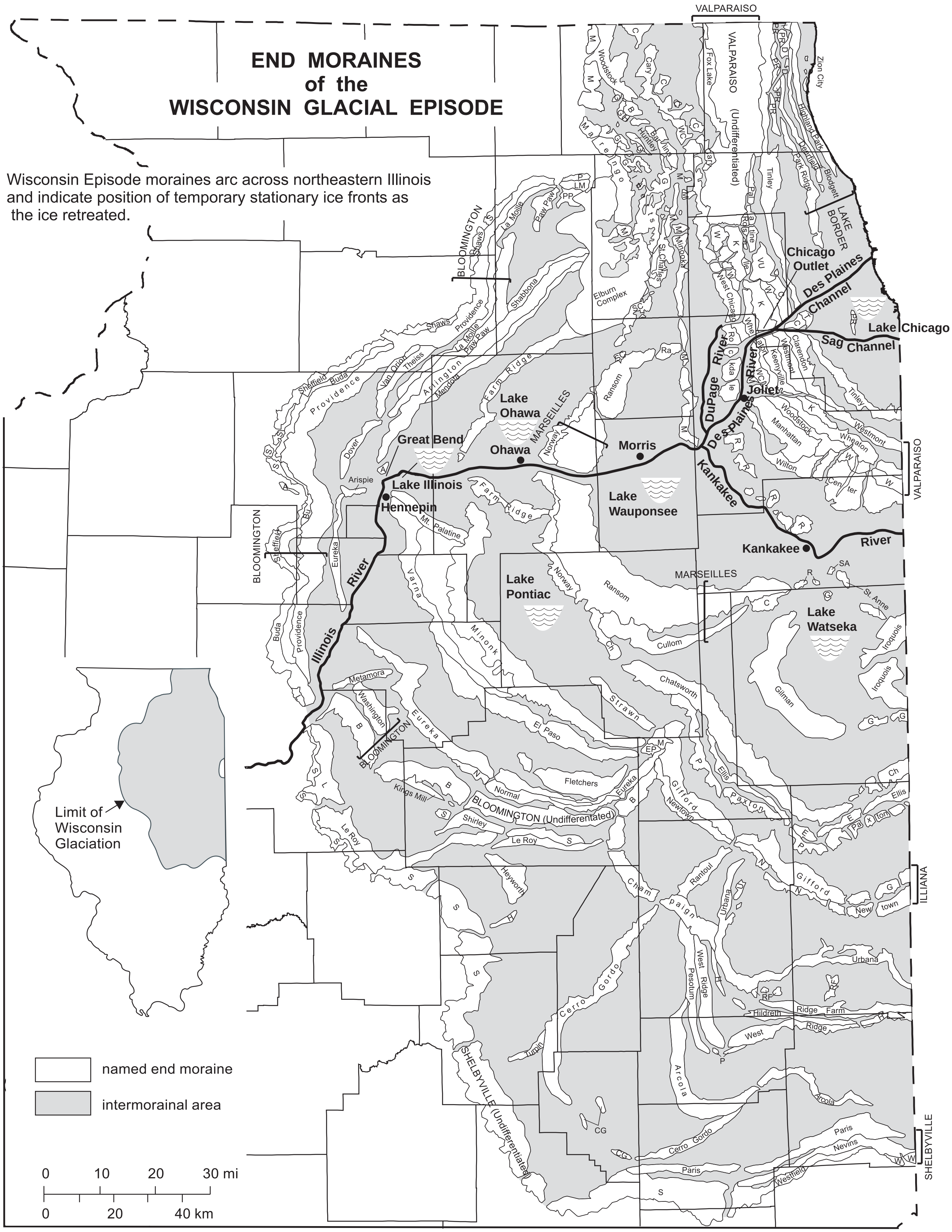


Figure 13 Areal distribution of Wisconsin Glacial Episode moraines of the Wedron Group (modified from Hansel and Johnson 1996).

out the finer materials, such as fine sand and silt, and carried them eastward across the terrain. These loess deposits were laid down by the wind during all of the glacial episodes, from the earliest pre-Illinois glacial episode (approximately 1.6 million years ago) to the last glacial episode, the Wisconsin Episode (approximately 25,000 to 13,500 years ago).

The loess blankets the landscape and composes the parent materials for our modern Holocene soils. Fresh exposures of loess are generally yellowish brown. The loess in the field trip area is typically less than 2 feet thick, but erosion has completely removed the loess in scattered areas. In general, the thickness of the loess decreases to the east. The loess, which covers most of Illinois, is up to 15 feet thick along the Illinois River valley and is more than 50 feet thick, in some localities, along the east edge of the Mississippi River valley.

GEOMORPHOLOGY

Physiography is a general term used for describing landforms; a physiographic province is a region in which the relief or landforms differ markedly from those in adjacent regions. The field trip area is located in the Kankakee Plain of the Till Plains Section of the Central Lowland Physiographic Province (fig.14). The present landforms are a result of the last major glaciation during the Wisconsin Episode and subsequent processes of weathering, erosion, transportation (by wind and water), and deposition.

Kankakee Plain

The Kankakee Plain, according to Leighton et al. (1948), is characterized by a level to gently undulatory plain, with low morainic islands, glacial terraces, torrent bars, and dunes. It is partially fluviolacustrine in origin, but it differs from the lake plains of the Great Lake Section in that the lakes that covered it were temporary expansions of glacial floods and did not extensively alter its surface either by deposition or by erosion, except along the courses of strong currents. It could be considered a modified intermorainic basin, floored largely with ground moraine and bedrock.

The Kankakee Plain district is enclosed by the Iroquois Moraine to the southeast, the Marseilles Morainic System to the west and southwest, and the Manhattan Moraine and the Valparaiso Morainic System on the north. The Kankakee Plain is fairly level, with gently rolling uplands, and contains large quantities of glacial outwash. Local relief is typically less than 100 feet.

Most of the region is poorly drained by shallow low-gradient streams that follow glacially constructed depressions. The Kankakee and the Des Plaines Rivers occupy glacial sluiceways, which, near Kankakee and Joliet, are entrenched in Silurian dolomites. The drift is thick to thin and scarcely conceals the bedrock surface along the Kankakee and Des Plaines River valleys.

NATURAL DIVISIONS AND GEOLOGY

Glacial history has played an important role in shaping Illinois topography by eroding the preglacial landscape and depositing glacial sediments. Topography influences the diversity of plants and animals (biota) of Illinois by strongly influencing the diversity of habitats. Geological processes form, shape, and create the topography on all of the Earth’s surface. Specifically, geology not only determines the composition of the parent material of soils, but geological processes also form soils through the weathering of parent materials. Thus, the geology of a region is the foundation of its habitats.

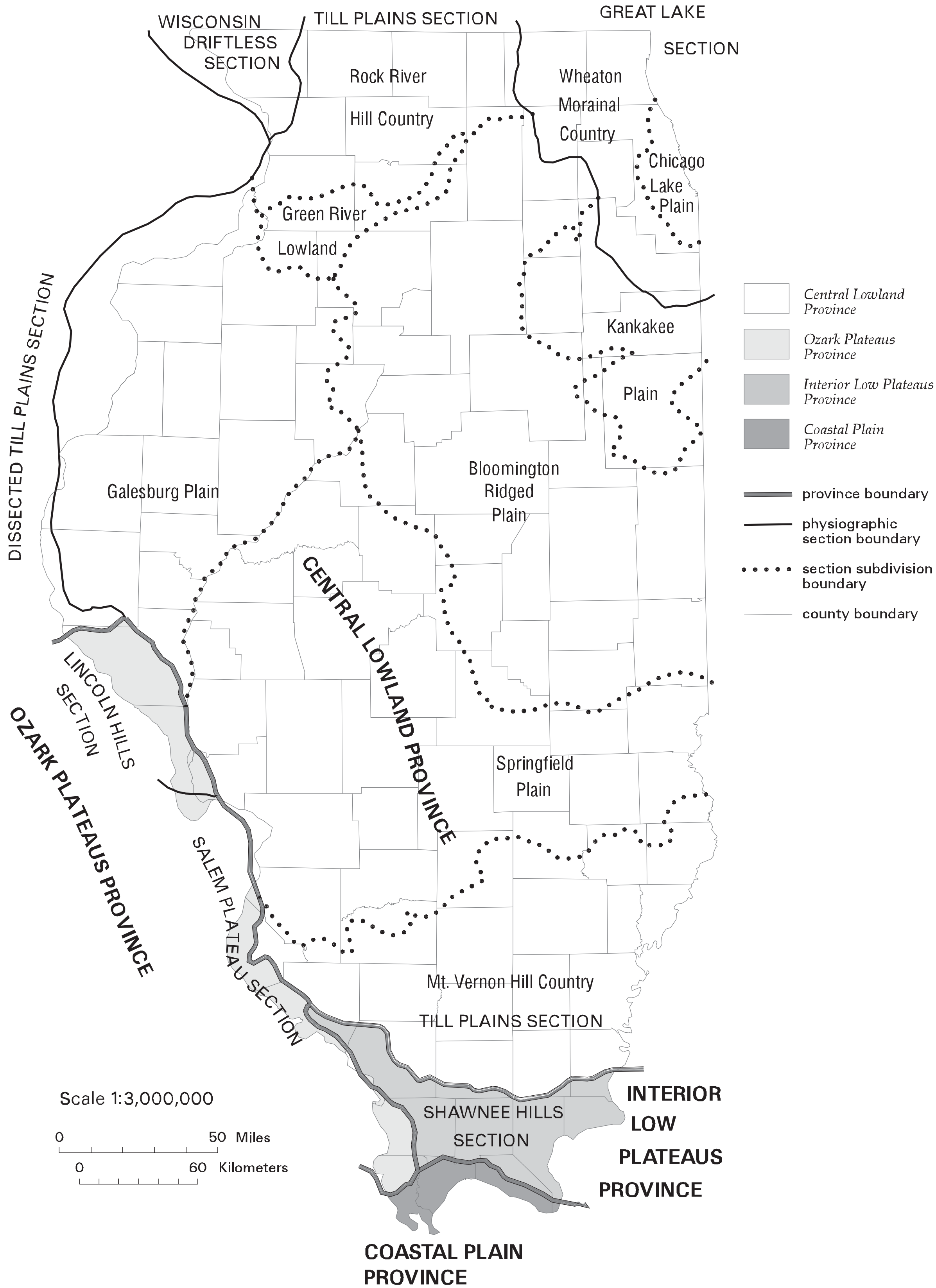


Figure 14 Physiographic divisions of Illinois (modified from Leighton et al. 1948).

Natural Divisions

The state has been divided into 14 different Natural Divisions. These divisions are distinguished according to differences in significant aspects of topography, glacial history, bedrock geology, soils, aquatic habitats, and distribution of plants and animals (flora and fauna). A strong relationship exists between the Physiographic Divisions of Illinois and the Natural Divisions of Illinois because the geologic factors used to determine the Physiographic Divisions were important elements used to define the boundaries of the Natural Divisions. The field trip area is located within the Northeastern Morainal Division. The following descriptions of the Natural Divisions are modified from Schwegman (1973).

Northeastern Morainal Division

The Northeastern Morainal Division is the region of most recent glaciation in Illinois. Glacial landforms are common features and are responsible for the rough topography over most of the area. Lakebed deposits and beach sands are also frequent features. Unlike most of Illinois, the soils of this division are mainly derived from glacial drift rather than loess. Drainage is poorly developed, and many natural lakes are found. This division contains distinctive northern and eastern floral elements including the bog community. Several species of animals are known in Illinois only from this area. The Sections are recognized because of differences in topography, soil, glacial history, flora, and fauna.

- ***Bedrock*** The bedrock is primarily Ordovician and Silurian limestone and dolomite with some shale. The bedrock is thin to deeply buried by glacial drift, but limestone crops out along some of the streams.

- ***Glacial History*** The Northeastern Morainal Division is covered with glacial drift from the Wisconsin Glacial Episode. Moraines, kames, eskers, and other glacial landforms occur throughout the division.

- ***Topography*** Moraines and morainic systems are dominant topographic features and account for the rough, hilly, and rolling terrain of most of the division. There are outwash plains at the fronts of major terminal moraines, such as the Marengo Ridge. The Chicago lake plain and ancient beach ridges are prominent features of the Chicago area and were formed along Lake Michigan north of Chicago during high water stages of glacial Lake Chicago. Sand dunes are present along Lake Michigan north of Waukegan and east of the Sugar River in Winnebago County. The Lake Michigan dunes are well developed and are associated with the beach area. This division is the only one to have a natural beach and dunes association. Ridges and swales occur in the sand area north of Waukegan and in the Chicago lake plain.

- ***Soils*** The soils are derived primarily from glacial drift, lakebed sediments, beach deposits, and peat. They range from very poorly drained to well drained on the uplands. They are diverse in texture, ranging from gravel and sand to silty clay loams. The many different soils are responsible for the diversity of plant communities found in this division.

NATURAL RESOURCES

Mineral Production

The total value of all minerals extracted, processed, and manufactured in Illinois during 1998 was $1,950,000,000 (Ipe 2000). Minerals extracted accounted for 86.4% of this total. Coal continued to be the leading commodity, followed by construction stone (limestone and dolomite), sand and gravel, and oil. The 2001 Illinois production data for stone, sand, and gravel was $546,000,000. Illinois ranked 5th among coal producing states, 13th among the 31 oil-producing states, and 16th among the 50 states in total production of nonfuel minerals but continues to lead all other states in production of industrial sand and tripoli. Current production in Will, Grundy, and Kankakee Counties is limited to stone, sand, and gravel.

Groundwater

Few of us are likely to think of groundwater as a mineral resource when we consider the natural resource potential of an area. Yet the availability of groundwater is essential for orderly economic and community development. More than 35% of the state's 11.5 million citizens and 97% of those who live in rural areas depend on groundwater for their water supply.

The source of groundwater in Illinois is precipitation that infiltrates the soil and percolates into the groundwater system lying below the water table in the zone of saturation. Groundwater is stored in and transmitted through saturated earth materials called aquifers. An *aquifer* is any body of saturated earth materials that yields sufficient water to serve as a water supply for some use. Pores and other void spaces in the earth materials of an aquifer must be permeable; that is, they must be large enough and interconnected so that water can overcome confining friction and move readily toward a point of discharge such as a well, spring, or seep. Generally, the water-yielding capacity of an aquifer can be evaluated only by constructing wells into it. The wells are then pumped to determine the quantity and quality of groundwater available for use.

Northeastern Illinois is underlain by four major aquifer systems that are separated from one another on the basis of hydrogeologic properties and source of recharge. The aquifer systems are (1) the glacial drift, (2) the shallow bedrock, (3) the deep Cambrian-Ordovician bedrock, and (4) the deep Cambrian bedrock (Reinertsen and Smith 1990).

The glacial drift aquifer system, known as the Prairie Aquigroup, consists only of the unconsolidated materials that overlie bedrock. The system is recharged by local precipitation and thus is susceptible to surface contamination. A spring in Pilcher Park, Joliet (NE NE NW SE Sec. 7, T35N, R11E, 3rd P.M; Joliet 7.5-minute Quadrangle), furnishes natural spring water for area residents. Permeable sand and gravel deposits occur locally in the Des Plaines, Kankakee, and Illinois River valleys. Electrical earth resistivity surveys (a geophysical method for characterizing buried sand and gravel deposits) can be useful in locating groundwater supplies in these valleys.

The shallow bedrock aquifer system consists generally of those bedrock formations that directly underlie the glacial drift. These formations consist mostly of Silurian dolomites that are relatively nonporous. They contain water only in open joints and cracks and also are recharged by local precipitation. The only filtering of the recharge water is by the overlying glacial deposits. Where recharge is directly into the rock units, there is little if any filtering of harmful materials. Silurian and Ordovician dolomite units are creviced and water-bearing. Most domestic water wells in the area get their water from these formations at depths of less than 250 feet. Wells into these creviced formations are susceptible to bacterial pollution, particularly where the formation is overlain by less than 35 feet of overburden (soil and/or unconsolidated materials above the formation). Open crevices provide little filtering action, and polluted water may travel long distances through these openings with little loss of pollutants.

The two deep bedrock aquifer systems are made up mostly of relatively porous sandstones. They receive most of their recharge from regions where they are exposed or where they directly underlie the glacial drift miles to the west and north of the study area. Between the regions where the upper bedrock aquifer system outcrops and the field trip area, the upper bedrock aquifer system also receives some recharge water from the overlying shallow aquifer system through open joints and cracks that connect them. The water in the two deep bedrock systems has been in contact with the rocks that make up the aquifer for a relatively long time. Consequently, the water in the deep bedrock aquifer systems has had plenty of time to dissolve some of the minerals in the rocks and generally has a fairly high content of dissolved solids.

Future of Mineral Industries in Illinois

For many years, the mineral resources of the midcontinent have been instrumental in development of our nation's economy. The mineral resource extraction and processing industries continue to play a prime role in the state's economy and in the lives of Illinois citizens.

The prime mission of the ISGS is to map the geology and mineral resources of the state, conduct field mapping, collect basic geologic data in the field and in the laboratory, and interpret and compile these data on maps and in reports for use by industry, the general public, and the scientific community. Over the years, maps of the geology of the state have been published at various scales. Recently, more detailed maps and reports covering particular regions have been completed. To meet growing demands for detailed geologic information to guide economic development and environmental decision-making, the ISGS is conducting a program to geologically map all 1,071 of the 7.5-minute quadrangles of Illinois.

CANAL HISTORY

Although we will not be visiting the Illinois and Michigan (I&M) Canal on this field trip, a history of this canal is included because of its importance in the development of the early quarrying history and the manufacturing industrialization and the growth of the communities within this area. A visit to the I&M Canal Visitor Center at the Gaylord Building in Lockport and the Channahon State Park in Channahon, both located along the canal, are well worth the time.

The following two sections were modified from Mikulic et al. (1985), Smith et al. (1986), and Reinertsen and Smith (1990).

Illinois and Michigan Canal

The feasibility of digging a canal to connect Lake Michigan and the Illinois River via the Chicago and Des Plaines Rivers was recognized early during the settlement of Illinois. As early as 1673, Fathers Joliet and Marquette had noted the possibility of digging a canal link.

In 1829, Congress authorized the State of Illinois to build a canal to join Lake Michigan and the Illinois River at an estimated cost of $4 million. Work began in 1836, but the 1837 business panic affected the project, and construction was stopped in 1839. Work resumed later, but in 1843, after almost $5,000,000 had been spent, the original lake-level canal program was abandoned in favor of a cheaper, shallow-cut canal with locks. When the canal was finally completed in 1848, it extended 95 miles from La Salle to a point in Chicago that is now near Ashland Avenue, just north of Interstate 55.

Illinois mineral producers were among the prominent users of the canal. Coal could be shipped easily to eastern markets, and building stone, sand, and gravel were shipped from place to place along the canal. Lumber, salt, agricultural implements, and steel tracks for railroads were imported into Illinois via the canal.

The I&M Canal was instrumental in turning Chicago into a major transportation hub by linking the central part of the state to the industrialized east via the Great Lakes and the Erie Canal. After the railroads had been constructed, however, their competition led to a sharp slump in the use of the canal. Additional competition from the larger Chicago Sanitary and Ship Canal in the 1890s finally put the I&M Canal out of business, and it rapidly deteriorated into discontinuous fetid sloughs that became local trash heaps.

The I&M Canal National Heritage Corridor was nominated by the National Park Service (NPS) as a historic landmark in 1963. In the early 1970s, the State of Illinois designated canal lands between Joliet and La Salle as the Illinois-Michigan Canal State Trail and began to make substantial improvements along that portion. The corridor was first seriously studied by the NPS in 1979 along with an Open Lands Project inventory. In 1980, after a series of articles in the *Chicago Tribune*, the Illinois congressional delegation sponsored a bill to make the canal a national park. This bill was followed by the completion of the NPS feasibility study. Open Lands Project sponsored a number of town meetings throughout the area encouraging Illinois Valley industry to become involved. With so many segments of the population involved, new federal legislation was introduced into Congress in 1982. The 98th Congress passed the Illinois and Michigan Canal National Heritage Corridor Act of 1984 in August. In 1985, under that legislation, the NPS was provided with funds to produce a geological inventory of the corridor and contracted with the Illinois State Geological Survey to do so. A report was submitted to the NPS in the fall of 1986 (see Smith et al. 1986).

The I&M Canal National Heritage Corridor is a new kind of national park. It directs attention to geology, archeology, prehistory, history of settlement, and history of industrial development, as well as economic revitalization. The I&M Canal Corridor thus represents a zone of special federal interest for fostering restoration and for recreation through open land preservation. For the first time, however, the Department of the Interior also included economic development as one of the important reasons for park designation. In addition, the corridor represents a trend toward bringing national parks to the people, especially where national, cultural, and recreational resources are in the midst of urbanized regions.

QUARRY HISTORY OF THE LOWER DES PLAINES VALLEY

Stone, one of Earth's most abundant and useful building resources, has been used by man from earliest history to the present. Because of the durability and availability of this naturally occurring material, early civilizations made wide use of it in constructing temples, walls, and pyramids.

Like the ancient cultures before us, the "New World" used natural stone for its foundations. Limestone and dolomite were of special importance, providing building stone and lime used in mortar and later in cement. Most permanent structures were made of stone, usually quarried rock. If quarried rock was unavailable locally, fieldstone of glacial cobbles and boulders was used instead.

Quarried stone was labor intensive and costly, which prohibited all but the wealthiest individuals and businesses from constructing buildings made entirely from cut stone. If a landowner was fortunate enough to have outcrops of quality stone on his property, he could quarry the stone and build at low cost; thus, buildings of all types were constructed of stone.

Stone construction proved to be both practical and aesthetic. Strong stone foundations added stability to wood structures. The durability and insulating properties of stone had many practical benefits. Because they were attractive, stone buildings were welcomed as an alternative to wood or brick structures.

Some of the earliest recorded uses of building stone in Illinois were the 1753 reconstruction of Fort de Chartres from material from bluffs 3 miles to the east of it and the foundation of the Pierre Menard House in 1802, both in Randolph County of southwestern Illinois. As settlement continued through the early 1800s, additional stone deposits were discovered, and, as the transportation network improved, so did the demand for cut stone. This increased demand provided enough work to support specialized stone cutters and produce a rapidly expanding building stone trade.

The stone trade was especially successful in northeastern Illinois as there was both a high demand for stone products and a readily available source from the rock of Silurian age that underlies the region. Quarries were opened in Chicago in the 1830s. The stone made excellent lime but was not suitable for veneer or solid block. Use was mainly for rough foundation stone.

Extensive high-quality dolomite that was able to be quarried and that was well bedded, smooth textured, and of variable bed thickness occurs in the Silurian bedrock along the Des Plaines River valley west of Chicago. This stone was used only locally during the 1830s and 1840s. However, the opening of the I&M Canal in 1848 provided a major boost to the use of Silurian rocks from existing quarries in the Des Plaines Valley. The stone could be easily and cheaply transported directly to the center of Chicago. The building of the canal also resulted in the discovery of additional quarry sites near the small community of Athens, now known as Lemont. The stone here was first discovered in 1846 during canal construction but was considered useful only for foundation use.

Throughout much of the Des Plaines Valley between Lemont and Joliet, the canal is excavated in Silurian bedrock. During canal construction, several contractors realized the economic potential of these sites, located at the very edge of a cheap transportation system. Beginning in 1851, several quarry operations began in the Athens (Lemont) area. In 1852, rock from this area was first used successfully as cut stone facing in Chicago. The success of this new product induced the rapid opening of several businesses in Chicago to sell the “Athens Marble” exclusively. In 1869 and 1870, some 30 to 40 “marble” front buildings were constructed on State Street in Chicago; the famous Water Tower on Michigan Avenue also was constructed from Athens Marble. The stone for the Water Tower was from the National Quarry, now the Joliet Quarry (Stop 3).

Most of the quarries that opened to supply the “marble” yards of Chicago were small and short-lived mainly due to poor quality stone and economic conditions. Although several quarries survived and the number of new ones steadily grew until the 1870s, by the end of the century, mergers and purchases had reduced the number considerably. Many remaining firms became quite large; the giant Western Stone Company formed in 1889. More than 50 quarries are known to have existed in the Des Plaines Valley between Sag Bridge and Joliet. Many others probably were present, but all traces have been obliterated through urban expansion, especially near Joliet.

In the Athens (Lemont) and Joliet quarries, three main stone products were produced: (1) dimension stone, (2) flagstone, and (3) riprap and crushed stone. Dimension stone was used for rock-faced block or foundation stone, veneer, cornices, pillars, columns, and vault covers. Flagstone was a naturally splitting, uncut building stone made from fairly thin beds. Riprap and crushed stone were used for fill, concrete, road surface material, and railroad ballast. The stone from this area was less well suited for lime than was rock from Chicago. Stone quality varied between different quarries and between different beds within a quarry, depending upon which formation was present. In the Joliet-Lemont (Athens) area, most of the high-quality building stone was quarried from the Silurian Sugar Run Formation.

By the late 1880s, “Athens Marble” had been in use for nearly 40 years and was beginning to show signs of age. Critics began to publicize the stone’s shortcomings, and builders looked elsewhere for dimension stone, which created an influx of other types of stone for the building industry. Adding to the problems of the quarry operator were the adverse economic conditions, high labor costs, and the move toward unionization of the 1890s. However, the geology of the Silurian rocks was also a significant reason for the decline of the building stone industry in Illinois. The Illinois stone occurs in layers seldom more than one foot thick and may be interbedded with poor quality layers, thereby becoming more labor intensive to quarry. In the long run, Illinois stone was unable to compete with the thicker bedded, purer stone from Indiana.

The “Athens Marble” that was used for many fine structures in Chicago and elsewhere during the mid- to late-1880s simply went out of use around the turn of the century as a building stone. It became obsolete due to changing styles and beliefs, the availability of a better-quality stone, and the availability of new building materials. Fortunately, a number of gracious survivors from the heyday of Joliet limestone and “Athens Marble” remain as vivid reminders of the stone’s widest use as a building material. In recent decades, limestone and dolomite have been almost completely replaced as a building material by a cheaper, more convenient product—concrete.

The “Athens Marble,” now called Lemont stone, was briefly revived from 1938 to 1940 for use in the State Archives in Springfield and the Natural Resources Building headquarters of the Illinois State Geological Survey in Urbana. The stone was cut for interior use but failed to “catch” in Chicago and other areas.

GUIDE TO THE ROUTE

We will start the field trip at the headquarters of the Midewin National Tallgrass Prairie (SW, SW, NW, Sec.18, T33N, R10E, 3rd P.M., Wilmington 7.5-minute Quadrangle, Will County). Mileage will start at the main entrance to the headquarters off Illinois Route 53. 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 of 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.

Seven USGS 7.5-Minute Quadrangle maps (Elwood, Essex, Channahon, Gardner, Joliet, Symerton, and Wilmington) provide coverage for this field trip area.

START: Headquarters, Midewin National Tallgrass Prairie We will start at the parking lot of the headquarters of the Midewin National Tallgrass Prairie (SW, SW, NW, Sec.18, T33N, R10E, 3rd P.M., Wilmington 7.5-minute Quadrangle, Will County).

Miles to next point	Miles from start	
0.0	0.0	At the main entrance to the headquarters off Illinois Route 53, set your odometer to 0.0. Turn right onto Illinois Route 53. Note: Illinois Route 53 follows along what is marked as part of the Historic U.S. Route 66. Do you remember the old slogan? "Get Your Kicks on Route 66."
0.2	0.2	The water tower on the right is located on top of the Rockdale Moraine.
0.5	0.7	Cross Prairie Creek.
0.4	1.1	Elevated ground on the right is part of the Rockdale Moraine.
0.2	1.3	Merge into the left lane and prepare to turn left.
0.3	1.6	T-intersection from the left. TURN LEFT. CAUTION: Divided highway.
0.05	1.65	CAUTION: Cross single-track railroad (signal lights and guard gates).
0.05	1.7	Crest of outer portion of Rockdale Moraine. Prairie can be seen on the left and right.
0.5	2.2	Parking lot on the left for Newton and Henslow interim hiking trails and gate straight ahead. Pass through gate. CONTINUE AHEAD and immediately cross the north-south road immediately west of the gate.
0.3	2.5	Road curves 90° to the left.
0.3	2.8	T-intersection. TURN RIGHT. After turning to the right, you will cross eight unimproved roads and abandoned railroads that run in front of the abandoned ammunition storage bunkers.
0.3	3.1	Small wetland on the right.
0.5	3.6	T-intersection from the right, located west of the last row of bunkers. TURN RIGHT. Abandoned ammunition bunker 811-10 is located at the northeast corner of this intersection.

STOP 1: Prairie Creek, Midewin National Tallgrass Prairie (NW, NE, NW, Sec.11, T33N, R9E, 3rd P.M., Wilmington 7.5-minute Quadrangle, Will County). On the day of the field trip, we will park along the road.

0.0	3.6	Leave Stop 1. CONTINUE AHEAD following road in front of the last row of bunkers.
0.1	3.7	A slump has occurred in the earthen material covering bunker 811-8 on the right. A number of the bunkers in this area have developed similar slump features.
0.2	3.9	Spoil piles from abandoned sand and gravel pits on the left.
0.2	4.1	Cross a small drainage ditch.
0.2	4.3	T-intersection from the right, just past bunker 811-1. CONTINUE AHEAD.
0.2	4.5	SLOW DOWN and cross cattle guard grate in the road, and immediately cross Grant Creek. Note the open air ammunition bunker on the right. I believe these bunkers were used as temporary bunkers while the TNT was curing.
0.05	4.55	Crossroad intersection. CONTINUE AHEAD to the Y-intersection and TURN AROUND to retrace the route back to the T-intersection.
0.1	4.65	T-intersection. Park along the road, and walk approximately 500 yards to the east along the road to Stop 2.

STOP 2: Grant Creek, Midewin National Tallgrass Prairie (NW, NE, NE, Sec. 2, T33N, R9E, 3rd P.M., Wilmington 7.5-minute Quadrangle, Will County). On the day of the field trip, we will park along the road.

0.0	4.65	Leave Stop 2. CONTINUE AHEAD. Retrace route back to Stop 1.
0.75	5.4	T-intersection. TURN RIGHT.
0.1	5.5	View of meander in Prairie Creek and spoil piles from abandoned sand and gravel pits, on the left. As the road descends you enter into a topographically low area that was scoured by glacial outwash from the Kankakee Torrent.
0.2	5.7	T-intersection. TURN LEFT.
0.2	5.9	Spoil piles from abandoned sand and gravel pits on the left. These sands and gravels belong to the Mackinaw facies of the Henry Formation.

0.2	6.1	Monitoring well on the left. There are numerous monitoring wells located along the perimeter of the old Joliet Army Ammunition Plant.
0.2	6.3	Cross Prairie Creek. The base of the creek flows along dolomite bedrock from the bridge to its confluence with the Kankakee River. The base load contains a number of glacial erratics.
0.4	6.7	Exit through the south gate. The main road curves 90° to the left. A land survey monument is located immediately northwest of the gate. After passing through the gate, CONTINUE AHEAD. A hedge row has been cleared exposing the black, organic rich sandy soil on the left. A number of large igneous glacial erratics occur in the fields and along the roadway.
0.5	7.2	Cultivated native prairie plant seed production beds are located on the right. More than 70 prairie plant species have been planted. Seeds from these plants are being used in the prairie restoration projects.
0.2	7.4	Exit through south gate. Intersection of North River Road immediately south of the gate. TURN LEFT onto North River Road. CAUTION: Fast-moving traffic.
1.6	9.0	T-intersection from the right (Kankakee Street). CONTINUE AHEAD.
0.4	9.4	CAUTION: Cross single-track railroad (signal lights and guard gates).
0.4	9.8	STOP (one-way). T-intersection (North River Road and Illinois Route 53). TURN LEFT onto Illinois Route 53, heading north. CAUTION: Fast-moving traffic.
0.3	10.1	Illinois Route 53 becomes a divided four-lane highway. Exposure of till on the right, where a new water line has been buried.
0.7	10.8	Entrance to headquarters of the Midewin National Tallgrass Prairie on the right. CONTINUE AHEAD.
0.8	11.6	Cross Prairie Creek.
1.4	13.0	Cross topographic high along crest of Rockdale Moraine.
0.8	13.8	Cross Grant Creek.
0.6	14.4	Crossroad intersection (Hoff Road). CONTINUE AHEAD. A left turn on Hoff Road (west) will lead you to the entrance of the Abraham Lincoln National Cemetery.
0.6	15.0	T-intersection from the left (Elwood Road). CONTINUE AHEAD.
0.4	15.4	Crossroad intersection (Mississippi Road). CONTINUE AHEAD.

0.9	16.3	Crossroad intersection (Tehle Road). CONTINUE AHEAD.
1.3	17.6	STOP LIGHT (intersection of Manhattan/Arsenal Road). CONTINUE AHEAD.
0.4	18.0	Cross Jackson Creek.
0.7	18.7	T-intersection from the right (Breen Road). CONTINUE AHEAD.
0.5	19.2	T-intersection from the left (Millsdale Road). CONTINUE AHEAD.
1.1	20.3	Crossroad intersection (Schweitzer Road). CONTINUE AHEAD. Entrance to Route 66 Raceway is to the right.
0.9	21.2	STOP LIGHT (intersection of Laraway Road). CONTINUE AHEAD.
0.3	21.5	Enter Preston Heights.
0.7	22.2	Merge into the left lane and prepare to turn left.
0.4	22.6	STOPLIGHT (T-intersection of Mills Road to the right). Entrance to Joliet Quarry to the left. TURN LEFT and follow the quarry road to the bottom of the quarry.

STOP 3: Joliet Quarry, Vulcan Materials Company (SE, Sec. 21, T35N, R10E, 3rd P.M., Joliet and Elwood 7.5-minute Quadrangles, Will County). On the day of the field trip, we will pull into the quarry and park on the bed of the quarry. Please wait for instructions from your field trip leaders before you attack the outcrop.

0.0	22.6	Leave Stop 3. Retrace your route back to the quarry entrance and the stoplight at Illinois Route 53 and Mills Road.
0.7	23.3	STOPLIGHT (T-intersection of Mills Road and Illinois Route 53). TURN RIGHT. Head south on Illinois Route 53.
1.8	25.1	STOP LIGHT (intersection of Laraway Road). CONTINUE AHEAD.
1.1	26.2	Crossroad intersection (Schweitzer Road). CONTINUE AHEAD. Route 66 Raceway is to the left.
1.0	27.2	T-intersection from the right (Millsdale Road). CONTINUE AHEAD.
1.0	28.2	T-intersection from the right (Noel Road). CONTINUE AHEAD.
0.2	28.4	Cross Jackson Creek and prepare to turn right.
0.2	28.6	STOP LIGHT (intersection of Manhattan/Arsenal Road). TURN RIGHT.

0.6	29.2	T-intersection from the left (Tehle Road). CONTINUE AHEAD. View of meanders within Jackson Creek to the right.
0.3	29.5	Cross Jackson Creek.
0.3	29.8	CAUTION: Cross single-track railroad (signal lights and guard gates).
0.3	30.1	STOP (four-way). Crossroad intersection of Brandon Road. CONTINUE AHEAD. The U.S. Army Joliet Training Center is located on the right, past the intersection.
2.0	32.1	T-intersection from the left (Base Line Road). CONTINUE AHEAD. Note that Base Line Road is 0.5 miles west of the true base line separating Ranges 9 and 10 East.
0.7	32.8	Road begins descent into the Des Plains River valley.
0.4	33.2	T-intersection from the right (Millsdale Road). CONTINUE AHEAD.
0.2	33.4	CAUTION: Cross three railroad tracks (signal lights and guard gates).
0.3	33.7	Mobile/Exon refinery on the left.
0.5	34.2	STOP LIGHT. Entrance to refinery. CONTINUE AHEAD. View of Des Plains River to the right.
0.3	34.5	T-intersections from the left. (Frontage road and entrance ramp for north-bound Interstate 55). CONTINUE AHEAD.
0.2	34.7	Cross over Interstate 55.
0.1	34.8	T-intersection from the left (entrance ramp for south bound Interstate 55). CONTINUE AHEAD.
0.05	34.85	Road curves 90° to the left. After the curve the road becomes the west front-age road along Interstate 55.
0.45	35.3	BASF Polymer Division headquarters to the right.
1.4	36.7	Dow Chemical Company, Joliet marine terminal to the right.
0.05	36.75	Entrance to Des Plaines Fish and Wildlife Area, parking lot no. 14, Blodgett Dolomite Prairie. TURN LEFT into the parking lot.

STOP 4: Blodgett Dolomite Prairie, Des Plaines Fish and Wildlife Area (NE, NE, Sec. 33, T34N, R9E, 3rd P.M., Wilmington 7.5-minute Quadrangle, Will County). On the day of the field trip, we will follow the gravel road west of the parking lot and take an auto safari through the dolomite prairie.

0.0	36.75	Leave Stop 4. TURN RIGHT onto the frontage road.
0.65	37.4	Backwater low area to the right is a tributary to Grant Creek.
0.3	37.7	STOP (one-way). T-intersection (Blodgett Road). TURN RIGHT.
0.1	37.8	CAUTION: Cross single-track railroad UNGUARDED (NO signal lights).
0.5	38.3	T-intersection from the left (North River Road). TURN LEFT. Entrance to Des Plaines Fish and Wildlife Area.
0.3	38.6	STOP (two-way). CONTINUE AHEAD. Headquarters for the Des Plaines Fish and Wildlife Area is to the left.
0.7	39.3	T-intersection from the right. CONTINUE AHEAD. The road to the right leads to the camping, picnicking, fishing areas, and boat launching facilities. An archery range is located to the left.
0.2	39.5	CAUTION: Cross dual-railroad tracks (signal lights and guard gates).
0.3	39.8	Hand trap range to the left.
0.3	40.1	Second hand trap range to the left. View of Kankakee River to the right.
0.1	40.2	T-intersections to the left (frontage road and entrance ramp for Interstate 55 south). CONTINUE AHEAD.
0.1	40.3	Cross over Interstate-55.
0.1	40.4	T-intersections to the left (frontage road and entrance ramp for Interstate 55 north). CONTINUE AHEAD.
0.3	40.7	Entrance to Des Plaines Fish and Wildlife Area, Kankakee River access area on the left. CONTINUE AHEAD.
0.4	41.1	Cross Prairie Creek. Silurian age dolomitic bedrock exposed along the creek. Prepare to turn right.
0.2	41.3	Entrance to Des Plaines Fish and Wildlife Area, Milliken Lake and Prairie Creek Picnic Area. TURN RIGHT, and make an immediate second right.

0.2	41.5	Prairie Creek joins the Kankakee River to the right. Two small waterfalls are visible in Prairie Creek. CAUTION. Several speed bumps are waiting on the roadway to test your shocks.
0.3	41.8	Large picnic shelter on the left. Ahh! Lunch at last.

STOP 5: Lunch, Milliken Lake and Prairie Creek Picnic Area, Des Plaines Fish and Wildlife Area (NE, SE, SW, Sec.15, T33N, R9E, 3rd P.M., Wilmington 7.5-minute Quadrangle, Will County).

0.0	41.8	Leave Stop 5. Retrace the route back to intersection with North River Road. Reset your odometer to 0.0 at the entrance.
0.0	0.0	TURN RIGHT onto North River Road.
0.4	0.4	T-intersection from the right (Boat House Road). CONTINUE AHEAD.
1.6	2.0	T-intersection from the right (Kankakee Road). CONTINUE AHEAD.
0.4	2.4	CAUTION: Cross single-track railroad (signal lights and guard gates).
0.4	2.8	STOP (one-way) (North River Road and Illinois Route 53). TURN RIGHT onto Illinois Route 53, heading south.
0.2	3.0	Exposure of till on the left in the area of new housing development.
0.2	3.2	STOP LIGHT (Wilmington/Peotone Road). CONTINUE AHEAD.
0.5	3.7	Road curves 90° to the right.
0.2	3.9	Cross Forked Creek.
0.1	4.0	Enter Wilmington (population 5,134). Follow Illinois Route 53 through Wilmington.
0.1	4.1	Pass the Gemini Giant and the Launching Pad Restaurant.
0.5	4.6	STOP LIGHT (Water Street). CONTINUE AHEAD.
0.05	4.65	Cross over the backwater slough of Kankakee River and onto Island Park.
0.15	4.8	Cross Kankakee River. Spillway to the left has an elevation of 531 feet.
0.2	5.0	STOP LIGHT (First Street). CONTINUE AHEAD.
0.3	5.3	Four-point intersection. Illinois Route 53 curves 45° to the left, Strip Mine Road is straight ahead, and West River Road is 90° to the left. Follow Illinois Route 53 and the Historic U.S. Route 66 signs.

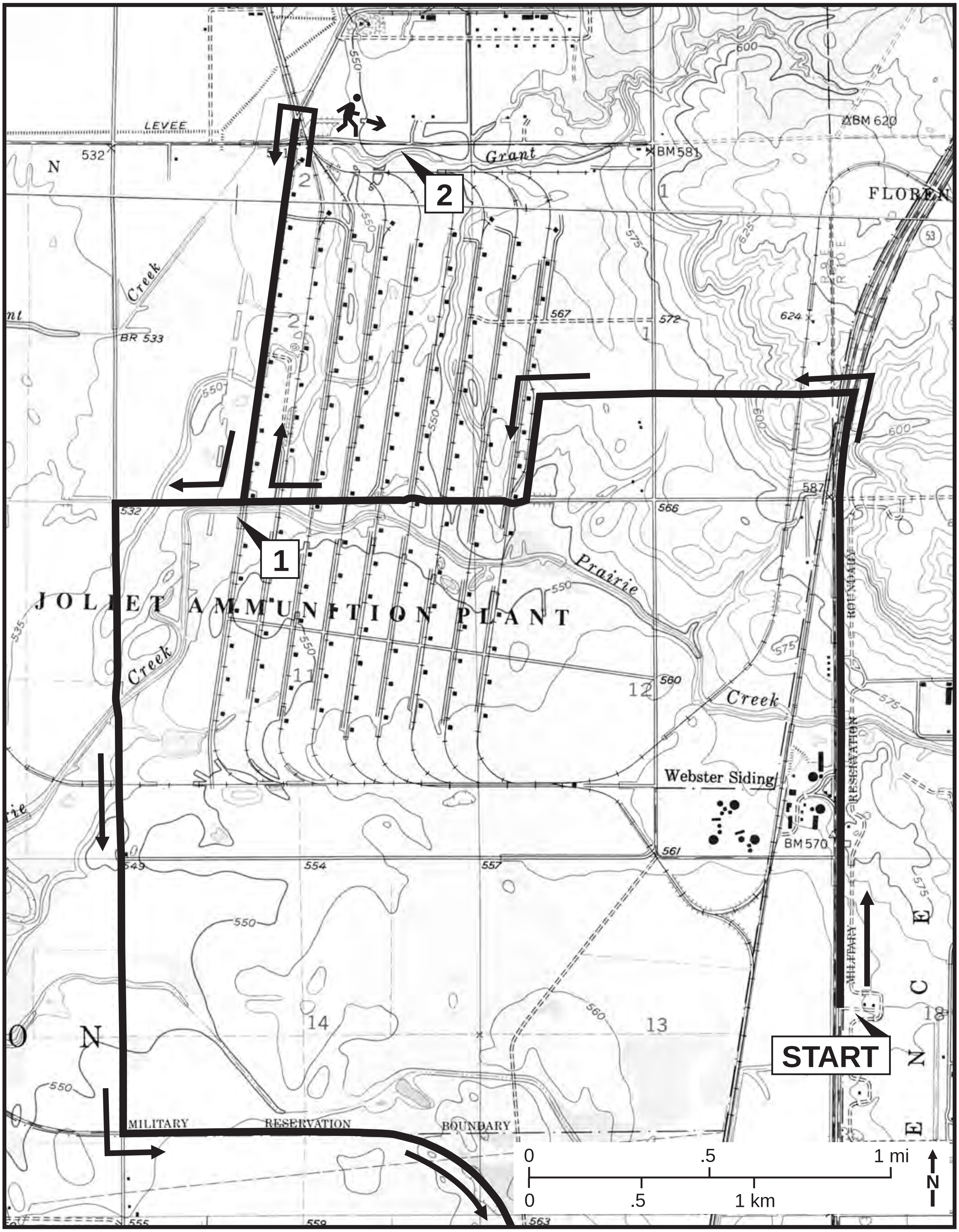
1.4	6.7	Crossroad intersection (Coal City Road). CONTINUE AHEAD.
1.0	7.7	Abandoned surface mine spoil piles on the right and left. The golf course on the right is constructed on an old surface mine area.
0.4	8.1	New housing development along flooded surface mine pit to the left. Spoil piles are west of the houses.
0.8	8.9	Enter Braidwood (population 5,203).
0.3	9.2	STOP (four-way). (Illinois Route 53/Front Street and Illinois Route 113/East Main). CONTINUE AHEAD.
0.4	9.6	Crossroad intersection (Center Street). CONTINUE AHEAD.
0.6	10.2	Crossroad intersection (Division Street). CONTINUE AHEAD.
0.4	10.6	CAUTION: Cross single-track railroad (signal lights only).
0.05	10.65	Exelon Nuclear Corporation, Braidwood Generating Station on the left.
0.35	11.0	Enter Godley (population 600).
0.7	11.7	Crossroad intersection (Kankakee Street). CONTINUE AHEAD.
0.2	11.9	Abandoned surface mine spoil piles on the right and left. View of large gob pile from abandoned surface mine to the southwest.
0.9	12.8	Enter Braceville (population 800).
0.3	13.1	STOP (four-way) (South Mitchell Road). CONTINUE AHEAD.
0.6	13.7	T-intersection from the left (Huston Road). TURN LEFT. Enter Mazonia/ Braidwood Fish and Wildlife Area.
0.2	13.9	Mazonia/Braidwood Fish and Wildlife Area headquarters on the left.
0.3	14.2	STOP (two-way) (Mitchell Road). CONTINUE AHEAD.
0.7	14.9	Good view of large abandoned gob pile to the southeast (see guidebook cover).
0.3	15.2	STOP (one-way). T-intersection (Huston Road and Kankakee Road). TURN RIGHT. The large berm on the left is the impoundment dike around Braidwood Lake. The lake waters are used for cooling by the Braidwood Nuclear Power Station.

0.9	16.1	Crossroad intersection (Dondanville Road/6000N and Kankakee Road 1900W). TURN LEFT. The middle of this intersection is a tri-county junction, Will County is to the northeast, Kankakee County is to the southeast, and Grundy County is to the west.
0.6	16.7	Entrance to parking lot on the right. TURN RIGHT into parking lot.

STOP 6: Pit 11, Mazonia/Braidwood Fish and Wildlife Area (NE, NE, NW, Sec. 6, T31N, R9E, 3rd P.M., Essex 7.5-minute Quadrangle, Kankakee County). On the day of the field trip, we will follow the service road located east of the parking lot. The stop will be in the Pit 11 area, within the Mazonia South Unit.

After leaving the last stop, you can gain access to Interstate 55 by retracing the route back to Illinois Route 53. At Illinois Route 53, turn left and head south toward the community of Gardner. Turn right on Main Street, and follow the street to Interstate 55. NOTE: If you are interested in architecture of early turn-of-the-nineteenth-century stone buildings, a historic block jail, near downtown Gardner, was constructed using large blocks of native dolomite. A nice place to visit but I wouldn’t want to stay there.

END OF TRIP! HAVE A SAFE JOURNEY HOME.


JOLIET AMMUNITION PLANT
START
1
2
LEVEE
Grant
Creek
Prairie
Creek
Webster Siding
MILITARY RESERVATION BOUNDARY
FLOREN
BM 581
BM 620
BM 570
BR 533
0 .5 1 mi
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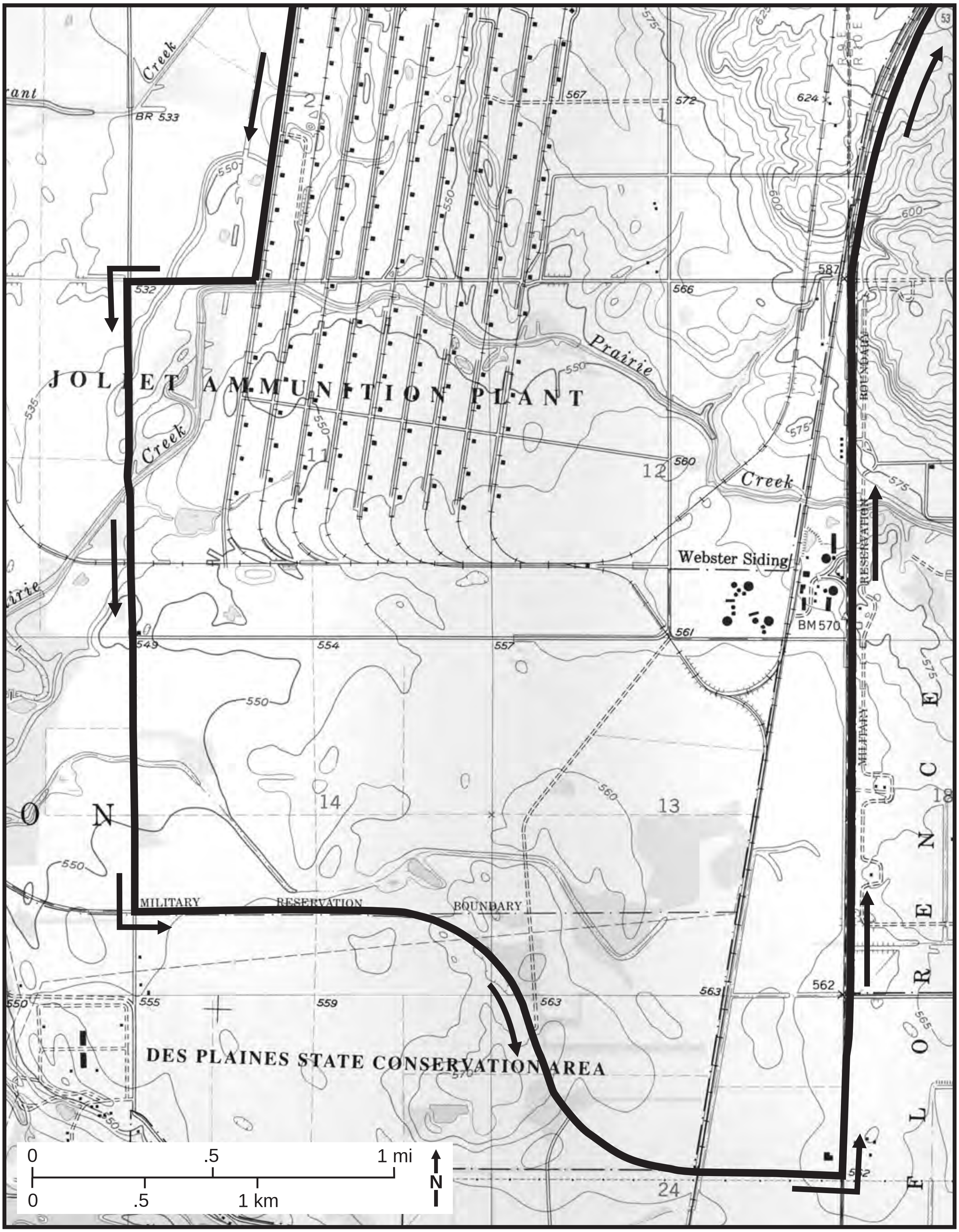
JOLIET AMMUNITION PLANT
DES PLAINES STATE CONSERVATION AREA
MILITARY RESERVATION BOUNDARY
Webster Siding
Prairie Creek
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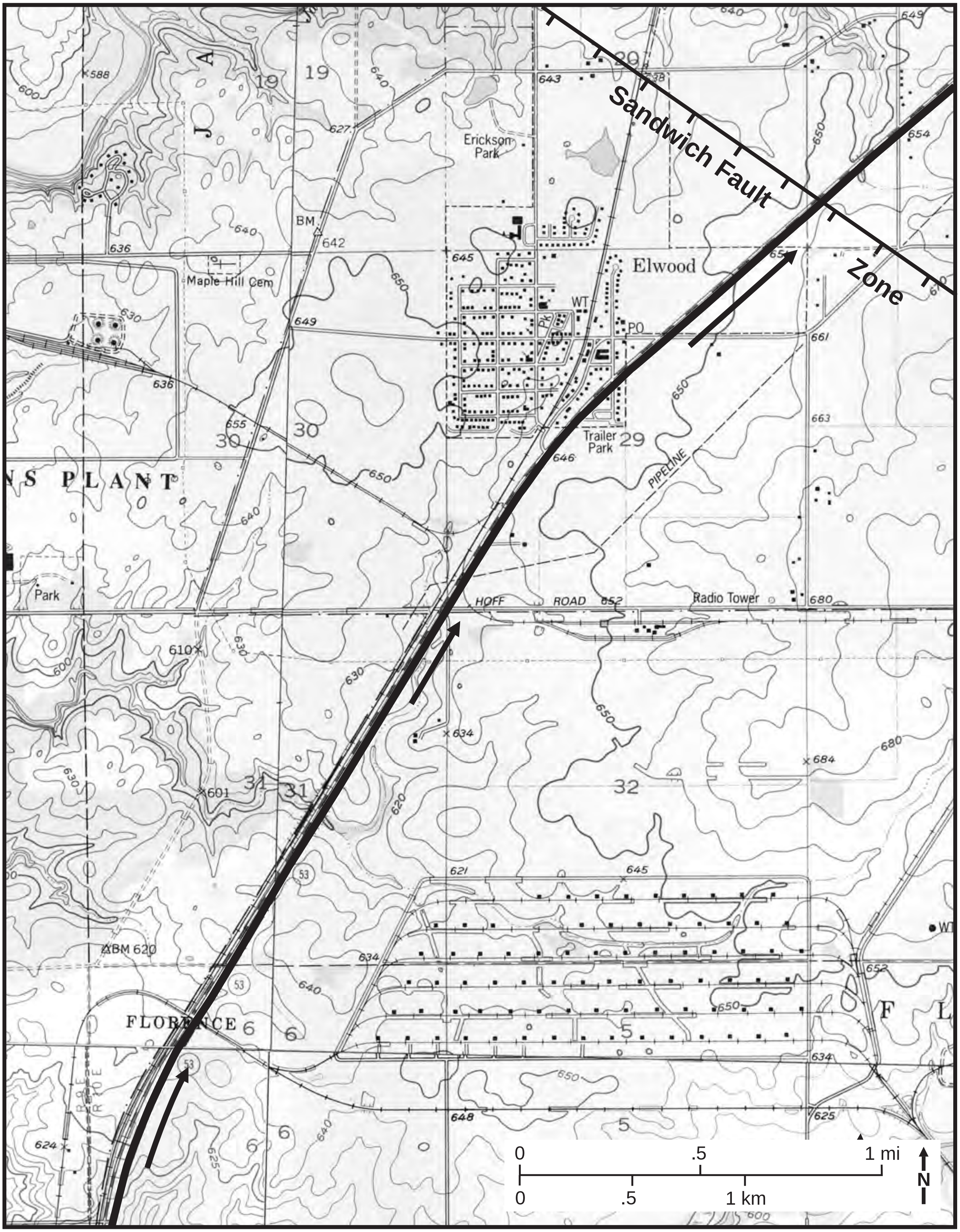

Sandwich Fault
Zone
Elwood
Erickson Park
Maple Hill Cem
Trailer Park
PIPELINE
HOFF ROAD
Radio Tower
FLORENCE
NS PLANT
Park
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1 km
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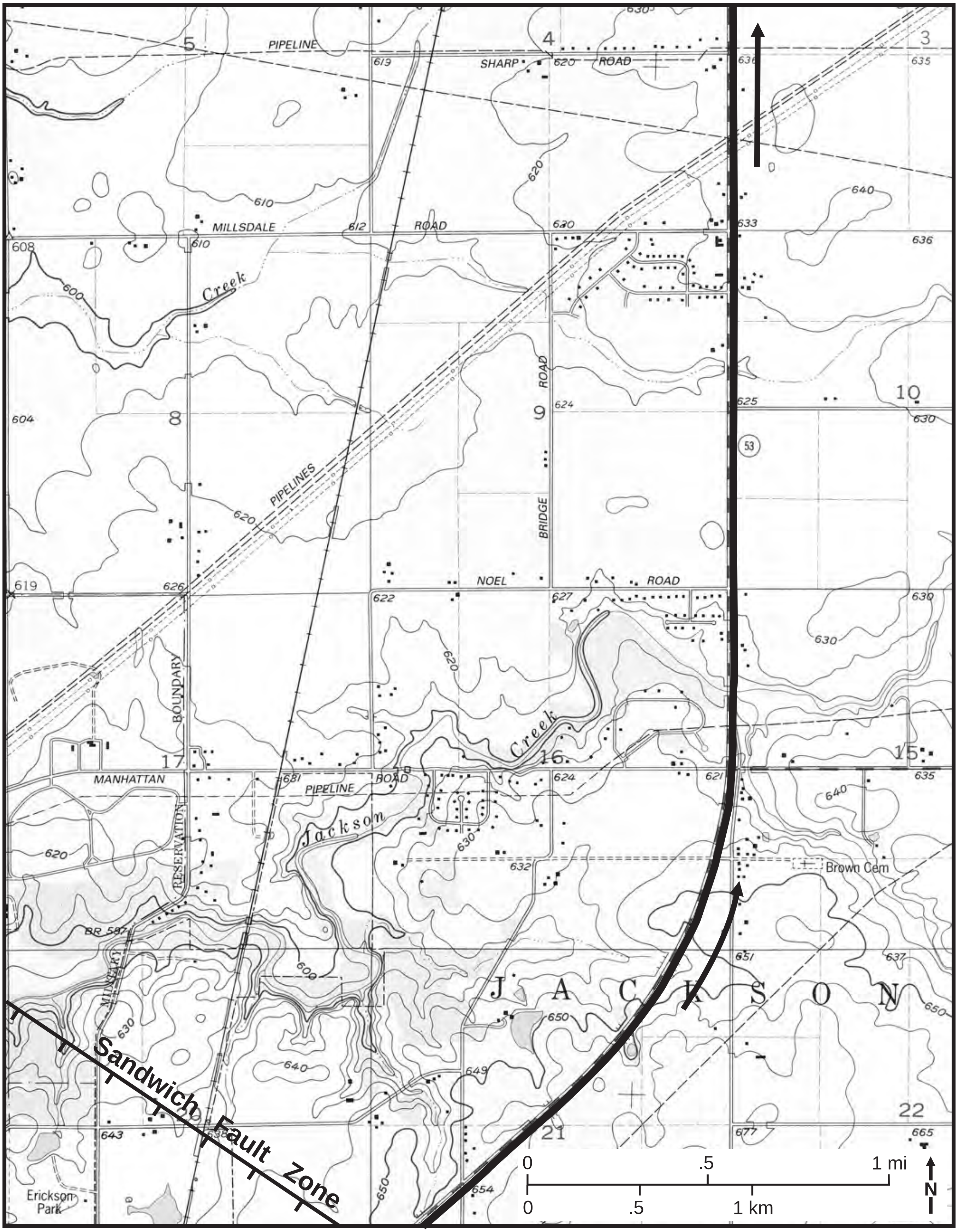

PIPELINE
SHARP
ROAD
MILLSDALE
ROAD
Creek
PIPELINES
BRIDGE
ROAD
NOEL
ROAD
BOUNDARY
MANHATTAN
PIPELINE
ROAD
Jackson
Creek
RESERVATION
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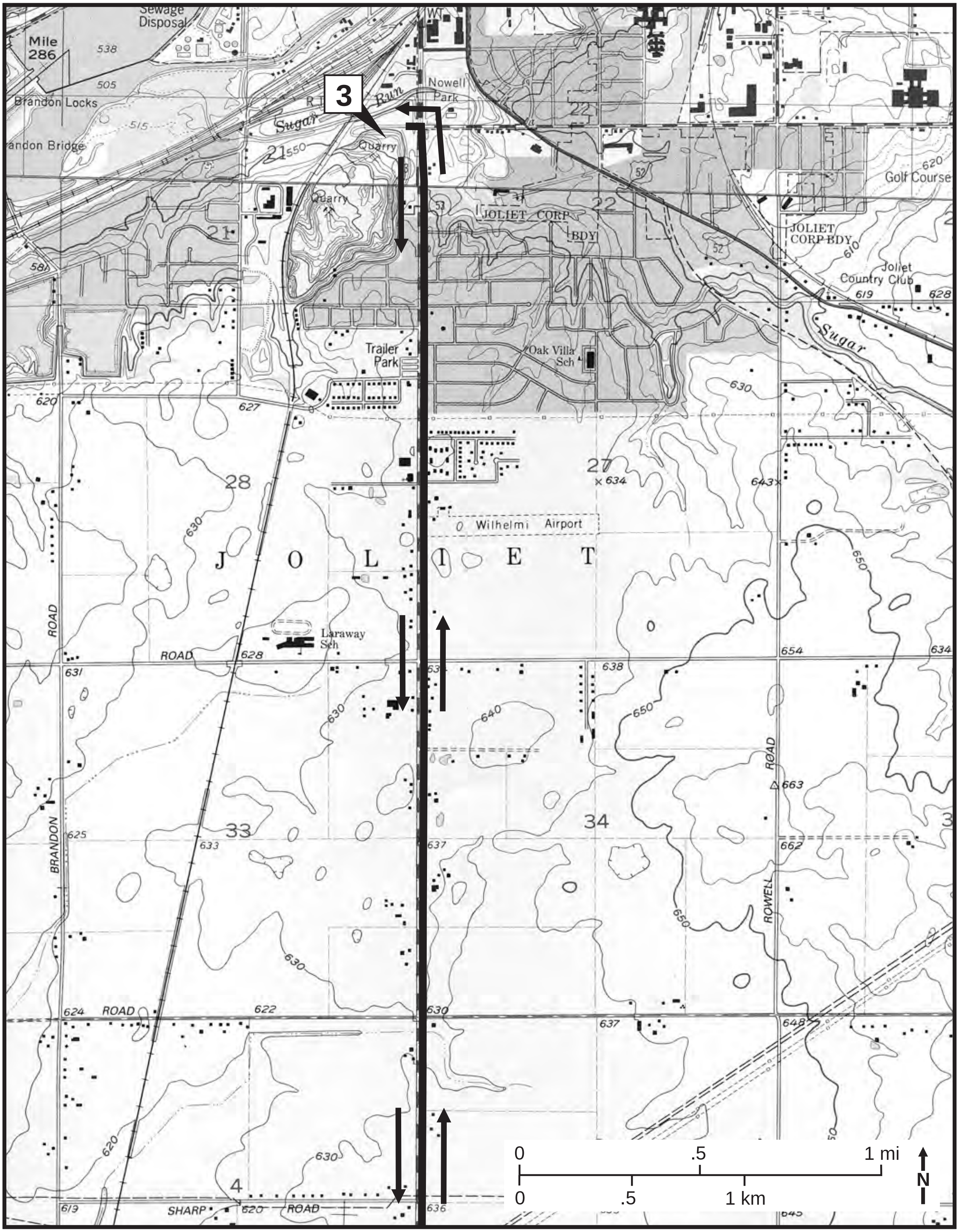
Sewage Disposal
Mile 286
Brandon Locks
Brandon Bridge
3
Sugar Run
Nowell Park
Quarry
Quarry
JOLIET CORP BDY
JOLIET CORP BDY
Golf Course
Joliet Country Club
Sugar
Trailer Park
Oak Villa Sch
Wilhelmi Airport
J O L I E T
Laraway Sch
ROAD
BRANDON
ROAD
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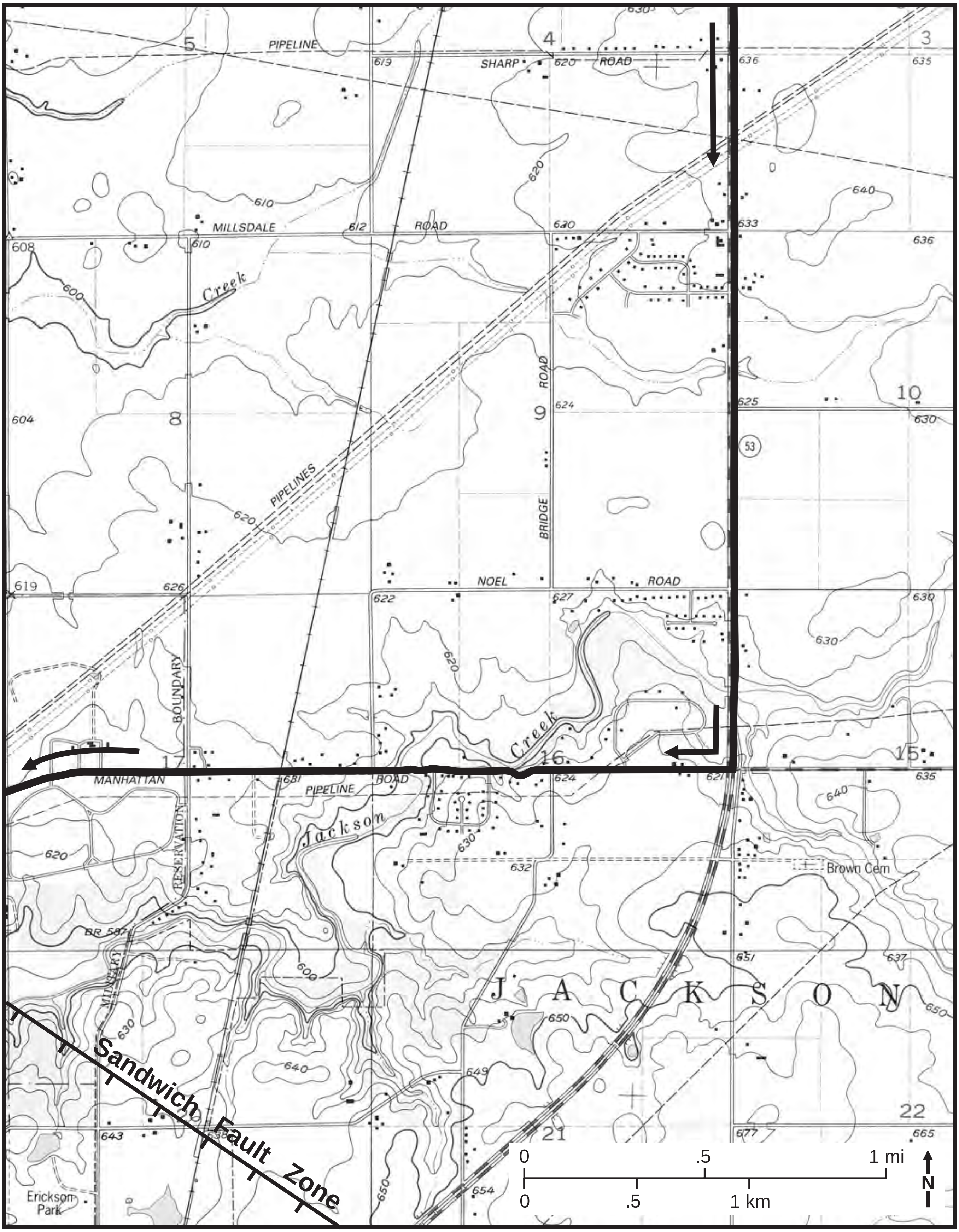

PIPELINE
SHARP
ROAD
MILLSDALE
ROAD
Creek
PIPELINES
BRIDGE
ROAD
NOEL
ROAD
BOUNDARY
Creek
MANHATTAN
PIPELINE
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Jackson
RESERVATION
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MILITARY
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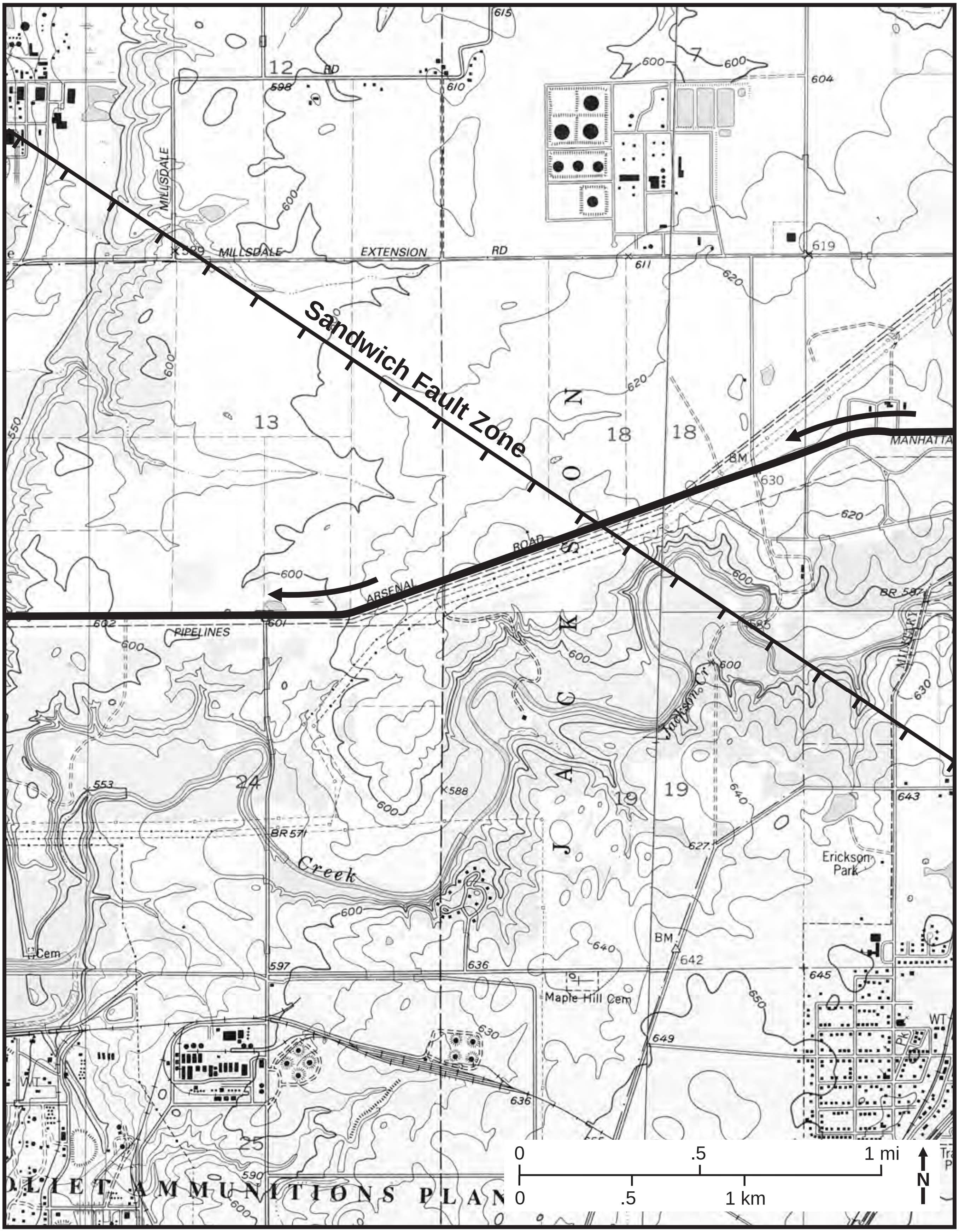
Sandwich Fault Zone
MILLSDALE
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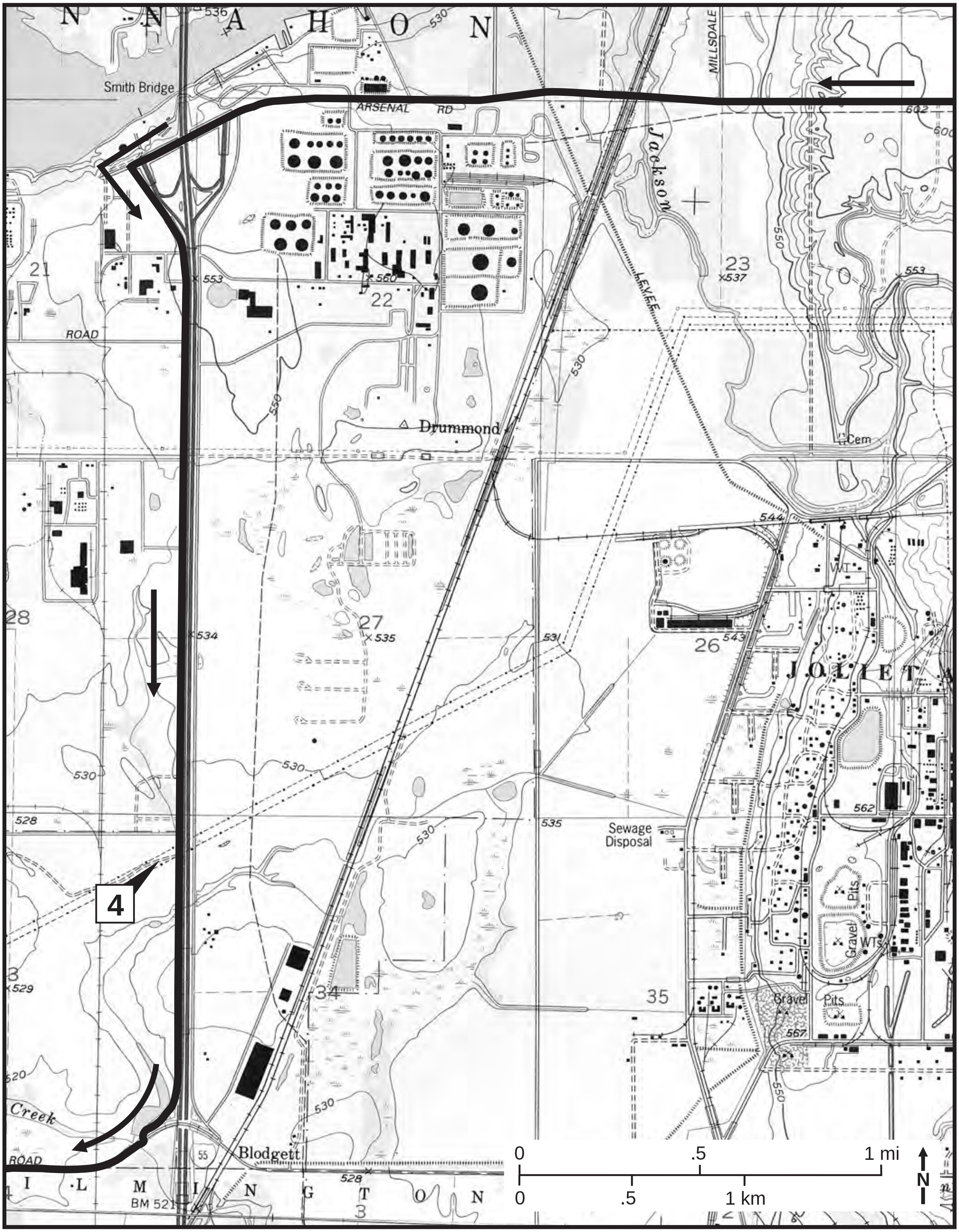
N N A H O N
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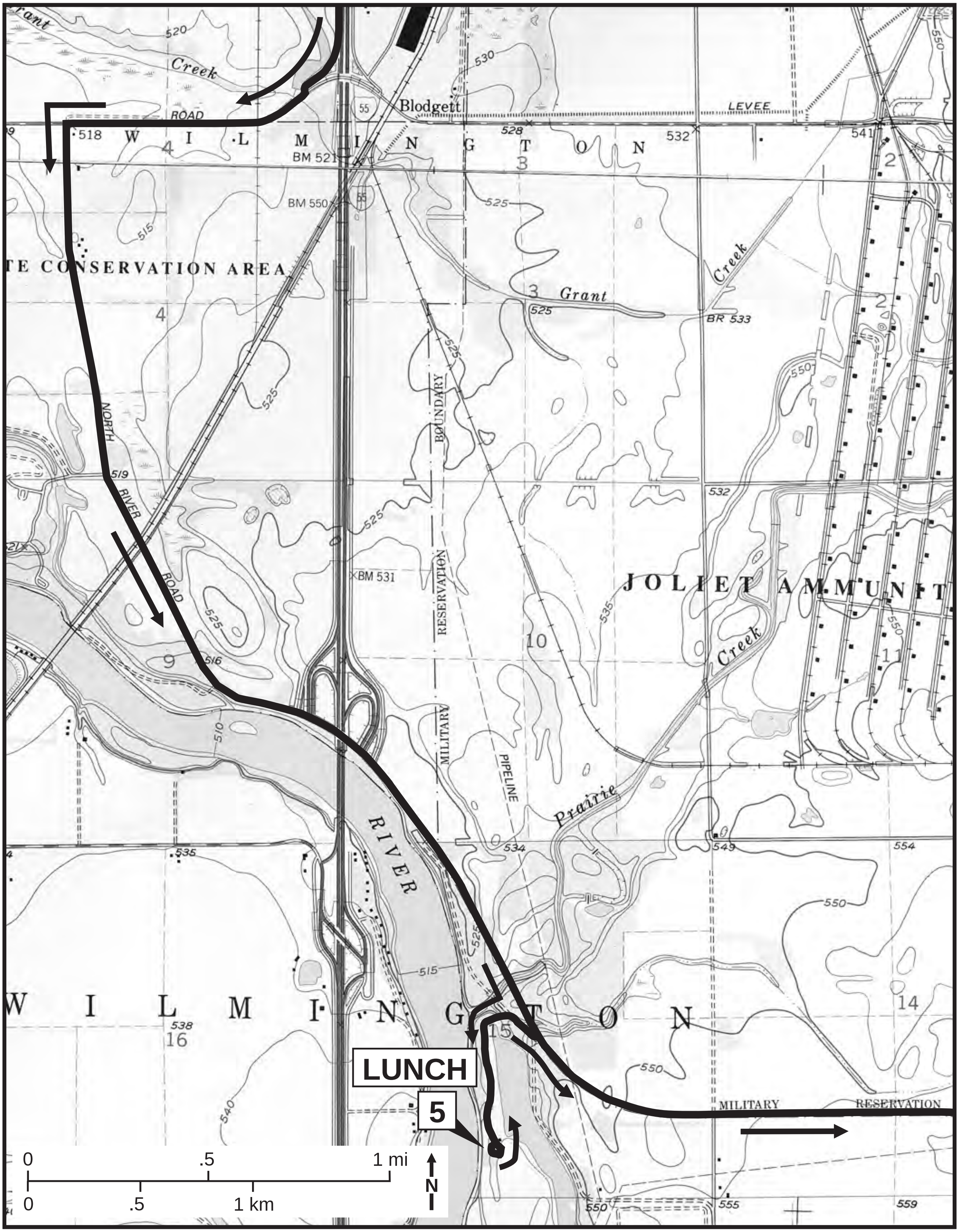

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TE CONSERVATION AREA
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BR 533
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BM 531
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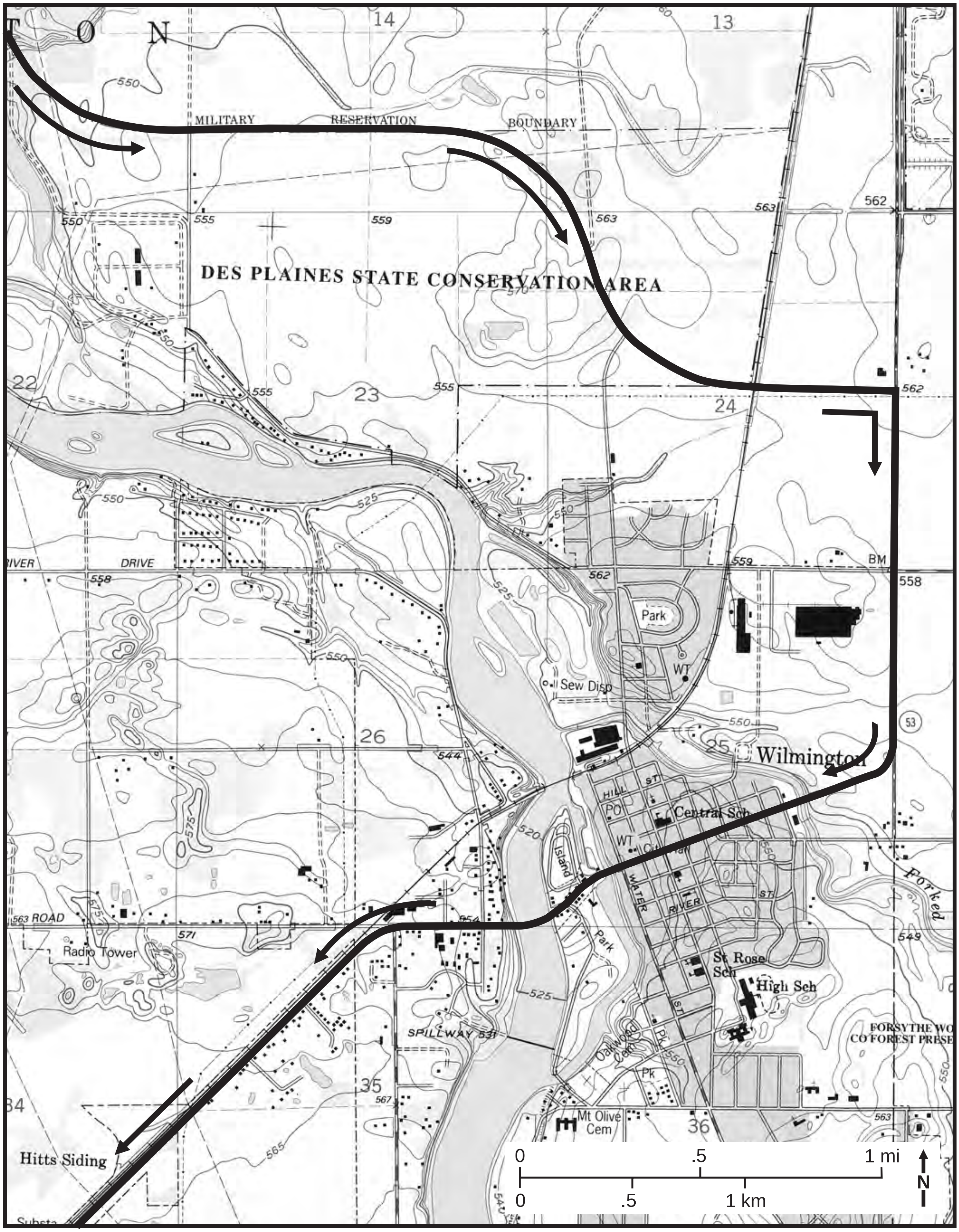
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MILITARY
RESERVATION
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DES PLAINES STATE CONSERVATION AREA
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Park
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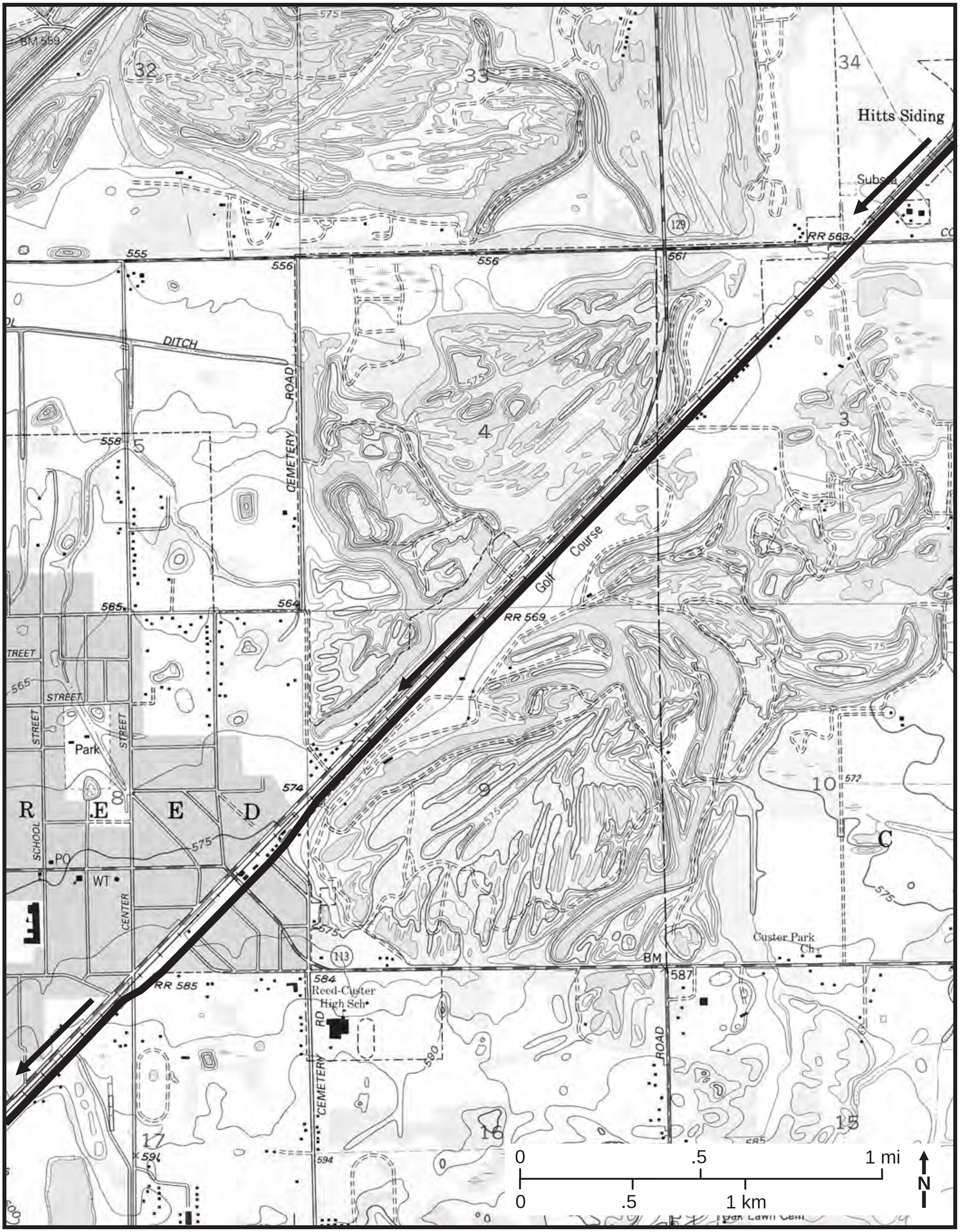

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RR 569
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CENTER
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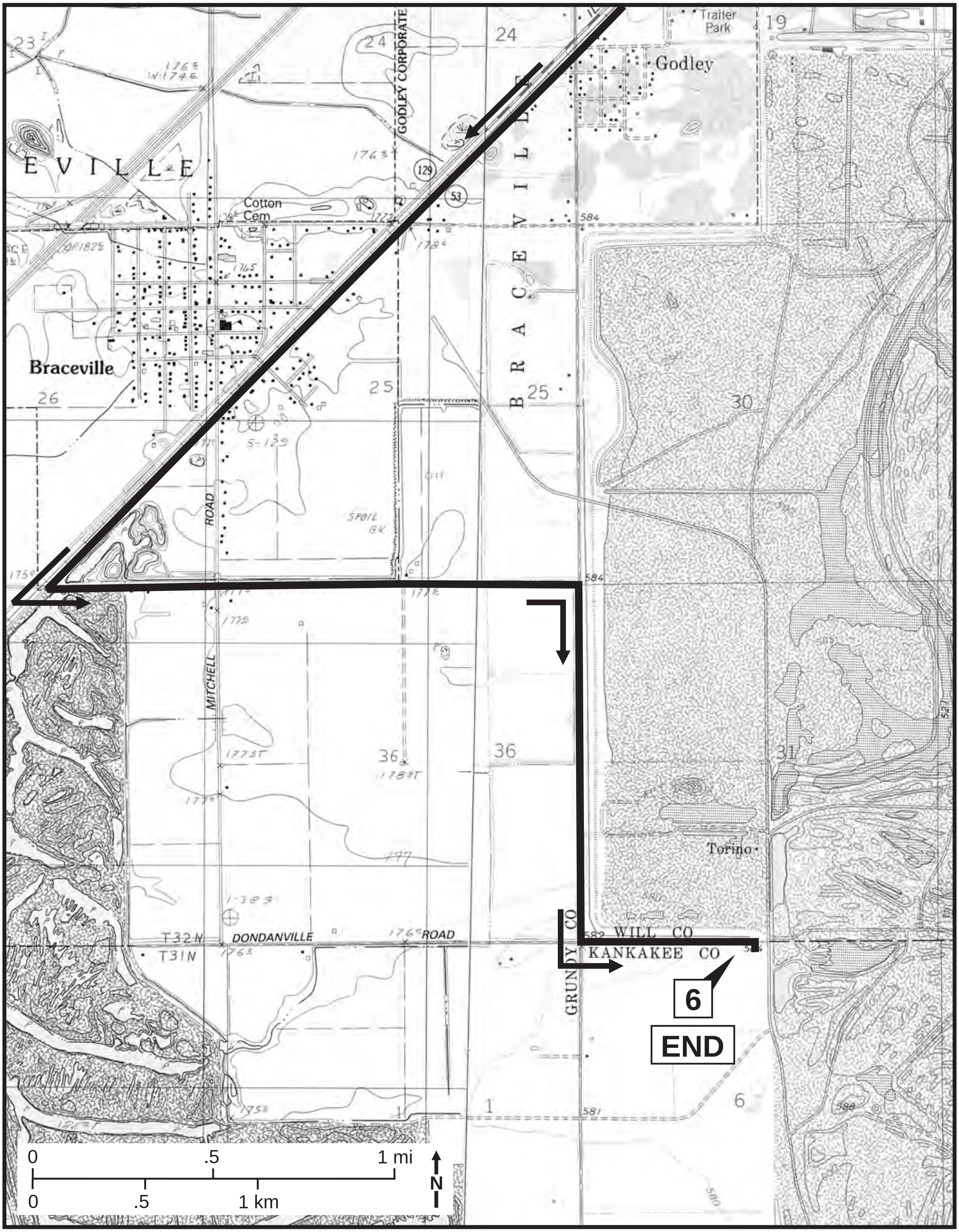
Trailer Park
Godley
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Cotton Cem
Braceville
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STOP DESCRIPTIONS

START: Headquarters, Midewin National Tallgrass Prairie (SW, SW, NW, Sec.18, T33N, R10E, 3rd P.M., Wilmington 7.5-minute Quadrangle, Will County).

Midewin National Tallgrass Prairie

The name Midewin, pronounced (Mih-DAY-win), is a Potawatomi term for "healing society." The following is modified from the United States Department of Agriculture, Forest Service's Midewin National Tallgrass Prairie, fact sheet, dated June 2002.

The Vision

" . . . I started with surprise and delight. I was in the midst of a prairie! A world of grass and flowers stretched around me, rising and falling in gentle undulations, as if an enchanter had struck the ocean swell, and it was at rest forever. . . . You will scarcely credit the profusion of flowers upon these prairies. We passed whole acres of blossoms all bearing one hue, as purple, perhaps, or masses of yellow or rose: and then again a carpet of every color intermixed, or narrow bands, as if a rainbow had fallen upon the verdant slopes. When the sun flooded this Mosaic floor with light, and the summer breeze stirred among their leaves the iridescent glow was beautiful and wondrous beyond anything I had ever conceived. . ."

—Eliza Steele, near Joliet, Illinois, from her journal,
Summer Journey in the West, 1840

Today

The Joliet Army Ammunition Plant, established in 1939, was a 23,500-acre site where ammunition and explosives (TNT) were once produced for the U.S. Army. Having ceased most of its operations in the late 1970s, the Army decided in 1993 that it no longer needed the land at the Joliet facility. Today, the 19,000 acres of the former arsenal are the largest piece of protected open space in northeastern Illinois and the first national tallgrass prairie in the United States.

The Illinois Land Conservation Act of 1995, sponsored by Congressman Jerry Weller, was signed into law on February 10, 1996, and established the Midewin National Tallgrass Prairie on the former Joliet Army Ammunition Plant. The law also established the adjoining Abraham Lincoln National Cemetery (982 acres), two industrial parks (approximately 3,000 acres), and a county landfill (455 acres). On March 10, 1997, the Army transferred the first 15,080 acres of former arsenal lands to the USDA Forest Service. Thanks to recent acquisition of some small adjoining pieces of land, Midewin currently encompasses 15,189 acres. The Army will transfer additional former arsenal lands after the environmental cleanup is completed.

The Midewin National Tallgrass Prairie was designated for these purposes:

1. To manage the land and water resources of the Prairie in a manner that will conserve and enhance the native populations and habitats of fish, wildlife, and plants;

2. To provide opportunities for scientific, environmental, and land use education and research;

3. To allow the continuation of agricultural use under certain conditions; and

4. To provide a variety of recreation opportunities that are consistent with the preceding purposes.

Midewin is administered by the Forest Service in close cooperation with the Illinois Department of Natural Resources and the support of hundreds of volunteers and partner agencies, businesses, and organizations.

Public access to Midewin continues to be restricted because of the Army's ongoing cleanup of contaminated areas. Two interim hiking trails are available on the west side, and escorted interpretive tours are held during the spring, summer, and fall months.

Less than 2% of Midewin today remains in native vegetation, but prairie restoration activities are already under way. Three native seed gardens have been developed, and 70 prairie plant species have been planted; more will be introduced each year. Pure fields of five different prairie grass species have also been established as seed sources. Of highest ecological importance at Midewin is the rare dolomite prairie in the northwestern corner of the site, the vast acreage of grassland habitat supporting the largest population of the state-listed upland sandpiper in Illinois, and a recently discovered population of the federally listed leafy prairie clover. Midewin is already a refuge for grassland bird species whose numbers are severely declining across the Midwest due to loss of habitats. Midewin's sheer size provides the opportunity to foster a variety of habitats required by many endangered species, particularly those that require wide-open spaces.

Volunteer contributions are vital to Midewin, from planting and maintaining the seed gardens, to leading public tours, to conducting environmental education workshops. Specially trained volunteers are collecting important data as biological monitors for vegetation, streams, butterflies, amphibians, plants, and birds.

Agricultural leasing at Midewin will eventually be phased out, as intended by the establishing legislation. But today, about 47% of Midewin is in row crops, hay, or cattle grazing, and in many areas the leases are maintaining the land in good shape until it can be restored to prairie. Row crops and hay prevent invasive weeds from taking over and even provide good habitats for some resident sensitive bird species. In some areas, cattle grazing maintains good habitats for birds that require large expanses of short grass. In 2001, agricultural leasing generated more than $678,000 in revenue, and more than $217,000 of this money was returned to Will County for schools and roads.

For more information about the Midewin National Tallgrass Prairie, see the Forest Service Web site at http://www.fs.fed.us/mntp/ or contact Public Affairs Officer Marta Witt at 815-423-6370 or mlwitt@fs.fed.us.

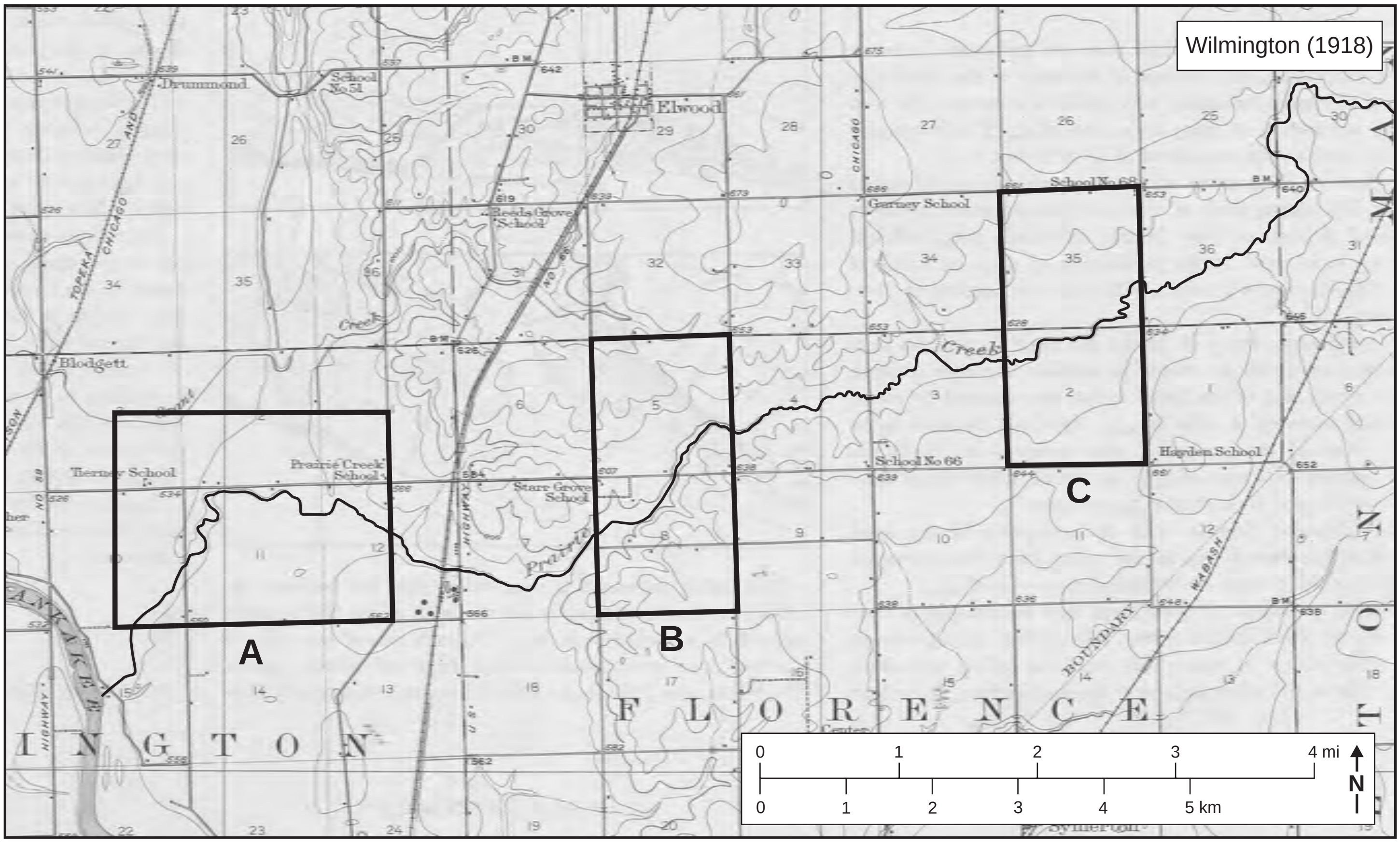
STOP 1: Prairie Creek, Midewin National Tallgrass Prairie (NW, NE, NW, Sec. 11, T33N, R9E, 3rd P.M., Wilmington 7.5-minute Quadrangle, Will County). On the day of the field trip, we will park along the road.

We will discuss some of the efforts underway to restore Prairie Creek (fig. 15) to its natural state. Current restoration efforts include stream bank stabilization projects. The original course was modified during the development of the Joliet Arsenal. This modification included channelization of significant portions of the creek to remove meanders and increase the rate of flowing water.

Figure 15 Prairie Creek at Midewin National Tallgrass Prairie at Stop 1. This portion of the creek has been channelized (photo by W.T. Frankie).

A significant problem associated with the removing of meanders in a fluvial system is that the stream gradient is affected. Simply stated, the distance from point A to point B within a stream is shorter when meanders are removed. However, changing the stream's natural gradient causes the stream to be out of equilibrium, and the stream will try to reestablish equilibrium by downcutting, which leads to increased erosion. A second modification to Prairie Creek was the construction of Kemery Lake, and a third modification was rerouting portions of Prairie Creek. Comparison of the 1918 Wilmington, 15-minute Quadrangle (before Joliet Arsenal construction) with the 1954 Wilmington, 15-minute Quadrangle (after Joliet Arsenal construction) illustrates the amount of modification (fig. 16). Three areas along Prairie Creek were selected for detailed comparison between the 1918 and 1954 topographic maps (fig. 17). These areas, labeled A, B, and C, highlight rerouting and channelization (A), construction of Kemery Lake (B), and channelization and cutting off of meanders (C) (fig.17).

On a different note, a study of Prairie Creek is in a way a look back into the past. Early settlers described most of Illinois' rivers and streams as clear. However, since the development of the agriculture industry most Illinois creeks, streams, and rivers now flow—for lack of a better term—murky to muddy. This change is a result of the increased amount of fine-grained sediments entering the waterways from cultivated lands that are held in suspension. Because the surrounding landscape at Midewin along Prairie Creek is largely in pasture and prairie, the natural filtering effect of these plants helps hold the soil in place and filters out the fine-grained silts and clay as surface water flows toward Prairie Creek. As a result, Prairie Creek generally flows clear. However, as in most cases, during heavy rains, Prairie Creek becomes murky for a while.



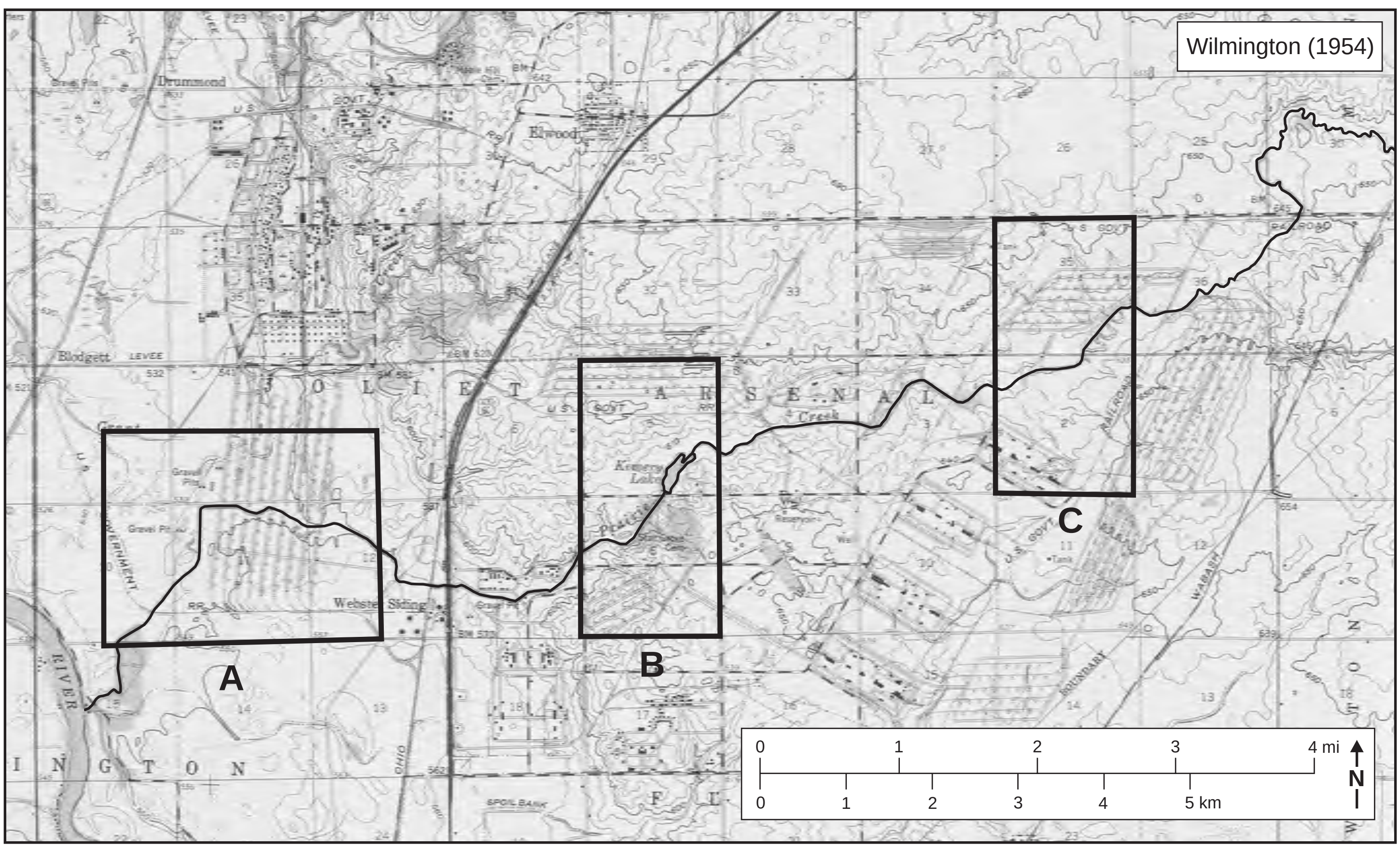


Figure 16 Comparison of the course of Prairie Creek between 1918 and 1954, from the USGS 15-minute quadrangles.

Figure 17 Exploded view of 1918 and 1954 quadrangles, parts A, B, and C.

The following information was extracted and modified from a water quality fact sheet from the Illinois Environmental Protection Agency, dated 1997. The streams in this report were rated good, fair, or poor.

Prairie Creek (FA), located in Kankakee County, is a 27-mile tributary to the Kankakee mainstream assessed as having "good" overall resource quality. The lower reach of Prairie Creek flows through the Joliet Army Ammunition Plant, a federal facility that produced, packed, and shipped military explosives from prior to World War II to the end of the Vietnam War. The Joliet Army Ammunition Plant has two Superfund sites within its borders (Illinois Environmental Protection Agency 1997).

The following items are for thought and discussion:

- How will Prairie Creek evolve if it is left alone and no restoration is attempted?
- What would happen if Kemery Lake were removed?
- What other factors might be responsible for the normally clear-flowing water?
- Are there potential problems associated with restoring the creek to its original condition?

STOP 2: Grant Creek, Midewin National Tallgrass Prairie (NW, NE, NE, Sec. 2, T33N, R9E, 3rd P.M., Wilmington 7.5-minute Quadrangle, Will County). On the day of the field trip, we will park along the road.

Depositional Materials

This stop provides the opportunity to examine several types of glacial fluvial sediments of the Mackinaw facies of the Henry Formation. These sediments were deposited as outwash from the glacier that formed the Valparaiso Morainic System (fig. 13). The majority of the sediments are interpreted as braided stream deposits. Because of the crisscrossing nature of braided stream deposits, there is no one place along Grant Creek to see all of the units in one place. However, along the outside bend of the meander, a sequence of exposed sediments allows intepretation.

When the glacier stood at the Valparaiso Morainic System (fig. 13), torrents of meltwater flowing from the glacier stripped all of the pre-existing unconsolidated sediments and exposed the Silurian age dolomite bedrock. Then, as the torrent waned, materials ranging in size from gravel to coarse sand were deposited. The top of this deposit is exposed near the base of the cutbank (outside bend of the meander) along Grant Creek (figs. 18 and 19). These deposits of coarse gravel and sand were mined in a series of gravel pits along Prairie Creek (see Guide to the Route, miles 5.5 to 5.9). The lower gravel to coarse sand unit in Grant Creek is overlain by a series of upward-fining cycles of fine gravel to silt or sandy silt (fig. 19). Each of these cycles was deposited by sediment-choked braided meltwater streams as the streams lost velocity. A few dropstones (pebbles released from floating ice chunks or tree roots) are locally present in the silty part of the cycles. A dropstone is located within a layer of silt near the middle of the sequence of sediments in figure 19. The top of the lower cyclic sediments is marked by a cobble to coarse gravel lag. The lag is overlain by a gray to dark gray, silty, clayey sand to sandy, silty clay that represents lake floor

Figure 18 Meander in Grant Creek at Midewin National Tallgrass Prairie at Stop 2. A slump has occurred along the outside bend in the meander; note the leaning tree in slump block (photo by R.S. Nelson).

deposits of proglacial Lake Wauponsee. There numerous irregular darker-gray features that penetrate the lake floor sediment and part of the underlying cyclic sediments. These features are filled burrows and root cases. A mature prairie soil profile is developed in the lake floor sediment and upper part of the cyclic sediments. At places along the creek, the soil profile is buried by up to 2 feet of tan- to brown-colored disturbed materials. Elsewhere along the creek, thin lenses of diamictons occur within the cycles. These diamictons may be mudflows derived from glacial till as the Rockdale Moraine was dissected by the meltwater from the glacier forming the Valparaiso Morainic System. The Rockdale Moraine was severely eroded and dissected by the meltwater outwash from the Valparaiso Moraine (for more details, see the Building the Foundation section in Stop 4).

Figure 19 Exposure of deposits illustrating fining-upward sequences within the Henry Formation of the Wedron Group in Grant Creek at Stop 2. Notice the dropstone (arrow) ithin the fine silt layer near the middle of the sequence (photo by W.T. Frankie).

Geomorphology

It is interesting to look at the geomorphology of a meander. Grant Creek has cut a narrow “valley” down through the lake floor deposit and the cyclic sediments and has cut into the coarse sand and gravel. The creek itself occupies only a small portion of the “valley floor.” At some locations the creek is flowing through a meander. Water flowing through a meander curve is forced against the outside bank (called the cutbank). As the cutbank is eroded back along the outside curve of the meander, the bank is continually undercut, which eventually leads to failure (slumping) in the cutbank (fig. 18). The inside curve of a meander, located on the opposite side of the creek, is the slip-off slope. The material within the creek bed along the slip-off slope is composed of reworked sand and gravel. There are abandoned channels or chutes between the slip-off slope (inside) and the cutbank (outside) valley walls. It is interesting to note that when this area was investigated in November and again in February, some of the areas of the stream were frozen and other reaches were open water. The open-water areas all headed into seeps or springs where relatively warmer groundwater issued from the coarse sand and gravel exposed in cutbanks. The creek was generally frozen where it was not directly against a “valley wall.” It is important to remember that large floods may reconfigure the nature of the valley floor and the shape of the creek.

STOP 3: Joliet Quarry, Vulcan Materials Company (SE, Sec. 21, T35N, R10E, 3rd P.M., Joliet and Elwood 7.5-minute Quadrangles, Will County). On the day of the field trip, we will pull into the quarry and park on the bed of the quarry. Please wait for instructions from your field trip leaders before you attack the outcrop.

This stop provides an opportunity to present some of the most basic, yet most powerful tools a geologist brings to the field.

A Geologic Primer

The study of the layering of the earths materials requires a basic understanding of sedimentary rocks. *Clastic* sedimentary rocks form by the accumulation of sediment particles eroded from older rocks, and they represent mud, sand, or gravel that has hardened into rock. Carbonate sedimentary rocks, including limestone and dolostone, form when organic activity or inorganic precipitation extracts carbonate from seawater to form a sediment composed of calcium carbonate or calcium-magnesium carbonate.

Most sedimentary rocks are deposited under water as layers, which can also be called beds or strata. An important aspect of this process is the Law of Superposition. Simply stated, in any undisturbed sequence of rocks, the bed or layer at the bottom of the sequence was deposited first and is therefore the oldest, and any layer above in the sequence is younger and therefore was deposited after the underlying layer and before the overlying layer. Any sedimentary layer or bed can be assigned an “older” or “younger” age relative to the layers below and above it. This principle is critical as the basis for the relative geologic time scale.

Another important aspect of sedimentary rocks is the Principle of Uniformitarianism, often summarized as “the present is the key to the past.” In its most general form, this principle tells us to interpret geologic features in terms of things or processes that we can see today. For example, if you find a rock from this quarry and it contains abundant fossil corals, you are faced with the problem of how it formed. Modern corals live only in seawater, so a marine origin can be inferred for the rock. This process leads to a determination about the environment of deposition. The sediments that make up the rock were deposited in a marine environment.

Another important rule is the Principle of Lateral Continuity. When the same rocks outcrop in different places (for example, on opposite sides of a river valley), it is assumed that they were once continuous and that erosion has removed the intervening region.

The Silurian Period

The Silurian can be defined as a period of geologic time between 417 and 443 million years ago that was preceded by the Ordovician Period and followed by the Devonian Period. The term "Silurian" comes from "Silures", the name of a Celtic tribe of people that lived along the border of England and Wales before the time of the Romans. In the early 1800s, British geologists recognized rocks in this area that contained a distinctive assemblage of fossils that were different from the fossils in both underlying (or older) strata and overlying (or younger) strata. "Silurian" was applied to the period of time represented by this fossil assemblage. Silurian fossils, identical to those in Britain, were subsequently discovered in many other regions of the world, including the Great Lakes region of North America.

Fossilization

A fossil is a feature preserved in a rock that indicates the presence of ancient life. Body fossils are parts of organisms such as shells, bones, and leaves. Footprints, trails, and burrows in rocks also demonstrate the presence of ancient life, even though no part of the body is present. These fossils are called trace fossils. Recognition of fossils is based on a comparison of modern and ancient materials and follows the Principle of Uniformitarianism.

Diagenesis refers to the chemical and physical changes that occur in sedimentary geologic materials after their initial deposition or formation. During the Silurian Period, the sediments being deposited consisted of shells and soft mud composed of calcium carbonate. The shells and mud eventually crystallized into rock called limestone. Later in geologic time, the limestone was altered into a rock called dolostone, which consists of calcium-magnesium carbonate. A discussion of dolomitization is given later in this stop description.

Although some fossils have not been changed from their original composition, most fossils have undergone some degree of diagenesis. Petrification occurs when tiny spaces in bone or wood are filled by new minerals. Silicification is the alteration of a shell composed of calcium carbonate into a fossil shell composed of silica (SiO_2).

Shells may also be dissolved during diagenesis, leaving only their impression in the rock, which is the way most Silurian fossils in Illinois are preserved. The external mold is an impression that preserves the appearance of the outer surface of a shell. The internal mold is an impression of the inner surface of a shell. External and internal molds of the same shell are often very different in appearance.

Most body fossils represent hard and durable parts of an organism, such as shells, bone, or teeth. Soft tissues, such as tentacles, eyes, and internal organs are readily consumed by microbial organisms and are not generally preserved as fossils. Only in rare cases are soft tissues or entirely soft-bodied animals preserved as fossils. These cases usually involve a lack of oxygen in the original environment, which inhibits the activity of microbial organisms. The impressions of soft-bodied organisms have been found within siderite concretions collected from the Pennsylvanian age shales (see Stop 6).

Joliet Quarry

The Joliet Quarry (fig. 20), formerly the National Quarry and currently operated by Vulcan Materials Company, is located south of Joliet on the west side of Illinois Highway 53, just south of Sugar Run. The highest bedrock elevation is about 540 feet. The quarry contains an extensive section that includes the Ordovician Fort Atkinson Dolomite and the Wilhelmi through Sugar Run Formations of the Silurian (fig. 2). This section is the type section of the Sugar Run and Joliet Dolomites and the Romeo Member of the Joliet Dolomite.

Figure 20 Vulcan Materials Company, Joliet Quarry at Stop 3. Notice the joint faces in the highwall on the right (photo by W.T. Frankie).

At this stop we will examine the Ordovician-Silurian boundary and the overlying Silurian formations. The following descriptions of the stratigraphy were modified from those of Mikulic et al. (1985).

Silurian System

Racine Dolomite +2 feet (0.6 m)

Lowenstan (1948) mentioned a 2-foot (0.6-m) erosional remnant of cherty argillaceous dolomite at the top of the Sugar Run ("Waukesha") Dolomite. These strata can no longer be seen in the quarry, but their lithologies and position indicate that they probably were Racine Dolomite.

Sugar Run Dolomite 26.3 feet (8.0 m)

The Sugar Run Dolomite is a very well-bedded, fine-grained, nonporous, argillaceous, light gray dolomite that contains a few small chert nodules. This dolomite breaks into large blocks and thinner flaggy layers. Bedding surfaces contain long, sinuous trails. Fossils are rare at this quarry but include poorly preserved complete specimens of the trilobite *Gravicalymene celebra* and scattered orthoconic nautiloids (see Lowenstam 1948). The lower 9.7 feet (2.9 m) of the Sugar Run is more porous and crystalline and represents a transition to the underlying Romeo (Willman 1973). Pelmatozoan debris and dendritic root systems occur. This transition zone is lithologically more similar to Romeo than to Sugar Run.

Joliet Dolomite 63 feet (19.2 m)

Romeo Member 20.3 feet (6.1 m)

The upper 5.8 feet (1.7 m) is crystalline, massive, porous, rough-textured, gray dolomite that contains some pelmatozoan debris. The remainder of the unit is similar to the upper strata, but contains bands of chert nodules.

Markgraf Member 22.7 feet (6.9 m)

The Markgraf is argillaceous, dense, fine-grained, thick- to thin-bedded, light gray dolomite. Chert occurs in bands but is absent from the lower 6.6 feet (2.0 m).

Brandon Bridge Member 20.0 feet (6.0 m)

The Brandon Bridge is divided into two parts. The upper 8 feet (2.4 m) is crystalline, greenish gray to pinkish gray, nonporous, argillaceous dolomite. Thin, irregular, discontinuous, argillaceous partings are common. The top is marked by a zone of abundant argillaceous partings. These upper strata overlie a 0- to 9-inch (0- to 22.8-cm) layer of greenish gray shale. The lower 12 feet (3.6 m) is highly argillaceous, dark greenish gray to reddish gray, thin-bedded dolomite. The base of the Brandon Bridge is marked by a sharp bedding plane that represents a regional unconformity.

Kankakee Dolomite 41.9 feet (12.7 m)

Plaines Member 3.3 feet (12.7 m)

The Plaines is a conspicuous, highly crystalline, porous, pure, light brownish gray dolomite. Pelmatozoan debris is common and occurs with rare rugose corals and stromatoporoids. Dark greenish-gray trails and burrows are common. A layer of pentamerid brachiopods (e.g., *Microcardinalia* occurs about 1 foot (0.3 m) below the top.

Troutman Member 20.8 feet (6.3 m)

This member is thin-bedded, crystalline, nonporous, very rubbly textured, olive-gray dolomite. Thick, irregular, argillaceous partings are common.

Offerman Member 8.3 feet (2.5 m)

The Offerman is a lighter olive-gray and more argillaceous dolomite than the Troutman.

Drummond Member 8.5 feet (2.6 m)

The Drummond Member is massive to thick-bedded, dense, nonporous, olive-gray dolomite. The lower 5.5 feet (1.7 m) is cherty, weakly bedded, and rubbly-textured. The upper 3 feet (0.9 m) is massive, vuggy, porous, and noncherty. Silicified *Favosites* (a coral) and *Platymerella* spp. (a brachiopod) occur near the base. Except for cone elements, conodonts are uncommon through the Kankakee.

Elwood Dolomite 33 feet (10.0 m)

The Elwood Dolomite is a very cherty, argillaceous to pure, olive-gray dolomite. The upper 5 feet (1.5 m) contains *Platymerella* sp., primarily as disarticulated, nonoriented valves that are well-preserved in chert nodules, but poorly preserved in the surrounding dolomite. Gastropods, rugose corals, and trilobites are interbedded with thick zones of argillaceous partings at the base. The upper surface of the lower dolomite layer contains a variety of fossils, including brachiopods, rugose corals, bryozoans, pelmatozoan ossicles, and trilobites (calymenids, encrinurines, and *Leonaspis* sp.).

Wilhelmi Formation 40 feet (12.1 m)

The Wilhelmi grades upward from a dolomitic shale to a dolomite interbedded with shale. The upper strata are similar to basal Elwood. Distinct dolomite layers are separated by thinner zones of argillaceous partings. These dolomite layers are fossiliferous, containing gastropods, brachiopods, bryozoans, cephalopods, and trilobites (calyinenids and *Leonaspis* sp.). The dolomite layers become less distinct, more irregular, and more argillaceous toward the bottom. Light orange-gray dolomitic bands occur down to about 10 feet (3.0 m) above the base. As dolomite layers become thinner, zones of argillaceous partings become layers of dolomitic shale. From 7 to 10 feet (2.1 to 3.0 m) above the base, the unit is a uniform, fine-grained, massive, nonporous, argillaceous, dark gray dolomite that is highly bioturbated and has weakly defined burrows and trails. The lower 7 feet (2.1 m) is a dark greenish gray shale that is massive on fresh exposure but rapidly breaks down by weathering. Dalmanitid trilobites, lingulids, and rare trails occur near the top of this interval. Superficially, this unit resembles the Ordovician Brainard Formation and contains a few Ordovician conodonts but is considered to be basal Silurian because it lacks Brainard macro fossils and carbonate interbeds, because an unconformity occurs at its base, and because the broken and abraded condition of the few Ordovician conodonts suggests that they have been reworked.

Ordovician System

Maquoketa Group

Fort Atkinson Dolomite 33 feet (10.0 m)

The Fort Atkinson is a very crystalline, rough-textured, speckled, brownish red to light gray dolomite. Dense, nonporous layers interbed with porous, granular layers. It is thin-bedded with thick argillaceous partings at the top and base, but is massive in the center and only rarely contains partings. Lithologic variation represents a gradation from deposition of shale in the underlying strata to deposition of pure carbonates succeeded by more shale. Some layers are very fossiliferous; bryozoans and brachiopods are the most abundant fossils. The upper surface of this unit is marked by an unconformity that exhibits a very irregular undulating surface having as much as 2 feet (0.6 m) of relief.

Scales Shale

The top of the Scales is exposed in the sump. According to subsurface records, approximately 80 feet (24.3 m) of Scales underlies the Fort Atkinson here. Elevation at the top of the Galena Group is about 270 feet (82 m).

The most important feature of the National Quarry section is the occurrence of a thin Maquoketa Group and thick basal Silurian. The entire Brainard Formation was removed by erosion in this area, and the Wilhelmi was deposited directly on the Fort Atkinson surface (fig. 2). The Wilhelmi-Elwood interval represents a succession of basal dolomitic shales derived primarily from reworked Maquoketa sediments that grade upward into relatively pure carbonates.

Solution Features Although no longer visible, National Quarry was one of two sites in northeastern Illinois that contains common large solution cavities at the bedrock surface. These were up to 100 feet (30 m) across and extend downward as much a 60 feet (18.3 m) to the Brandon Bridge. The cavities were destroyed during the mining process. The cavities originally were filled with bluish gray clay and some angular white chert containing fossil debris such as pelmatozoans and favositid corals. The chert did not appear to have been derived from any of the existing Silurian strata in the quarry. More extensive cavities, some of which were filled with Pennsylvanian strata, occurred at the Lehigh Quarry west of Kankakee, but most of these also have been removed by quarrying.

Quarry History The National Stone Company began operations at this site around 1906, incorporating several small building-stone quarries. The company produced crushed stone and some flagstone. In 1929 the quarry was owned by the Dolese and Shepard Company, but operated under the name National Stone Company until it was purchased by Vulcan Materials Company in the late 1960s. More than 30 quarries operated in the area in the past.

Origin of the Dolomites

The dolomitic rocks were originally deposited as limestones by the chemical precipitation of calcium carbonate from sea water and by the accumulation of the calcareous remains of marine plants and animals. There is considerable evidence that the limestones were changed to dolomites, or dolomitized, at some time after their deposition.

During dolomitization, magnesium ions replace calcium ions in the atomic structure of the mineral calcite ($CaCO_3$). On the basis of the degree of dolomitization, a carbonate rock is classified as limestone (0 to 10% dolomite), dolomitic limestone (10 to 50% dolomite), calcitic dolomite (50 to 90% dolomite), or dolomite (90 to 100% dolomite). In pure dolomite, the calcium-magnesium ratio is about 1:1. Small amounts of ferrous iron usually replace some of the magnesium in dolomite, resulting in the characteristic light brown color of most weathered dolomite formations. Recrystallization also takes place during dolomitization, in many cases producing a sucrosic (sugary) texture that is also characteristic of many dolomites. Because of this recrystallization, primary sedimentary structures, such as internal bedding, are destroyed. In addition, the original shell material of the fossils have been largely destroyed or are poorly preserved because of the recrystallization of the limestone into dolomite. See the fossil plates in the back of the guidebook for identification.

There are several geologic models for the origin of the dolomites. Some geologists believe that dolomitization takes place soon after deposition, when the unconsolidated limy sediments are still in contact with the sea water. Magnesium in the sea water is exchanged for calcium in the sediments by a reaction with the sea water that bathes the upper part of the sediments. Other geologists believe that after the limy sediments have been consolidated to limestone, dolomitization takes place by a reaction with magnesium-rich formation water (connate water) that was trapped in the limy sediments or in associated sandstones and shales during deposition. Still another theory holds that dolomitization is accomplished by groundwater that becomes charged with magnesium from the zone of weathering at the Earth's surface. The magnesium-rich groundwater percolates through the pores and cracks (joints) in the limestones, altering them to dolomite. There is evidence that dolomite is precipitated directly from sea water under certain specialized environmental conditions and that many dolomites are primary in origin rather than secondary alteration products of limestone. However, the special conditions required for primary precipitation of dolomite generally are not found in most regions of present limestone deposition in the seas. Space does not permit an evaluation of all of the various theories that have been proposed to explain dolomitization. Suffice it to say that the problem is a complex one.

STOP 4: Blodgett Dolomite Prairie, Des Plaines Fish and Wildlife Area (NE, NE, Sec. 33, T34N, R9E, 3rd P.M., Wilmington 7.5-minute Quadrangle, Will County). On the day of the field trip, we will follow the gravel road west of the parking lot and take an auto safari through the dolomite prairie.

Blodgett Dolomite Prairie

The Blodgett Dolomite Prairie (fig. 21) represents a unique type of habitat that occurs along the Des Plaines River valley from Lockport southward to the Illinois River. During your visit to this prairie, regardless of season, you may derive pleasure in investigating the diversity of plants, animals, birds, and even insects. If you consider each of the seasons as an opportunity to participate in what may be described as a living outdoor play, you may not have considered what must take place before the play begins. The answer, of course, is that the stage must be set before the play goes on. The preparation of this natural stage is the building of the geological foundation, through the processes of weathering, erosion, transportation, and deposition.

Our rivers, streams, and landscapes are the product not only of flowing water and land use activities but also, most important, of the geologic foundation and landforms on which they evolved.

As with every story, there needs to be a beginning. This story starts with the last great continental glacier to enter Illinois, the Wisconsin Glacial Episode.

Building the Foundation

A history of the area surrounding the confluence of the Des Plaines and Kankakee River Basins, and the formation of the Illinois River, is a story of continental glaciation.

The last major advance of the Wisconsin Glacial Episode occurred during the Woodfordian time, which began about 22,000 years B.P. Glacial ice from an accumulation center located in Labrador slowly flowed southward through the Lake Michigan Basin to form the Lake Michigan Lobe (fig. 22). This lobe spread out across northeastern Illinois. The Wisconsin Glacial Episode melted (retreated) from northeastern Illinois about 13,500 years B.P.

Figure 21 Angular boulders of igneous erratics within Blodgett Dolomite Prairie at Stop 4 (photo by W.T. Frankie).

The present landscape in the Joliet area is largely the result of deposition and erosion during the Woodfordian Substage of the Wisconsin Glacial Episode. The various deposits (sediments) that formed during the Woodfordian time are classified as belonging to the Wedron Group. The surficial landscape and deposits have been modified somewhat by further erosion and deposition during the Holocene Stage, after the last glaciers melted away.

The glacier of the Wisconsin Episode reached its maximum westward extent about 21,000 years B.P., when it reached beyond Hennepin in Putnam County to block the ancient Mississippi River from its ancestral course south of the “great bend” of the present-day Illinois River. After establishing the Mississippi in its modern course, the ice front melted back. Whenever the rate of melting was approximately equal to the rate of forward movement of the ice mass, the ice front was relatively stationary. In this way, successive end moraines were deposited. The outermost series of moraines is part of the Bloomington Morainic System (fig. 13).

Advance and Retreat The Wisconsin glacier did not make a single advance and retreat, but advanced, retreated, and re-advanced many times in response to alternately warmer and cooler climatic conditions. How far the ice melted back at the end of each recession cannot be determined, but the marginal outline of each re-advance, marked by an end moraine, was different from the preceding one. The front of the Wisconsin glacier moved over the area of the field trip several times.

After the ice front melted eastward, additional surges of ice produced additional moraines to the east. During the northeastward retreat of the glaciers during the early Wisconsin Episode, the Illinois Valley was dammed by the Arlington Moraine located east of Hennepin. As the glacier melted back from this moraine (retreating toward La Salle), proglacial Lake Illinois was formed at an elevation of 600 feet. When the front of the Wisconsin glacier was located east of Ottawa, the

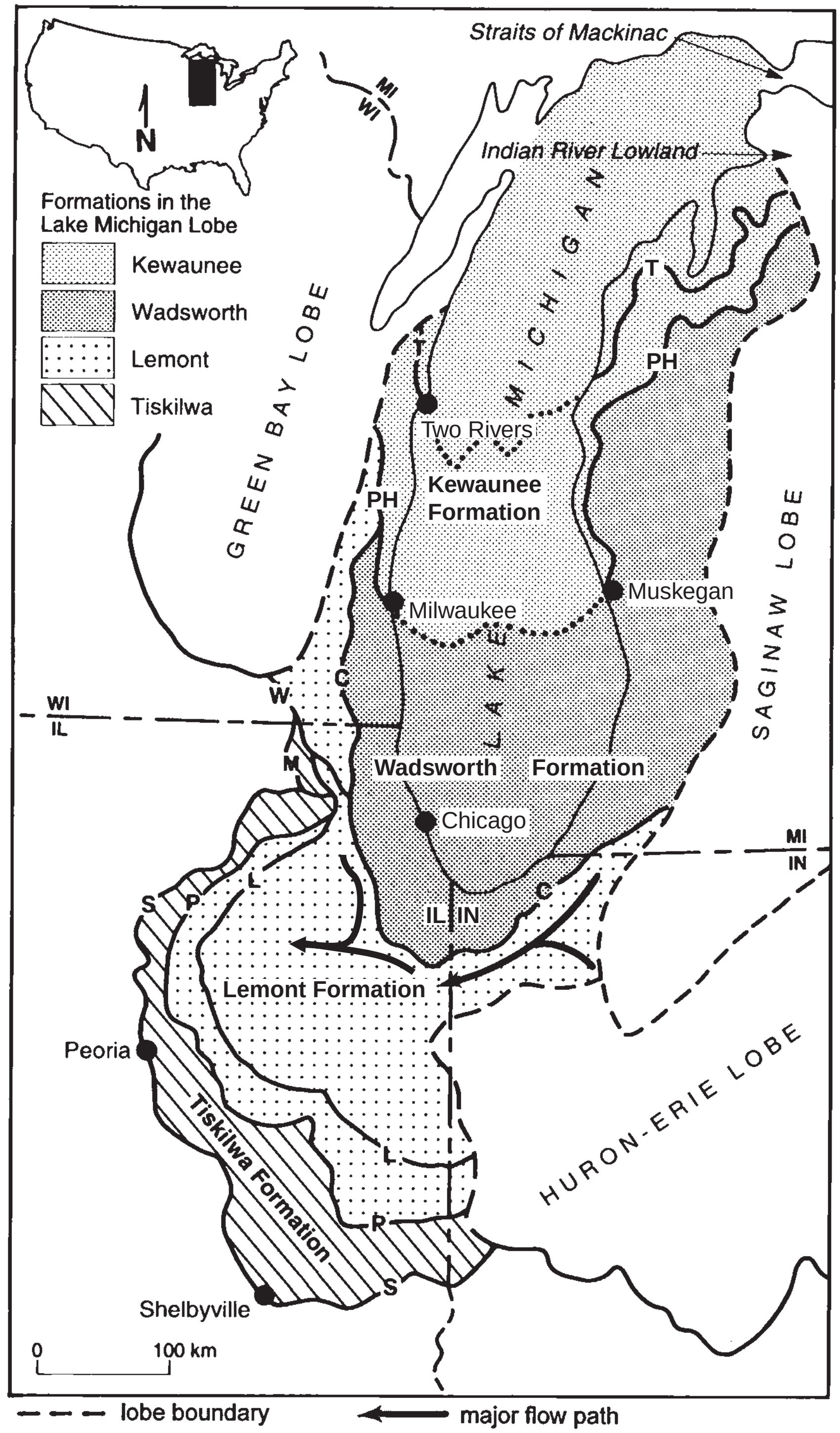


Figure 22 Position of the Green Bay, Lake Michigan, Saginaw, and Huron-Erie glacial lobes. Heavy arrows indicate major flow paths of glacial meltwaters during the Kankakee Torrent. Shown are the surface distribution of the Tiskilwa, Lemont, Wadsworth, and Kewanee Formations of the Wedron Group. Also shown are the maximum ice-margin positions during the glacial phases in the Lake Michigan Lobe: Marengo (M), Shelby (S), Putnam (P), Livingston (L), Woodstock (W), Crown Point (C), Port Huron (PH), and Two Rivers (T) (modified from Hansel and Johnson 1996).

Marseilles Morainic System formed about 18,000 years B.P. After the Wisconsin glacier had retreated from the Marseilles Moraine to the north and northeast, climate cooling caused the ice to re-advance to an area just west of Joliet. During this time, about 15,300 years B.P., the Rockdale Moraine formed (fig.13).

There is some doubt as to the exact location of the ice front because part of the front of the moraine has been removed by subsequent erosion, particularly by the Kankakee Torrent. The glacier may have advanced farther to the south than is now apparent. A slight warming of the climate caused the Rockdale glacier to melt back. After a period of glacial retreats and advances, the glacier retreated to a position located east of Joliet. Another chilling of the climate caused the ice to re-advance to the position of the Wilton Center Moraine (fig. 13). Retreat of the glacier from the Wilton Center Moraine was followed by a re-advance to the position of the Manhattan Moraine (fig. 13). Warming once again caused a retreat of the Manhattan glacier, which was followed by a major re-advance, leading to the development of the Valparaiso Moraine about 14,900 years B.P. (fig. 13).

The Valparaiso Moraine represents a major re-advance of the Wisconsin glacier into northeastern Illinois. For a time, the glacier's rate of melting was approximately equal to the rate of forward movement, and the ice front was relatively stationary. During this time, the moraines of the Valparaiso Morainic System were being formed. During melting of the Valparaiso ice, conditions were different from those of earlier times because ice lobes from the Lake Michigan, Saginaw, and Lake Erie basins in Illinois, Michigan, and Indiana coalesced in such a manner that the only drainageway for meltwater from these three glacial lobes was down the Kankakee Valley (fig. 13).

Water from the melting of the ice front, in the area east of Joliet, combined with huge volumes of meltwater from the glacial ice fronts in Michigan and Indiana. This large accumulation of meltwater flowed westward down what is called the Kankakee Valley, creating what is referred to as the Kankakee Torrent. (Note: This Kankakee Valley includes what today are the modern valleys of the Des Plaines, Du Page, and Kankakee Rivers.) The meltwater flooded the Kankakee Valley because either there was no outlet or the only outlet was possibly through a narrow constriction in the Marseilles Morainic System into the Illinois Valley to the west (fig. 13).

Kankakee Torrent The most important geologic event shaping the landscape and the character of the deposits in the basin was the ancient "Kankakee Flood," also known as the Kankakee Torrent.

At the height of the flood (peak flow), the volume of meltwater was so great that it was not able to escape into the Illinois Valley through the narrow outlet in the Marseilles Moraine. As a result, water spread widely over the uplands, resulting in the development of numerous proglacial lakes: Lake Wauponsee, Lake Watseka, Lake Ottawa, and Lake Pontiac (fig. 13). The deposits associated with these lakes consist of fine-grained lacustrine sediment (clays). When the lake level finally topped a low sag in the Marseilles Moraine crest, meltwater quickly eroded a channel westward. This channel was rapidly deepened and widened as the lake drained.

After the ice front retreated from the area of the Valparaiso moraines, a re-advancement formed the Tinley Moraine (fig. 13). When the glacier that had deposited the Tinley Moraine began to melt back from that moraine about 14,000 years B.P., the proglacial Lake Chicago was formed between the melting ice front and the back slope of the Tinley Moraine (fig. 13). Initially Lake

Chicago was a crescent-shaped body of water around the ice front that eventually expanded to cover much of the area that is now Chicago. As the ice margin continued to melt, the lake expanded northward.

Lake Chicago drained by way of an outlet through the Valparaiso and Tinley Moraines southwest of the present site of Chicago. This outlet, the "Chicago Outlet," consisted of two channels on the east side of the outlet (the Des Plaines and Sag Channels) that crossed the Tinley and Valparaiso Moraines and converged near Sag Bridge to form a single channel, the Des Plaines Valley (fig. 13). This channel emerges from the Valparaiso Morainic System, north of Joliet near Romeoville, and flows approximately 20 miles southwestward, where it is joined by the Du Page River about 4 miles upstream from the confluence with the Kankakee River (fig. 13). The Illinois River is formed by the confluence of the Des Plaines and Kankakee Rivers at mile post 273 (mile post 0 is at the Illinois/Mississippi confluence at Grafton). The Des Plaines River probably originated as a subglacial channel during the early formation of the (outer) moraines of the Valparaiso Morainic System, and it persisted as an outlet for meltwater during the formation of the later (inner) moraines of the Valparaiso Morainic System and for the even younger moraines that formed to the east.

Eventually, as the Valparaiso glacier melted back, an eastern outlet to the south was opened along the Wabash Valley, and some of the meltwater was diverted from the Lake Erie Lobe, decreasing the volume of flow in the Kankakee Valley.

About 13,500 years B.P., the Wisconsin Episode Glacier ice front melted back from Illinois into the Lake Michigan Basin, but the Chicago Outlet continued to drain glacial meltwater. As the ice retreated northward, the Chicago Outlet served as the outlet not only for Lake Chicago but also for lakes that formed in the Lake Huron, Lake Saginaw, and Lake Erie basins. It was probably at this time (between 13,500 and 12,000 years ago) that Lake Chicago (ancestral Lake Michigan) reached its highest elevation (640 feet) and formed the Glenwood beach.

By about 12,000 B.P., retreat of the ice margin had opened lower outlets for the proglacial lakes in the eastern basins as well as the lower northern outlet for the Lake Michigan Basin at the Straits of Mackinac. The elevation of these outlets was below the elevation of the Chicago Outlet. This difference caused the lake level to fall to a level near that of present-day Lake Michigan. The Chicago Outlet was dry until a re-advance of the Lake Michigan Lobe about 11,800 B.P. blocked the Straits of Mackinac and Lake Chicago rose to the 620-foot level, reactivating the Chicago Outlet. It was during this time that the Calumet beach formed.

Final deglaciation (melting back) of the glacier from the Straits of Mackinac in northern Michigan, at about 11,000 years ago, re-opened the isostatically depressed lower northern outlets, and the lake level in the Lake Michigan Basin fell below the level of the Chicago Outlet (590 feet). The Chicago Outlet remained dry until 5,000 B.P., when differential isostatic uplift to the north caused a rise in the level of the lake to the 605-foot level. During this transgression, known as the Nipissing transgression, the Chicago Outlet was reactivated. The lake reached the 605-foot level, and the Toleston beach formed.

The Chicago Outlet was abandoned shortly after 4,000 B.P. when incision (downcutting by erosion) of the outlet at Port Huron caused the lake level to drop below the level of the Chicago Outlet. Continued retreat of the glacier allowed other river outlets to drain the region north and east of this locality. Eventually most of the meltwater was deflected away from the Kankakee Valley, marking the end of the Kankakee Torrent. After this time, water from the Lake Michigan Basin did not flow through the Des Plaines Channel again until the Illinois and Michigan Canal was constructed.

Summary Three high-level stands of lakes in the Lake Michigan Basin occurred until shortly after 4,000 years B.P., when northern outlets were finally incised deeply enough to form a water outlet level that was lower than the Chicago Outlet level. As the ice retreated northward, the Chicago Outlet served as the outlet not only for Lake Chicago but also for lakes that formed in the Lake Huron, Lake Saginaw, and Lake Erie basins. After this time, water from the Lake Michigan basin did not flow through the Des Plaines channel again until the construction of the I & M Canal. The Des Plaines River flows on a bedrock floor from the Chicago Outlet channel to Joliet and from there to the head of the Illinois River, about 18 miles downstream, the Des Plaines River occupies a shallow trench cut into bedrock.

Mechanics of the Kankakee Torrent

Of great importance in understanding the mechanics of the Kankakee Torrent is that the vast quantities of meltwater originating from the junction of these three glacial lobes and discharged through the Kankakee Valley was not a single occurrence, but rather are a great number of recurring floods, which are collectively referred to as the Kankakee Torrent.

As the meltwaters continually entered the flooded Kankakee Valley, their velocity and load-carrying capacity were sharply decreased. Much of the coarse rock debris being carried by the meltwater was deposited in the eastern portion of the Kankakee Valley. Finer materials, sand, silt, and clay were deposited in quieter waters of the proglacial lakes away from the main flow stream.

When a gap in the Marseilles Moraine was eventually eroded, the base level of the Kankakee Flood lowered considerably. Water flow became more concentrated in the central Kankakee Valley in the area surrounding the confluence of the Des Plaines and Kankakee Rivers. Eventually the floodwaters scoured broad areas down to the bedrock surface. Today, the bedrock within the area of the confluence and along the Kankakee and Des Plaines Rivers is exposed or covered by a thin layer of sediment. Most of the bedrock along the Des Plaines and Kankakee River valleys within the field trip area is Silurian age dolomite. The erosive force of the currents deposited numerous bars composed of angular and bouldery rubble, as well as relatively flat slabs of local bedrock that had been ripped up by the flowing water. These deposits are called *rubble bars*. (A favorite hangout for early Pleistocene man with the first name of Barney?)

There was sufficient gradient, as well as volume, to give the torrent a velocity capable of carrying rock slabs and erratic boulders up to several feet in diameter. The large number of glacial erratics strewn throughout the dolomite prairies is a prime example of the power associated with the torrents (fig. 21). Boulders were concentrated (left behind) as the fine-grained till deposits were scoured out of the valley. The swift currents also eroded the Silurian bedrock, ripping up blocks and slabs of dolomite. This erosion was most active in the early stages of the torrent as the flood waters receded. The inner margin of the Marseilles Moraine and the outer portions of the Rockdale Moraine were also cut away and perhaps straightened by this erosion. Great bars of rubble, sand, and gravel were built up, with a general decrease in coarseness from east to west, reflecting a slackening of the currents in that direction. As the torrent declined, the flood became divided into several channels and assumed a braided pattern between the rock ridges and rubble bars on the relatively flat floor of the Kankakee Valley.

As the Kankakee Torrent continued to subside, rivers became entrenched and large thick expanses of sandy outwash sediments left behind by the receding floodwaters were deposited in a wide belt along the Kankakee Valley. As a result, large tracts of sandy sediments occur along the Kankakee Valley, especially its southeastern part. This extensive sandy deposit is the primary source area for the sediments now residing in the Kankakee River. In addition, the sand deposits were exposed to eolian (wind) activity that resulted in dune building.

The final episode shaping the character of the geological materials in the river basin is the modern deposition of silt, sand, and gravel along the major rivers and their tributaries. In Illinois, this material is referred to as Cahokia Alluvium. It consists of materials transported down the valley and deposited in floodplains during intervals of flooding and also includes sediments deposited directly by tributary streams. The alluvium generally rests conformably on bedrock and glacial deposits.

Dolomite Prairie

The following was modified from information obtained from "The Prairie Plan" for the Midewin National Tallgrass Prairie (www.fs.fed.us/mntp/).

The dolomite prairie is considered to be the rarest and possibly the most unique natural community of the different types of prairies remaining in Illinois. This community is restricted to areas of exposed dolomite limestone or shallow soils less than 20 inches (50 cm) thick over dolomitic bedrock. Because of the close proximity of the bedrock to the soil surface, the water table is *perched*. These areas can be very wet in the spring and very dry during summer. The calcareous bedrock causes the soils to be more alkaline than other types of prairies. The extreme moisture fluctuations, shallow soils, and calcareous nature of the soils exclude many common prairie plants and allow for the presence of many regionally uncommon or rare plants. Because dolomite prairies are now very rare, so are many species restricted to this habitat. Specialized plants such as the federally endangered, leafy prairie-clover (*Dalea foliosa*) are dependent on these calcareous habitats.

The dolomite prairie habitats can be subdivided into five classes (or types) based on soil moisture: dry, dry-mesic, mesic, wet-mesic, and wet dolomite prairies. The locally complex nature of the physical conditions (soil depth and drainage) control the development of the specific dolomite prairie moisture classes. A single dolomite prairie often contains more than one type of dolomite prairie Two plants species, low calamint (*Satureja arkansana*) and flattened spikerush (*Eleocharis compressa*), are often present in all moisture classes of dolomite prairie. The mesic dolomite prairie is habitat for the endangered leafy prairie clover.

Physical Environment This dolomite prairie habitat occurs on shallow soils less than 20 inches (50 cm) thick over dolomite bedrock. The relatively shallow bedrock restricts plant rooting depth and certain deep-rooted prairie plants (white wild indigo, *Baptisia leucantha;* pale purple coneflower, *Echinacea pallida;* round-headed bush clover, *Lespedeza capitata;* prairie dock, *Silphium terebenthinaceu;* compass plant, *S. laciniatum;* and prairie gentian, *Gentiana puberulent*a) may be rare in a dolomite prairie or absent. The soils may be silty loam, clays, or sandy loams; they are usually derived from outwash, reworked glacial till, and decomposed (weathered) bedrock. Bedrock fragments and glacial erratics are usually present. There may be relatively extensive exposures of bedrock (outcroppings and pavements) with no or little accumulated soil cover. These areas, however, provide suitable substrate for lichens, bryophytes, and algae.

Dolomite is a calcareous, sedimentary bedrock similar to limestone; this rock is also called dolostone and dolomitic limestone. Some (or most) of the calcium carbonate, however, has been replaced by magnesium carbonate. Because of the relatively high magnesium levels derived from the bedrock and dolomite fragments, some common prairie plants may be reduced in abundance or even absent from dolomite prairie. This reduction in competition may allow other rare species to become predominant (for example, tufted hair grass, *Deschampsia caespitosa*).

In northeastern Illinois, dolomite prairies may be present on the outwash plains of river valleys or on bedrock terraces along the valley sides. Most dolomite prairies in Illinois are concentrated in the lower Des Plaines River valley, but smaller tracts are present in the lower Kankakee and upper Illinois, Fox, and Rock River valleys. Because of the shallow soils and relatively level topography of the Des Plaines River valley, internal drainage is often poor. Conversely, the shallow soils limit rooting depth and moisture storage, and dolomite prairies dehydrate rapidly between summer rains. Native plants unable to tolerate these moisture extremes may be excluded from dolomite prairie, and otherwise uncommon species may predominate (for example, nodding wild onion, *Allium cernuum*).

Where dolomite prairies occur on extensive outwash plains, the landscape is relatively level. However, there is some variation of the bedrock surface; deeper areas were created by the scouring action of the glacial ice and the postglacial flooding. The depth of the soil also varies, reflecting uneven deposition and erosion by postglacial flooding and more recent surface flow. This interaction between bedrock depth and surface topography creates a mosaic of soil moisture and drainage conditions, often reflected in the vegetation.

Natural disturbances are important factors in dolomite prairie. Fire removes accumulated litter, top-kills shrubs, and creates exposed soil, which serves as sites for seedling germination and establishment. Where the bedrock is near the surface, potential fuels are often low or patchy, effectively reducing fire frequency and intensity. Frost heaving and burrowing by small vertebrates and insects may disturb the soil. Large herbivores may also disturb the soil, and their selection of forage may favor certain less competitive plant species.

Some areas with bedrock greater than 20 inches (50 cm) thick also support dolomite prairie-like vegetation. These areas occur on the thicker deposits of the outwash plains. Examples of these habitats occur near Grant Creek and Prairie Creek within the Midewin National Tallgrass Prairie west of Illinois Route 53. Their similarity to dolomite prairies appears to be partly a result of a relatively shallow, dense layer of clay in the soil. Additionally, these outwash plain soils contain weathered dolomite fragments and particles, and the presence of the dissolved magnesium affects the vegetation. Many of the common plants (such as flattened spikerush and low calamint) of these areas are also characteristic of dolomite prairie.

Vegetation Because factors such as soil depth may change drastically within a short distance, dolomite prairie is often a mosaic of plant associations. A few plant species occur under a wide range of soil depths and moisture, including low calamint (*Satureja arkansana*) and flattened spikerush (*Eleocharis compressa*).

Where bedrock is exposed, there are generally no vascular plants. Instead, there may be covering of lichens (for example, *Dermatocarpon miniatum, Placynthium nigrum, Caloplaca* spp.) and mosses (for example, *Hedwigia ciliata*), or cyanobacterial mats ("blue-green algae"). Some perennial herbs may be present in bedrock cracks, especially Side-oats Grama (*Bouteloua curtipendula*), Prairie Satin Grass (*Muhlenbergia cuspidata*), and Aromatic Aster (*Aster oblongifolius*).

Where shallow soil has accumulated on the bedrock, there may be different lichens (*Catapyrenium lachneum*) and liverworts (*Asterella* spp. and *Riccia* spp.) or stands of annuals, including wiry panic grass (*Panicum flexile*), awned flatsedge (*Cyperus inflexus*), false mallow (*Malvastrum hispidum*), common ragweed (*Ambrosia artemisiifolia*), Pitcher's stitchwort (*Minuartia patula*), woolly croton (*Croton capitatus*), spring forget-me-not (*Myosotis verna*), whitlow-cress (*Draba reptans*), nodding spurge (*Chamaesyce maculata*), and rush grass (*Sporobolus vaginiflorus*). The prickly-pear cactus (*Opuntia humifusa*) occurs in this situation.

Perennial grasses and forbs occur in deeper soils adjacent to bedrock exposures and may be rooted in deep bedrock joints. Typical perennial species include nodding wild onion (*Allium cernuum*), hairy beardtongue (*Penstemon hirsutus*), sheathed rush grass (*Sporobolus clande stinus*), small skullcaps (*Scutellaria parvula*), scurfy-pea (*Psoralea tenuiflora*), stiff vervain (*Verbena simplex*), whorled milkweed (*Asclepias verticillata*), and Ohio horse-mint (*Blephilia ciliata*).

As the soils become thicker, greater than 2 inches (5 cm), plant species diversity increases. Perennial grasses become more important, especially prairie dropseed (*Sporobolus heterolepis*), but also big bluestem (*Andropogon gerardii*), Canada wild-rye (*Elymus canandensis*), Indian grass (*Sorghastrum nutans*), and little bluestem (*Schizachyrium scoparium*).

Frequent forbs include round-fruited St. John's wort (*Hypericum sphaerocarpum*), thicket parsley (*Perideridia americana*), wild hyacinth (*Camassia scilloides*), prairie ironweed (*Vernonia fasciculata*), Riddell's goldenrod (*Solidago riddellii*), Canada onion (*Allium canadense*), marsh phlox (*Phlox divaricata*), mountain-mint (*Pycnanthemum virginianum*), prairie milkweed (*Asclepias sullivantii*), and saw-toothed sunflower (*Helianthus grosseserratus*). Certain sedges (*Carex granularis, C. suberecta*) may be locally common.

As soil moisture and depth increase, additional species become common, including prairie cordgrass (*Spartina pectinata*), red bulrush (*Scirpus pendulus*), tufted hair-grass (*Deschampisa cespitosa*), switchgrass (*Panicum virgatum*), marsh hedge-nettle (*Stachys tenuifolia hispida*), Torrey's rush (*Juncus torreyi*), erect knotweed (*Polygonum ramosissimum*), wild madder (*Galium obtusum*), water horehound (*Lycopus americanus*), sedges (*Carex pellita*), and spikerushes (*Eleocharis erythropoda*).

Broad depressions over shallower soils are often dominated by stands of tufted hair grass. Smaller depressions with shallow soil over bedrock are important microhabitat for Butler's quillwort (*Isoëtes butleri*), glade onion (*Allium mobilense*), Crawe's sedge (*Carex crawei*), and scarlet loosestrife (*Ammania coccinea*); some species from drier sites are also present around the margins of these depressions (hairy beardtongue, nodding wild onion, Pitcher's stitchwort).

Smaller, but often deeper depressions within dolomite prairie provide important micro-habitats for certain wetland species, including white water-crowfoot (*Ranunculus longirostris*), mud-plantain (*Alisma trivale*), water purslane (*Ludwigia polycarpa*), smartweeds (*Polygonum* spp.), and spikerushes (*Eleocharis acicularis*, *E. obtusata*). The moss *Drepanocladus* is sometimes associated with these depressions.

Shrubs and trees are usually not important components of dolomite prairie. Well-drained sites may support occasional shrubs, such as lead plant (*Amorpha canescens*) or New Jersey tea (*Ceanothus americanus*). Pasture rose (*Rosa carolina*), another low shrub, may form colonies in dolomite prairie. Where dolomite prairie occurs along drainages or adjacent to streams, false indigobush (*Amorpha fruticosa*) may be present.

Figure 23 A coyote stands upstream of waterfalls formed by Silurian bedrock at Prairie Creek at Stop 5 (photo by W.T. Frankie).

STOP 5: Lunch, Milliken Lake and Prairie Creek Picnic Area, Des Plaines Fish and Wildlife Area (NE, SE, SW, Sec.15, T33N, R9E, 3rd P.M., Wilmington 7.5-minute Quadrangle, Will County).

At this stop you will have the opportunity to view the Kankakee River and Milliken Lake. Near the entrance to the picnic area, Prairie Creek flows into the Kankakee River. Two small waterfalls have developed immediately upstream from its confluence with the Kankakee River. Silurian age dolomite is exposed along Prairie Creek (fig. 23).

Milliken Lake

During the construction of Interstate 55, the Illinois Department of Transportation was in need of fill material for construction of overpasses. They approached the long-time site superintendent Clair Milliken and asked if he knew of an area where they might obtain the necessary material. As it turns out, Mr. Milliken had wanted a lake within the Des Plaines Fish and Wildlife Area for some time. Needless to say, he gave them permission to excavate the material, thus creating Milliken Lake. An interesting sidebar to this story is Mr. Milliken acted completely on his own and did not receive permission from Springfield. On hearing what he had done, the head of the Department of Conservation, now the Department of Natural Resources, a long-time friend of Clair, told him that the pit better hold water or he was going to be looking for a new job. The hole held water, and Mr. Milliken served as site superintendent from 1948 until his retirement in the mid-1980s (Dennis Doyle, current site superintendent, personal communication). Milliken Lake was originally Lake Des Plaines.

Kankakee River

The Kankakee and Iroquois River watersheds are located in east central Illinois. The Kankakee flows 57 miles in Illinois before its confluence with the Des Plaines River. The confluence of the Des Plaines and the Kankakee River form the Illinois River. The Kankakee River drains an area of 5,165 square miles in Illinois and has one major tributary, the Iroquois River, which flows west from Indiana. The Kankakee and Iroquois River watersheds cover a total of 1,375,068 acres.

Water Quality

The following water quality information was extracted and modified from a water quality fact sheet from the Illinois Environmental Protection Agency (1997). The streams in this report were rated either good, fair, or poor.

A total of 970 stream miles was assessed on the Kankakee River and its tributaries. The watersheds are exceptional water systems, as the watersheds have "good" overall resource quality for 893 stream miles (92%). Only 77 stream miles (8%) are rated as "fair." The causes of pollution are nutrients and siltation attributed to agriculture and municipal point source pollution.

Lake Des Plaines, otherwise known as Milliken Lake, is owned and managed by the State of Illinois. The lake has a surface area of 21 acres and has a relatively small watershed of 300 acres. The overall resource quality of Lake Des Plaines is considered "fair." Causes of pollution to the lake include nutrients, siltation, suspended solids, noxious aquatic plants, and organic enrichment (low dissolved oxygen). Primary sources of pollution include agriculture and nutrient enrichment from waterfowl waste.

The following information was modified from the Department of Natural Resources (1995) park brochure.

Des Plaines Fish and Wildlife Area A tranquil setting, flowing rivers, and natural prairie land—the Des Plaines Fish and Wildlife Area (fig. 24) has it all! Visitors will delight in the abundance of wildlife, restful picnic areas, and variety of sport-fishing species. Farmland and woodland, prairie and swamp, still water and shoreline offer unlimited opportunities for nature lovers and sportsmen.

History Prior to 1948, what is now called the Des Plaines Fish and Wildlife Area was owned by the federal government. The Illinois Department of Conservation acquired the site in 1948 and established its use as a recreation area. Additional land was accessed following the completion of Interstate 55 in the 1960s. From that time to 1975, the area was used primarily by hunters and unmanaged day use. The Division of Land Management took over management of the area in 1976, and since then, extensive upgrading of facilities has occurred. In recent years, more than 350,000 people annually visit Des Plaines, an area of over 5,000 acres, of which approximately 200 acres are water.

Picnicking A restful break from hunting, fishing, or hiking can be a special event. Picnickers can choose to lunch along the Kankakee River or under the large shelter on the banks of Milliken Lake. Both sites provide tables, grills, and water along with cooling shade trees and picturesque views. A playground area is also provided at the Milliken Lake site.

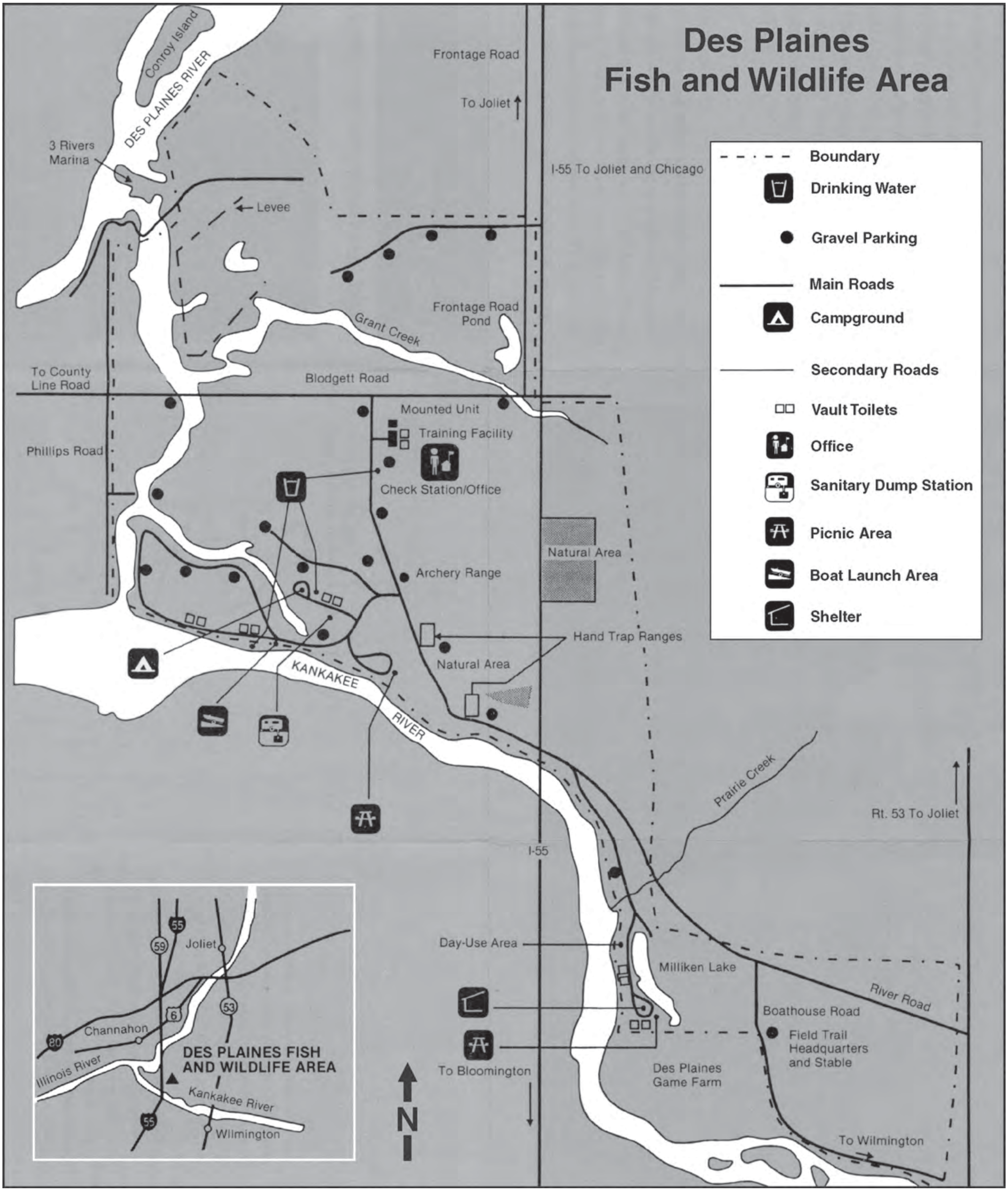


Figure 24 Des Plaines Fish and Wildlife Area (modified from Illinois Department of Natural Resources, park brochure, 1995).

Fishing Open water and ice fishing are popular and productive events as well. Milliken Lake, several ponds, and the river backwaters provide panfish, catfish, and bass fishing. The Kankakee River borders the site on the south. Three miles of shoreline provide access to boating enthusiasts and excellent walleye and northern pike fishing.

Camping Designated camping areas are available for those wanting to stay overnight at the site. These are Class C areas with graveled pads, water, and pit toilets. The area is closed to all camping during November and December.

Boating A public boat launch with three paved ramps is available on the Kankakee River for boating on the river or its backwaters. Motors are limited to 10 horsepower or less on the backwaters, but there are no limits on the Kankakee River. No boating is allowed on Milliken Lake.

Hunting Pheasant hunting (by permit only) is the most popular choice for sportsmen at Des Plaines, and the largest pheasant hunting facility in the state is located at the site. For variety, however, there are unlimited numbers of deer, rabbit, and dove. All hunters are required to have permits and check in at the site office. Waterfowl hunting is available at the nearby Will County Waterfowl Management Area; hunting blinds are allocated via drawings.

Nature Preserve Eighty acres of the Des Plaines Wildlife and Conservation Area make up a dedicated nature preserve that contains many remnants of the natural prairie of years past. The preserve is managed so it can protect and perpetuate this prairie heritage for future generations. Visitors are encouraged to view this area, but are reminded that all plants and animals here are protected and are not to be disturbed in any way.

Hand Trap Range Two hand trap ranges and an archery range are open to the public daily expect during pheasant hunting season. Sportsmen are welcome to practice and hone their skills so they will be ready to go on opening day.

Dog Training The Des Plaines Fish and Wildlife Area is well known for numerous field trials and dog training events held throughout the year. The plentiful open areas, swampy backwater areas, and woodlands provide a perfect spot for all types of training. Whether you are training your animal or just being a spectator, these events can be a great way to spend a day or weekend outdoors.

Directions Located 10 miles south of Joliet and 55 miles southwest of Chicago in Will County, the site is accessible from Interstate 55 at mile marker no. 241, Wilmington exit.

STOP 6: Pitt 11, Mazonia/Braidwood Fish and Wildlife Area (NE, NE, NW, Sec.6, T31N, R9E, 3rd P.M., Essex 7.5-minute Quadrangle, Kankakee County). On the day of the field trip, we will follow the service road located east of the parking lot.

We will have the opportunity to collect plant and animal fossils from the spoil piles in the area of the abandoned Peabody Coal Company, Northern Illinois Mine, Pit 11, located within the Mazonia South Unit.

In 1928, large-scale surface mining began in northern Illinois in the Colchester (No. 2) Coal Member, the lowermost member of the Pennsylvanian Carbondale Formation (fig. 2). The first surface mines were confined to areas of thin overburden near the outcrop of the coal seam. As mining equipment became more sophisticated, however, mine operators were able to recover the relatively thin coal from greater depths. In this vicinity, the Colchester Coal averaged about 3 feet thick, whereas in most other parts of Illinois, it was 24 to 30 inches thick. The Colchester Coal is overlain by the Francis Creek Shale, which is about 35 feet thick in this area. The latter is unconformably overlain by Wisconsinan Wedron Formation till and Parkland Sand.

Plant fossils are often found in the Francis Creek Shale exposed in Pit 11, but marine invertebrate fossils are more common. The Wilmington-Coal City-Braidwood area of northeastern Illinois is famous for an array of well-preserved flora and fauna. A number of books and scientific articles describe and illustrate the paleobotany/paleontology of the area. The fossils are preserved in siderite ($FeCO_3$, iron carbonate) concretions or nodules that range from less than 1 inch in diameter to more than 1 foot long and several inches wide. Not all concretions from this area are fossiliferous, however.

To find out whether you have specimens in the concretions that you have collected, you will need to open them. Wear safety glasses or goggles when working on the specimens. Place the concretion on a solid base, such as a large rock, and orient it so that you hold the short axis between your thumb and forefinger. Then, gently tap it around its entire circumference as you slowly rotate it about its short axis. Watch your fingers as you tap the specimen. You will not always get a clean break that will expose the whole specimen, especially if you strike it too hard and do not rotate it enough. Several rotations with light tapping are better than sharp blows with only one or two rotations.

The best method for splitting the concretions is to subject them to a series of freeze-thaw cycles. The best results are obtained by soaking the concretions in a plastic pail, filled with water, for two days. Then place them in a freezer for two days. Let the concretions thaw, and lightly tap them just as described. If they don't open, then continue to subject the concretions to a repeated series of freeze-thaw cycles until they break open either of their own accord or with very gentle taps. The number of freeze-thaw cycles range from a few times to as many as 20 or more. If they don't open after a number of freeze-thaw cycles and your patience has reached its limit, go ahead and give the concretion a good hard blow with a hammer (remember to wear safety glasses). Not all concretions contain specimens! If you don't have a large freezer at home to perform these cycles, you'll have to wait until winter for nature's help.

The following was modified from the Department of Natural Resources park brochure.

Mazonia/Braidwood State Fish and Wildlife Area

Mazonia Site Location Mazonia/Braidwood State Fish and Wildlife Area (fig 25) consists of 1,017 acres and is located in Grundy County 3 miles southeast of Braidwood on Illinois Route 53 and Huston Road.

History Braidwood Lake, owned by Commonwealth Edison, is a partially perched, cooling lake. Braidwood Lake was constructed in the late 1970s and impounded in 1980–1981 with water pumped from the Kankakee River. Several surface-mined pits were flooded within the lake, so fisheries management actually began in 1978, before the lake existed. The lake was considered a semi-private area used by employees of Commonwealth Edison until the fall of 1981 when the Department of Conservation (now the Department of Natural Resources) acquired a long termlease agreement from Commonwealth Edison, which allowed for general public access. Braidwood Lake currently is used for fishing, waterfowl hunting, fossil hunting by permit, and as a waterfowl refuge.

Existing Resources The area contains more than 200 water impoundments ranging from 3/4 acre to 30 acres. The water area currently contains largemouth bass, smallmouth bass, bluegill, green sunfish, crappie, channel catfish, and bullhead. Additional species will be stocked as the site is developed. Good wildlife habitat can be found on the site in the 700 acres of grassland, brushy draws, and limited woodland cover.

Area Objectives Mazonia is managed primarily for sport fish and waterfowl. Its purpose is to provide a quality sport fishery within the surface-mined lakes through habitat enhancement and supplemental stockings that, in turn, will provide the public quality bank and boat sport fishing opportunities. The site also will provide quality mid-migration and resident waterfowl habitat, including food, water, and sanctuary components that, in turn, will provide the public a quality waterfowl hunting opportunity. The area also will be managed for other resident or migratory game and non-game fish and wildlife species, particularly those listed as threatened or endangered. Although Mazonia features sport fishing and waterfowl hunting, a variety of other outdoor recreational opportunities are provided throughout the year. Upland game hunting, furbearer trapping, limited picnicking, nature study and birding, fossil hunting, and water-dog training are also available.

Facilities Although facilities currently are minimal, future development will include a paved access road to the main lakes, boat launches, ramps, parking lots, and toilets.

Hunting and Fishing Fishing and hunting are permitted on a seasonal basis and are subject to site regulations. Fishing closes 10 days prior to the Central Waterfowl Zone season and reopens at the conclusion of the Upland Game season, or as the ice becomes safe.

Mazonia South Unit The Mazonia South Unit was purchased by Department of Natural Resources from Commonwealth Edison in 1999. This acquisition was the first under the landmark Open Land Trust, a program that sets aside dollars to be used to purchase acreage for multiple-purpose recreation and to protect open space for future generations. The land making up the south unit was formerly surface mined, resulting in rugged terrain, four large lakes, and 10 smaller water impoundments that contain excellent fish populations. Access to most of the water will be available via boat launches, while some of the smaller lakes will be walk-in only. The area will be used for fishing, wildlife habitat, hunting, and other recreational activities.

Braidwood Lake Site Locations Braidwood Lake Fish and Wildlife Area consists of 2,640 acres and is located in Will County south of Braidwood off Illinois Route 53.

Boating Braidwood Lake can become very dangerous. Special precautions should be utilized. A wind warning system is in place by a flagpole located at the Cemetery Boat Ramp and the Kankakee Boat Ramp. The flag system displays predicted weather conditions for that day. Different colored flags will be raised to depict the weather conditions. The lake will be closed with 25-m.p.h. winds. Boats with a minimum length of 14 feet are recommended. Motor size is unlimited, but a 40-m.p.h. speed limit is strictly enforced.

Information For more information contact Mazonia/Braidwood State Fish & Wildlife Area, P.O. Box 126, Braceville, IL 60407, 815-237-0063.

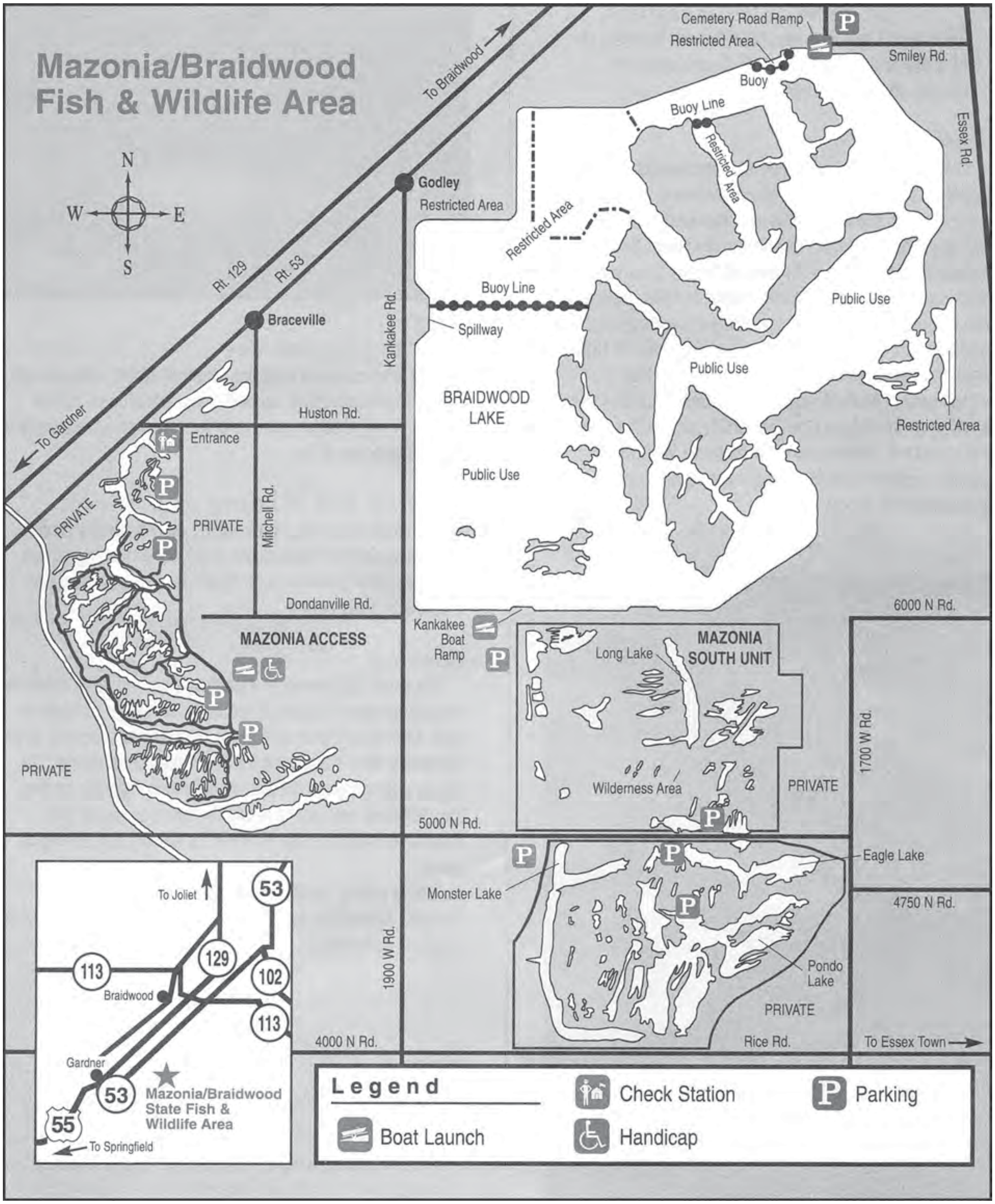


Figure 25 Mazonia/Braidwood State Fish and Wildlife Area (modified from Illinois Department of Natural Resources 2001).

For additional information on other state parks write to the Illinois Department of Natural Resources, Office of Public Services, One Natural Resources Way, Springfield, IL 62702-1271 or call 782-7454. Telecommunication Device for Deaf and Hearing Impaired Natural Resources Information 217 782-9175 for TDD only Relay Number 800-526-0844.

For more information on tourism in Illinois, call the Illinois Department of Commerce and Community Affairs' Bureau of Tourism at 1-800-2Connect.

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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 each other 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.

capric 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 windblown 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 maion body of groundwater by an unsaturated zone.

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

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 irregular 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 timeBrock 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 each other. 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 on exposure to the weather change in character and decay and finally crumble into soil.

OPTIONAL STOP: Lockport Dolomite Prairie, Lockport Nature Prairie Reserve (Sec. 22 and 27, T36N-R10E) Directions to the Lockport Dolomite Prairie: Take Interstate 55 north to exit 257 (Plainfield Road/U.S. Route 30 east). Take east Plainfield Road approximately 0.25 mile to Division Street. Turn left onto Division Street and head east approximately 4 miles to the intersection of Illinois Route 53. The entrance to the Lockport Dolomite Prairie is directly east of the intersection.

Lockport Dolomite Prairie

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Four main types of prairie (tallgrass, sand, hill, dolomite), all of which are in severe decline, are found in Illinois. Dolomite prairies are perhaps the rarest, being known at only a small number of localities. They can be roughly divided into two subtypes, dry and wet, although there are intermediates, and different dolomite prairies of varying degrees of moisture have sometimes been found not far from one another. Remnant dry dolomite prairies have been found in northwestern and north-central Illinois in Jo Daviess, Ogle, Stephenson, and Winnebago Counties (Post 1998, Corbett 1999, Frankie and Nelson 2002) and northeastern Illinois in Will and Kankakee Counties (DeMauro 1986, Corbett 1999). All known remnants of wet or mesic dolomite prairies have been found in Will County in northeastern Illinois (DeMauro 1986, Corbett 1999). The Lockport Prairie Nature Preserve contains the best known dolomite prairie in Illinois and is also probably the best managed prairie in the state. It is located on the floodplain of the Des Plaines River just east of Stateville Correctional Facility and west of Lockport in Lockport Township, Will County. This prairie is owned by the Metropolitan Water Reclamation District of Greater Chicago and is leased and managed by the Forest Preserve District of Will County. It has been officially dedicated as an Illinois Nature Preserve.

Geological Origin

The geological origin of this ecosystem remnant extends back to the Late Pleistocene. About 14,000 years B.P. when the Wisconsinan (Valparaiso) glacier was melting, large quantities of ponded meltwater formed Lake Chicago (precursor of Lake Michigan). Overflow was discharged into the Kankakee Valley and the path of the present Des Plaines River in an immense flood (called the Kankakee Torrent) down into the Illinois River valley (Cote et al. 1970, Willman and Frye 1970, Brown et al. 2001, Harris et al. undated). The great rush of water dislodged chunks of dolomite off the bedrock, which helped erode the present channel of the Des Plaines River. Subsequently, a thin layer of sediment was deposited on the bedrock, setting the stage for invasion of prairie organisms.

Geological Characteristics

The Lockport Prairie is in the Subdued Glaciated Plains Division just outside the Valparaiso Moraine (Harris et al. undated). The dolomite belongs to the Sugar Run Formation of the Niagaran Series in the Silurian System (Willman 1973). The Sugar Run dolomite was described by Willman (1973) as dense, smooth-surfaced medium beds, very fine grained, silty, and light gray in color with slightly green fresh surfaces (weathering to yellowish brown or reddish brown) and thin, wavy, green argillaceous streaks. Fossils are uncommon. In undisturbed dolomite prairie, the dolomite is quite evident, being scattered in localized areas (in an otherwise predominately sediment-covered

Figure 1 Bedrock outcrop in a dolomite prairie on Lockport Prairie Nature Preserve in Will County. R.S. Nelson, left, and L.E. Brown, right, are shown for scale (photo by W.T. Frankie).

substrate) as gravel, flakes, flagstones, and exposed bedrock (fig. 1). Some of the chunks of dolomite have rounded edges indicating that they tumbled down the channel of the Des Plaines River during the Kankakee Torrent. Large glacial erratic boulders (fig. 2) are also scattered across the prairie.

Human Use and Disruption of Dolomite

Fragments of dolomite are more evenly mixed into the soil in agriculturally disturbed areas (outside the nature preserves) that are tilled (or have been in the past). The paths of the Illinois and Michigan Canal and the Chicago Sanitary and Ship Canal adjacent to the Des Plaines River north of Lemont were cut through the dolomite bedrock, presumably by blasting. Much of the extracted waste dolomite can still be observed as an elongated spoil bank adjacent to the towpath along the Illinois and Michigan Canal. Interestingly, scattered clumps of prairie grass (e.g., big bluestem) still grow in this spoil bank along with numerous weedy species. Surface mining of dolomite (Willman 1973, Anderson and Brown 1991) for use as building stone has occurred on some areas of the floodplain. Extracted dolomite was used to construct a number of impressive commercial buildings in downtown Lemont near the canal (Conzen and Brosnan 2000). The quarried dolomite from the Lemont area has long been known as “Athens Marble” (Willman 1973). (“Athens” was the former name for Lemont.)

Figure 2 Erratic glacial boulder in a recently burned dolomite prairie at the Lockport Prairie Preserve (photo by W.T. Frankie).

Some dolomite quarries are huge—in depth as well as surface area covered—and pose various problems when they are abandoned. In the mid to late 1980s, a large quarry (Anderson and Brown 1988) on the floodplain of the Des Plains River northwest of Lemont was used as a landfill for fly ash. Strong winds from the north subsequently blew fly ash over Lemont, resulting in respiratory problems for the citizens. A thin layer of fly ash was deposited on vehicles, sidewalks, and other objects. Landfills in abandoned quarries can also pollute the groundwater. When actively mined, deep quarries require the continual use of pumps to remove water. Abandonment of mining and stoppage of pumping results in the filling of the quarry with water, which attracts human swimmers. Because of a lack of lifeguards and steep drop-off at the edge, drownings have sometimes occurred.

Soil

The soil of the prairie is mostly Romeo silt loam (Wascher et al. 1962). It is dark, medium textured, alluvial, sometimes highly organic (in fens, sedgemeadows, and marshs), and only about 0 to 25.4 cm in depth above dolomite bedrock (Wascher et al. 1962, DeMauro 1986, D. Mauger, personal communication). Soil that is permanently under water is poorly oxidized and calcareous. High pH also characterizes the soil (DeMauro 1986).

Topography

The floodplain is relatively flat, although some areas are slightly elevated and thus tend to be drier. Depressions occur in some other areas, and these often contain shallow water, particularly from spring through midsummer. Some depressions contain relatively permanent wetlands.

Biogeography

The warmer and more arid climate in the Early to Middle Holocene (Pielou 1991) precipitated an eastern movement of prairie vegetation (especially arid-adapted species) from the Great Plains into the Midwest (Baker et al. 1996) to form the Prairie Peninsula (Transeau 1935), which was predominantly tallgrass prairie. Subsequently, prairie vegetation colonized the valley of the Des Plaines River to form the dolomite prairie. Mesic-adapted and wetland plants more likely originated from the east and south.

Animal species probably invaded the valley from all directions. However, the warm arid period during the Holocene may not have been the most favorable time for migrations of mesic-adapted species such as amphibians (Brown et al. 1993). Thus, they probably arrived later in the Holocene after the establishment of prairie and the return of more moist environmental conditions. Furthermore, mesic-adapted and aquatic species often required mesic corridors or riparian passageways to enter the valley.

Flora and Fauna

The vegetation of the Lockport Prairie Nature Preserve was comprehensively studied by DeMauro (1986), and most of the account that follows in this paragraph was gleaned from her report. Plant diversity is rich: 399 species have been recorded, 311 of which are native. They are distributed in 11 communities, 9 of which are natural (dry mesic/mesic dolomite prairie, dry dolomite prairie, mesic/wet mesic dolomite prairie, marsh, sedge meadow, ponds and springs, fen, floodplain forest [secondary growth, D. Mauger, personal communication], wet dolomite prairie), and 2 of which have been disturbed by humans (old landfill, successional field). Many of the species are endangered, threatened, or rare in northeastern Illinois. Typical tallgrass prairie grasses (for example, big bluestem, little bluestem, blue joint grass, Indian grass, switch grass) are commonly encountered. Additionally, there is a great abundance and diversity of mesic-adapted and wetland species (for example, swamp marigold [2 species], sedges [19 species] rushes [*Juncus*, 7 species], common arrowhead [1 species], bulrushes [*Scirpus*, 6 species], prairie cord grass [1 species], cattail [2 species]). Furthermore, numerous species are calciphiles (DeMauro 1986).

The sedges deserve further commentary. Their great diversity and abundance (19 species) are indicative of high-quality (if not pristine) wet/mesic prairie and unforested wetlands. Such diversity and abundance are simply not found in human-disturbed environments.

Surveys of insects (125 species) by Panzer (1983) and birds (122 species) by Rutter (1986) showed a great diversity of species and the habitats they occupy. A number of species are endangered, threatened, or uncommon in northeastern Illinois. The amphibians and reptiles are moderately well known (D. Mauger and L. Brown, unpublished observations). Of particular significance is the spotted turtle, which is state endangered and occurs only in Will County in Illinois, but is more common in the eastern United States. The spotted turtle occupies sedge meadows, wet dolomite prairie, and other shallow wetlands (Phillips et al. 1999). Other animal groups are less well known.

Threats to the Prairie

In the past, there were a number of human-induced disturbances of the dolomite prairie: cattle grazing; presence of a major livestock thoroughfare leading to the Chicago stockyards; landfill in the south; construction of canals and levees; roadways (paved and unpaved); railroad and its associated pollutants; scattered dumping of trash and construction materials along an unpaved roadway and elsewhere in the prairie; spoil banks formed from river dredgings; use of dolomite flagstones as riprap on the sides of the levee of the Chicago Sanitary and Ship Canal; installation of power lines using a helicopter (which can frighten nesting birds, as well as other animals); small quarry operations; pollution from the prison; and runoff pollution from Division Street, which runs through the center of the prairie (DeMauro 1986; L.E. Brown, personal observation; Harris et al. undated). Although some of these threats are serious, none is showing a recent significant increase, and some have ceased to be a problem.

The presently existing major problems are mainly vegetational in nature. Like many other remnant prairies in Illinois, the Lockport dolomite prairie is continually threatened by invasive woody vegetation (DeMauro 1986). Cutting (done by Stateville prisoners) followed by periodic prescribed burns (fig. 3) and spot use of herbicides have been used as management tools (D. Mauger personal communication). These practices have been quite successful, but a considerable invasive shrubland on the west side of the Preserve remains to be cleared. Invasive non-woody vegetation (particularly cattails) is also a problem (DeMauro 1986; L. E. Brown, personal observation). Cattails are aggressive colonizers and often become over-dominant excluding less aggressive species such as sedges (Odum 1988, Anderson and Brown 1991). Eradication is difficult, and even complete physical removal of entire plants is not a completely effective management practice because of recolonization.

Past Distribution

It is possible that dolomite prairie was more extensively distributed along the valley of the Des Plaines River prior to European settlement. Evidence for this is (1) another sizeable dolomite prairie (Romeoville Prairie Nature Preserve) to the north of the Lockport Prairie, (2) occurrence of scattered prairie plants and prairie remnants at a number of locations along the floodplain, (3) presence of suitable soil, and (4) ample occurrence of exposed dolomite. Human development in the form of heavy industry, urbanization (residential, commercial), agriculture, and construction of the Chicago Sanitary and Ship Canal could have presumably eliminated most of the dolomite prairie. Conversely, human-constructed levees along the valley of the Des Plaines River presently protect the dolomite prairies from extensive and prolonged inundation. Thus, if such inundation was common before European settlement, it may have prevented the development of extensive dolomite prairie along the valley of the Des Plaines River. Indeed, it is even possible that more dolomite prairie exists today in the valley of the Des Plaines River than at any time in the past. However, Willman (1973, figs. 1, 4, and 7) mapped the extensive surface areas of Silurian dolomite (including exposed bedrock, outcroppings, and areas covered with glacial drift) in northeastern and northwestern Illinois (as well as a few smaller, isolated areas further south). Furthermore, the intervening upper bedrock in northern Illinois (in between the northeastern and northwestern Silurian deposits) is primarily Ordovician, which is largely dolomite and limestone (Reinertsen et al. 1992).

Figure 3 Prescribed burn of dolomite prairie on December 11, 2002, at the Lockport Prairie Nature Preserve. The burn crew is on the right (photo by W.T. Frankie).

Thus, prior to human settlement, dolomite prairie (dry and wet) was presumably more widespread in northern Illinois. Agriculture, industry, and urbanization destroyed most of this ecosystem.

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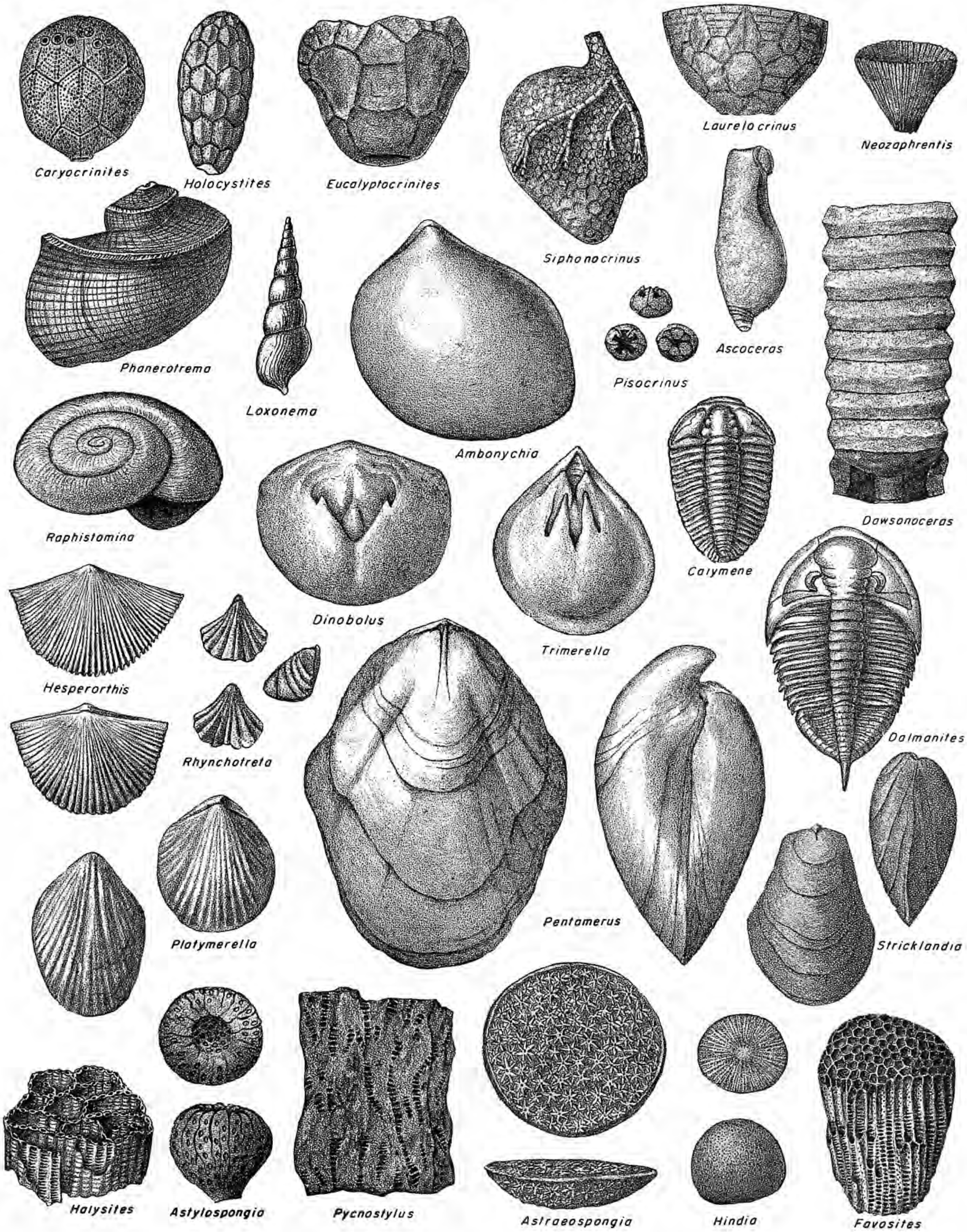
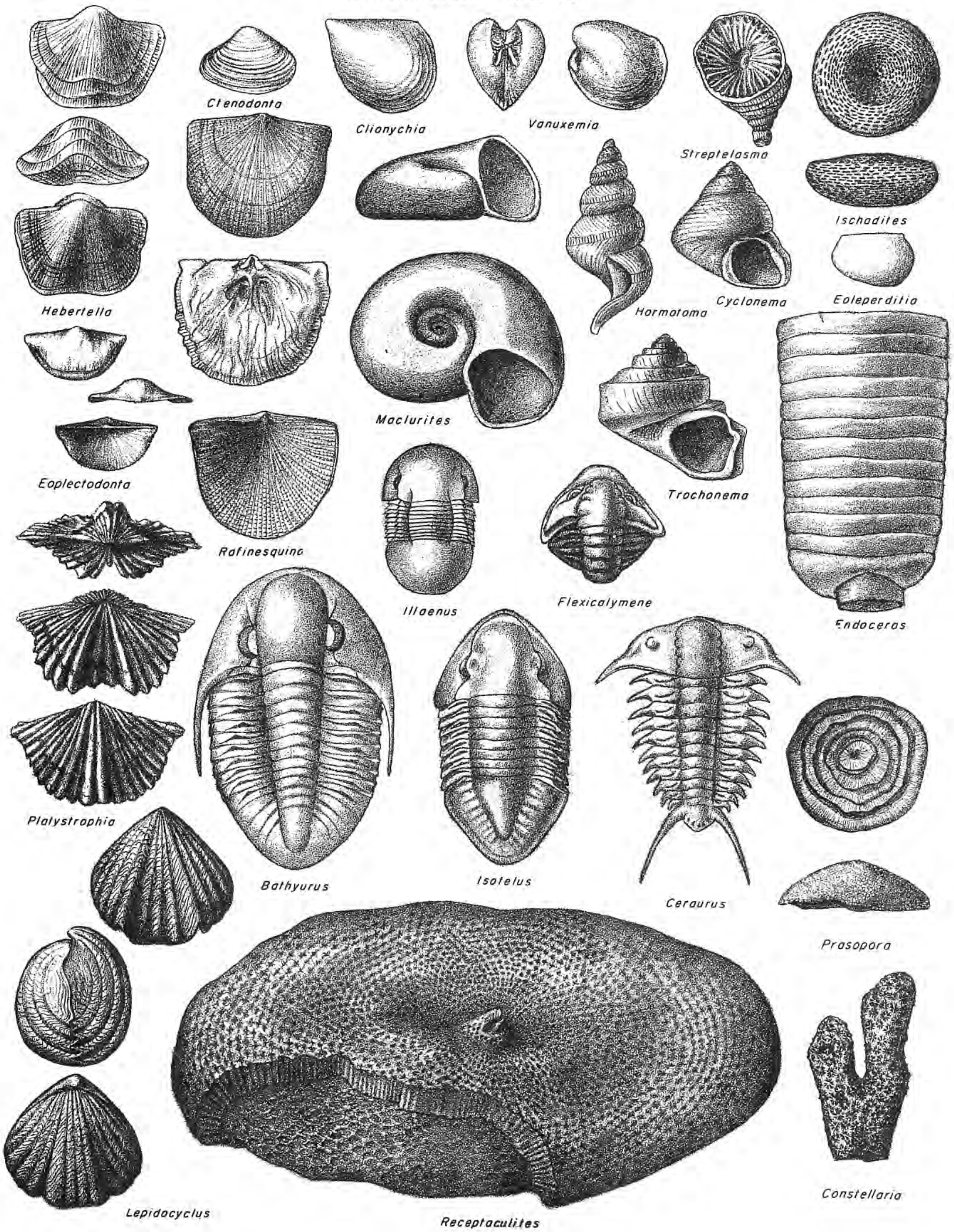
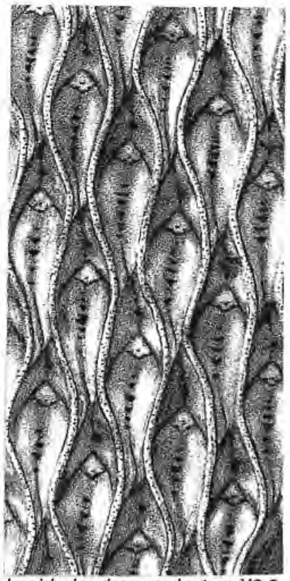
REPRESENTATIVE SILURIAN FOSSILS FROM NORTHWESTERN ILLINOIS



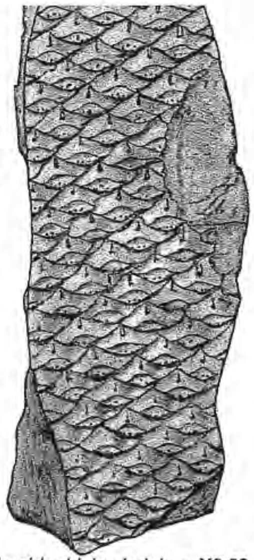
ORDOVICIAN FOSSILS



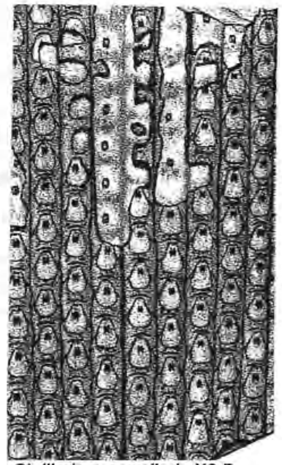
Common Pennsylvanian plants: lycopods, sphenophytes, and ferns



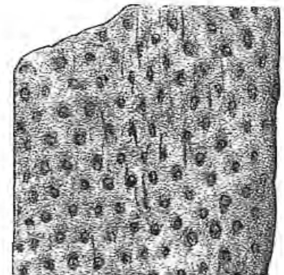
Lepidodendron aculeatum X0.8



Lepidophloios laricinus X0.63

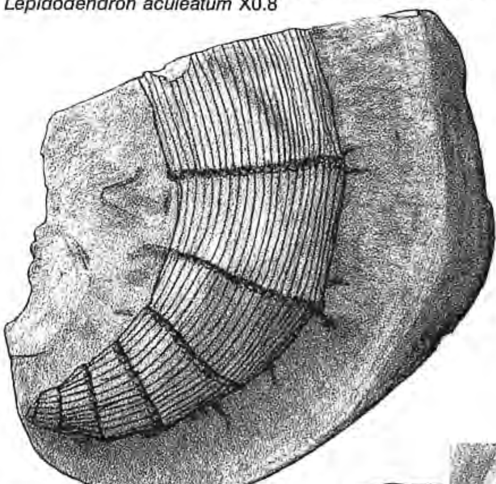


Sigillaria mammilaris X0.5



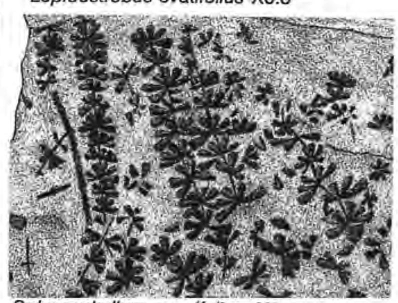
Stigmaria ficoides X0.32

Lepidostrobus ovatifolius X0.8



Calamites suckowii X0.5

Annularia stellata X0.63



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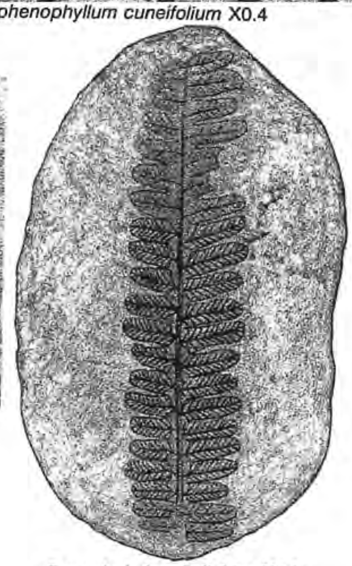
Pecopteris sp. X0.32

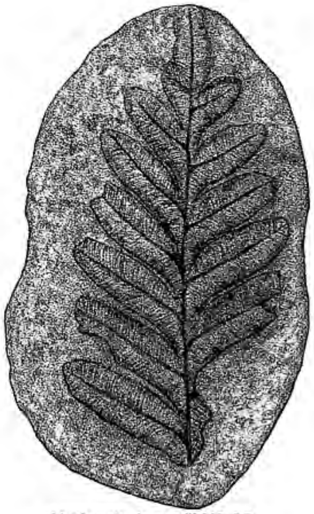
Pecopteris miltonii X2.0



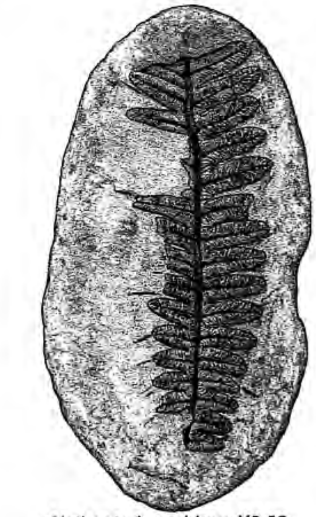
Pecopteris hemitelioides X1.0

J. R. Jennings, ISGS

Common Pennsylvanian plants: seed ferns and cordaiteans



Alethopteris serlii X0.63



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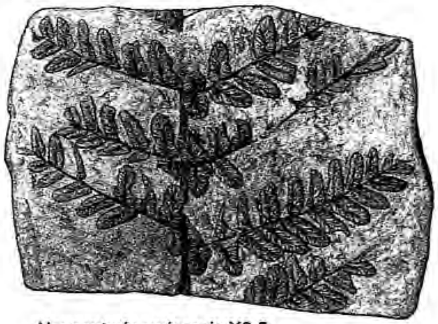
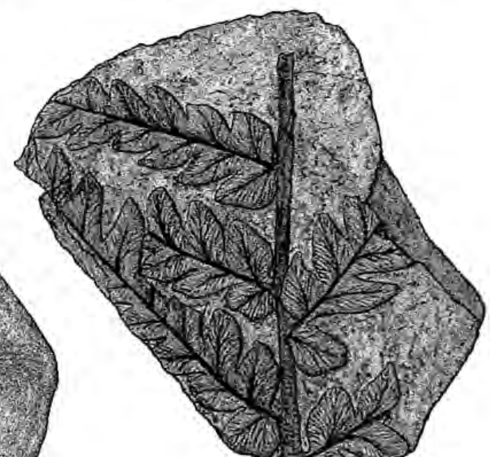
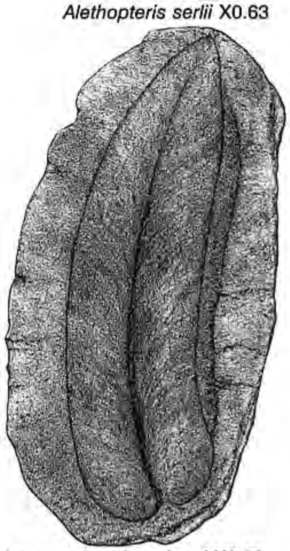


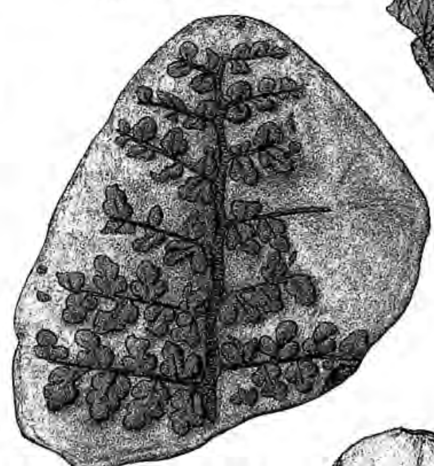
Neuropteris rarinervis X0.5



Mariopteris nervosa X0.8

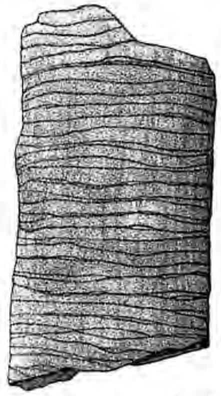


Neuropteris scheuchzeri X0.63



Sphenopteris rotundiloba X0.8

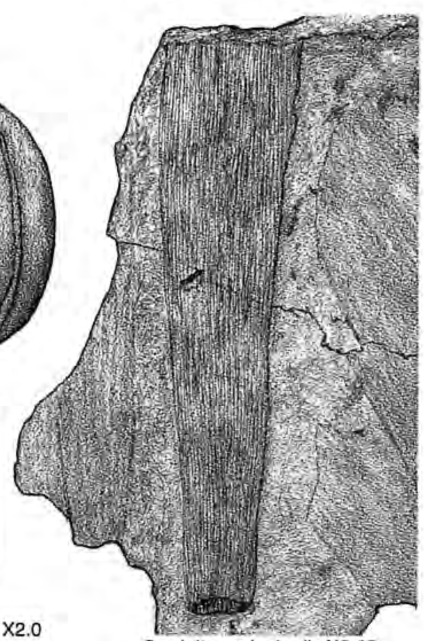
Cordaicladus sp. X1.0



Artisia transversa X0.63

Trigonocarpus parkinsonii X1.25

Cordaicarpon major X2.0



Cordaites principalis X0.63

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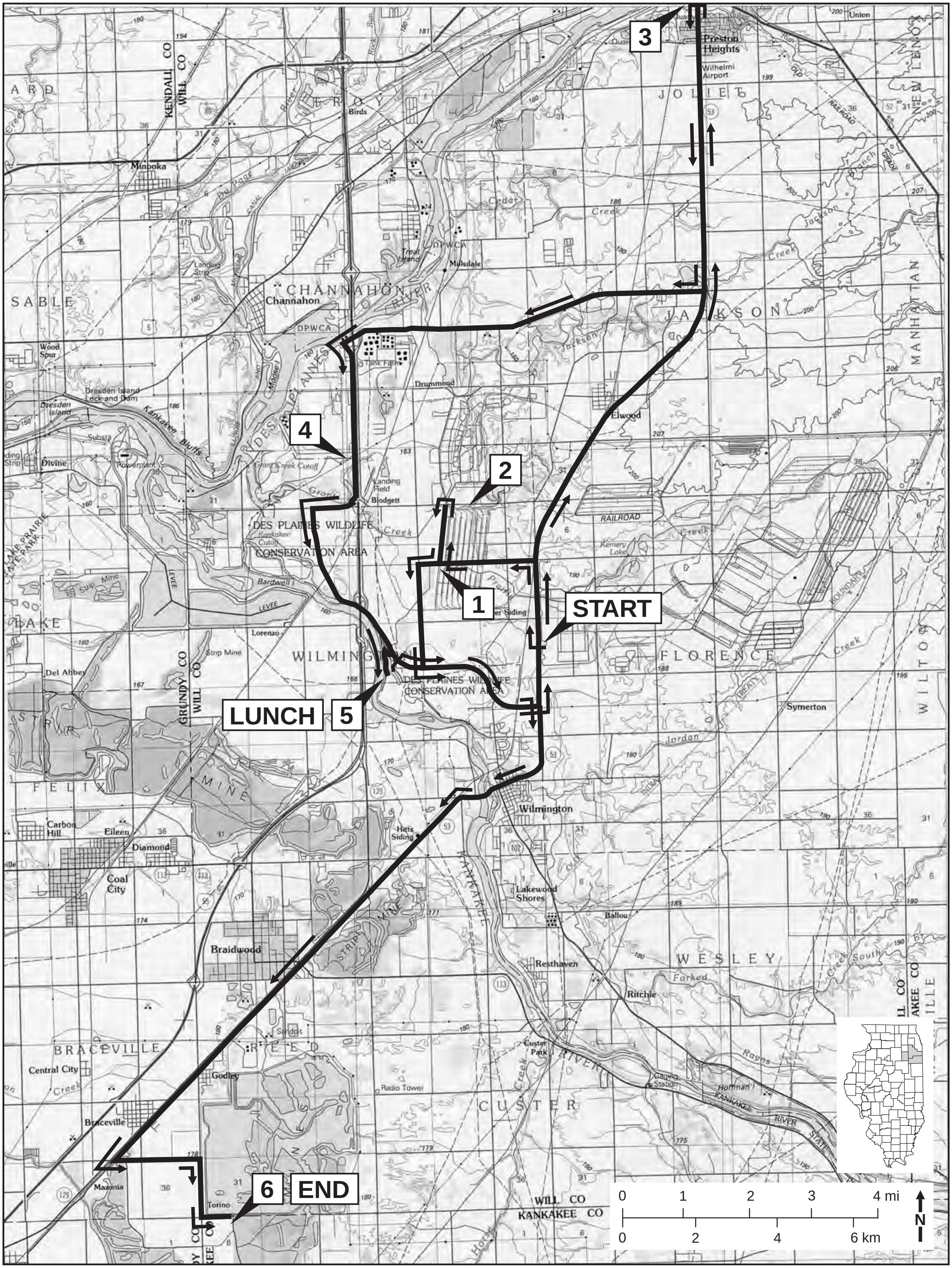
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Channahon
RIVER
SABLE
DPWCA
Treat Island
Millsdale
Cedar Creek
Jackson Creek
JACKSON
MANHATTAN
Wood Spur
Dresden Island Lock and Dam
Dresden Island
Kankakee Bluffs
DES PLAINES
Tank Farm
Drummond
Elwood
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Divine
Powerplant
Grant Creek Cutoff
Landing Field
Blodgett
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RAILROAD
DES PLAINES WILDLIFE CONSERVATION AREA
Kankakee Cutoff
Bardwell
LEVEE
Strip Mine
Kemery Lake
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Symerton
Del Abbey
GRUNDY CO
WILL CO
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FELIX
Jordan
Wilmington
Carbon Hill
Eileen
Diamond
Coal City
Hitts Siding
KANKAKEE
Lakewood Shores
Ballou
WILTON
Braidwood
STRIP MINE
Resthaven
WESLEY
Forked Creek
Ritchie
BRACEVILLE
REED
Sandpit
Central City
Godley
Radio Tower
Custer Park
RIVER
Gaging Station
Hoffman
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