GEOLOGY OF
CLEAR CREEK METROPARK

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Introduction

Clear Creek MetroPark, Ohio's largest dedicated nature preserve, is known for its 5,389 acres of rugged valleys and forestland hosting more than 2,200 plant and animal species. The park is habitat to nearly 100 species of breeding birds, 800 species of plants, several species of bass and trout, and approximately 40 plants and animals listed on Ohio's rare and endangered species lists.

To better understand how the ravines, cliffs, and streams that provide these habitats came to be, visitors must look millions of years into the past—into the geologic history of Ohio. This informational leaflet provides an overview of the major geologic themes and processes responsible for Clear Creek's features by exploring its bedrock geology, glacial geology, and modern-day water resources.

Bedrock Geology

The bedrock of Clear Creek MetroPark is primarily the Black Hand Sandstone Member of the Cuyahoga Formation. It derives its name from the image of a human hand inscribed by Native Americans on a cliff face in Black Hand Gorge, Licking County, Ohio. The Black Hand Sandstone was deposited between 359 and 318 million years ago (m.y.a.), during a time known as the Mississippian Period. At that time, present-day Ohio occupied a tropical climate to the west of the Paleozoic-era Acadian Mountains and south of the equator (fig. 1). The inland sea that had submerged the region during the Devonian Period (416–359 m.y.a.) was filling in with Acadian sediments,

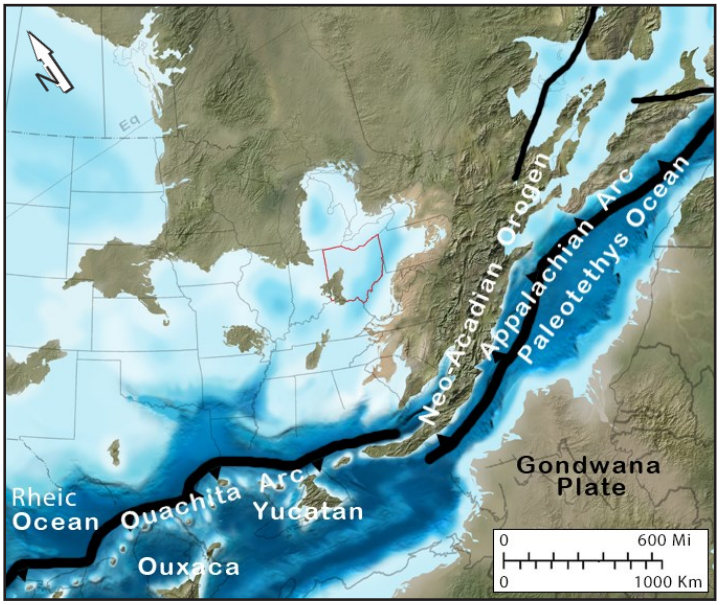

Figure 1. Geographic location of present-day Ohio (outlined in red) during the Early Mississippian Period.

Cover image: *Written Rock, Clear Creek MetroPark, Fairfield County, Ohio. Photo credit: Craig Nelson.*

accumulating the muds and silts that eventually would form shale and the coarser sands and gravels that would become sandstone.

The exact depositional environment of the Black Hand Sandstone is the subject of ongoing geological debate. One theory follows that the coarse sands comprising the unit were deposited at the mouths of Mississippian-age river deltas and then reworked by nearshore currents. An alternative theory suggests that pre-existing, fine-grained deltas were incised by streams as a result of lowering sea levels, creating channels into which coarser material infilled. Whether as a product of reworking or infilling, the Black Hand Sandstone formed from sediments eroded from the Acadian Mountains that were deposited in low-lying deltas and then covered by shale and siltstone.

During the ensuing 300+ million years, the overlying shale and siltstone eroded away, leaving the Black Hand Sandstone exposed both in Clear Creek and in parts of neighboring Licking, Muskingum, and Knox Counties. The light- to medium-brown, well-sorted, and massively bedded sandstone is visible throughout Clear Creek MetroPark, including the spectacular Written Rock (cover image) and Leaning Lena (fig. 2). Zones of milky-white quartzite pebbles, crossbedding, and honeycomb weathering are all prominent in these features, indicating high-

Figure 2. Leaning Lena, a prominent slump block of Black Hand Sandstone flanking Clear Creek Road.

energy depositional environments and heavy sediment loads.

Along ridges and at higher elevations in the park, the Logan Formation may also be found. Consisting of four members—the Berne Conglomerate, the Byer Sandstone, the Allensville Sandstone, and the Vinton Member—the Logan caps the Black Hand Sandstone, representing a later Mississippian-age unit and is believed to have been deposited in a shallow marine environment marked by rising sea levels. The Logan is not as widespread or as prominent as the Black Hand in Clear Creek, but it may be visible along upper portions of the Cemetery Ridge and Fern Trails.

Glacial Geology

The advance and retreat of ice during the Pleistocene Epoch (2.6 m.y.a.–11,700 y.a.) dramatically altered the landscape of Ohio. Pleistocene glaciers transported massive quantities of sediment, and their meltwaters unleashed erosional forces that would transform the state's topography. While located mostly outside the glaciated zone, Clear Creek MetroPark still bears the signs of the Ice Age, as evidenced in its striking features and deep valleys rich in glacial sand-and-gravel deposits known as *outwash*.

Approximately 250 m.y.a.—long after the erosion of the Acadian Mountains formed Clear Creek's Black Hand Sandstone and Logan Formation—the Appalachian Mountains rose to the east of Ohio, creating a new drainage network that stretched across much of the modern-day United States. The ancient Teays River, with its headwaters in North Carolina, eventually formed from this network, draining approximately two-thirds of Ohio before emptying into the Gulf of Mexico. In the area of Clear Creek, the ancestral Logan River (a tributary of the Teays) flowed from the east to the northwest, cutting a valley below what is now the Hocking River. As climate changed, pre-Illinoian (2.6 m.y.a.–780,000 y.a.) glaciers moved south from Canada and dammed the Teays, reversing its flow and initiating new drainage patterns. Subsequent Illinoian (300,000–130,000 y.a.) and Wisconsinan (24,000–18,000 y.a.) glaciations further altered interglacial drainage patterns and deposited rock and sediment in pre- and interglacial valleys. End moraines—elevated ridges of glacial material—formed where ice stopped for significant periods of time, and ground moraines—flattened zones of glacial sediment—came to blanket much of northern and western Ohio (fig. 3). Glacial meltwaters eroded pre-existing bedrock, leaving behind fresh or deepened valleys that then were filled with coarse outwash deposits.

Clear Creek MetroPark inhabits a special place in the glacial landscape of Ohio. It straddles the state's glacial margin, the line marking the farthest extent of Pleistocene glaciation. The Illinoian glacial boundary runs through the western edge of the park, and the Wisconsinan glacial boundary is located a mere 1.5 miles to the west. The rugged topography of the park is the result of millennia of melting glaciers, with floodwaters cutting into the park's bedrock and depositing coarse outwash in its exposed valleys. Although thin and dissected, Illinoian ground moraines are found on the western quarter of the park, marking the farthest reach of the ice.

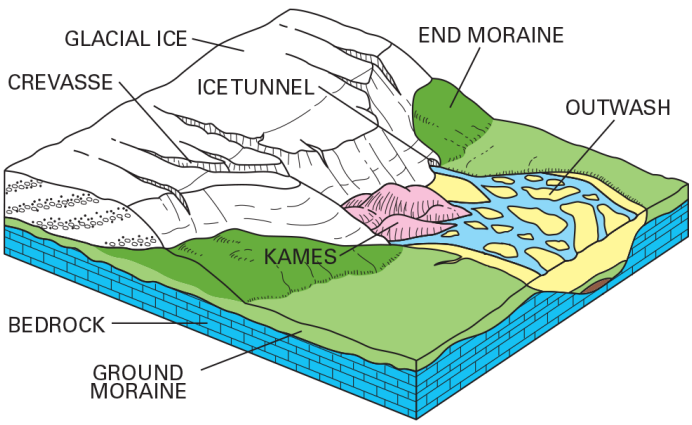

Figure 3. Conceptual diagram of a landscape during maximum glacial advance.

Hydrogeology

One of the most prominent features of Clear Creek MetroPark is, of course, Clear Creek itself. A tributary of the Hocking River, Clear Creek flows eastward through the park from its headwaters near Royalton to its confluence with the Hocking River at the park's eastern entrance. The creek cuts into the underlying Black Hand Sandstone along much of the park's length, with bedrock exposures visible at points along Clear Creek Road as well as on the Creekside Meadows and Pet Trails. Smaller streams feed Clear Creek from the north and south, cutting deep ravines in the valley walls and draining some of the park's upland fields and meadows.

Often invisible but equally important as a resource is the park's groundwater. Fed by rainfall both within the park and from surrounding areas, groundwater flows through the valley's outwash, alluvium (clay, silt, and sand deposits lining the main stream channel), and underlying sandstone. The Black Hand Sandstone is coarse grained, so it is also highly porous, allowing significant volumes of groundwater to flow through its pore spaces. It produces water well yields typically ranging from 5 to 25, but in some cases as high as 100 gallons per minute. Depth to groundwater is 5 to 15 feet below the land surface near Clear Creek itself but generally more than 100 feet in the park's slopes and uplands. Despite recorded water levels as deep as 280 feet, natural springs dot the park, signifying zones where the water table meets the land surface and groundwater seeps out, forming surface rivulets and seepage faces.

Summary

The geology of Clear Creek MetroPark tells the story of Mississippian-age sandstone deposited more than 300 m.y.a., buried under shale and siltstone, and then slowly exposed again. It tracks periods of Pleistocene glaciation that brought ice all the way to the park's border, depositing coarse outwash material and scouring the valleys with meltwater. It is reflected through time in the modern course of Clear Creek and the flow of groundwater that feeds its many channels and springs. The sum of this geologic history has sculpted Clear Creek MetroPark into the form we see it today, complete with its unique wildlife habitats, scenic trails, and rugged geologic features.

Further Reading

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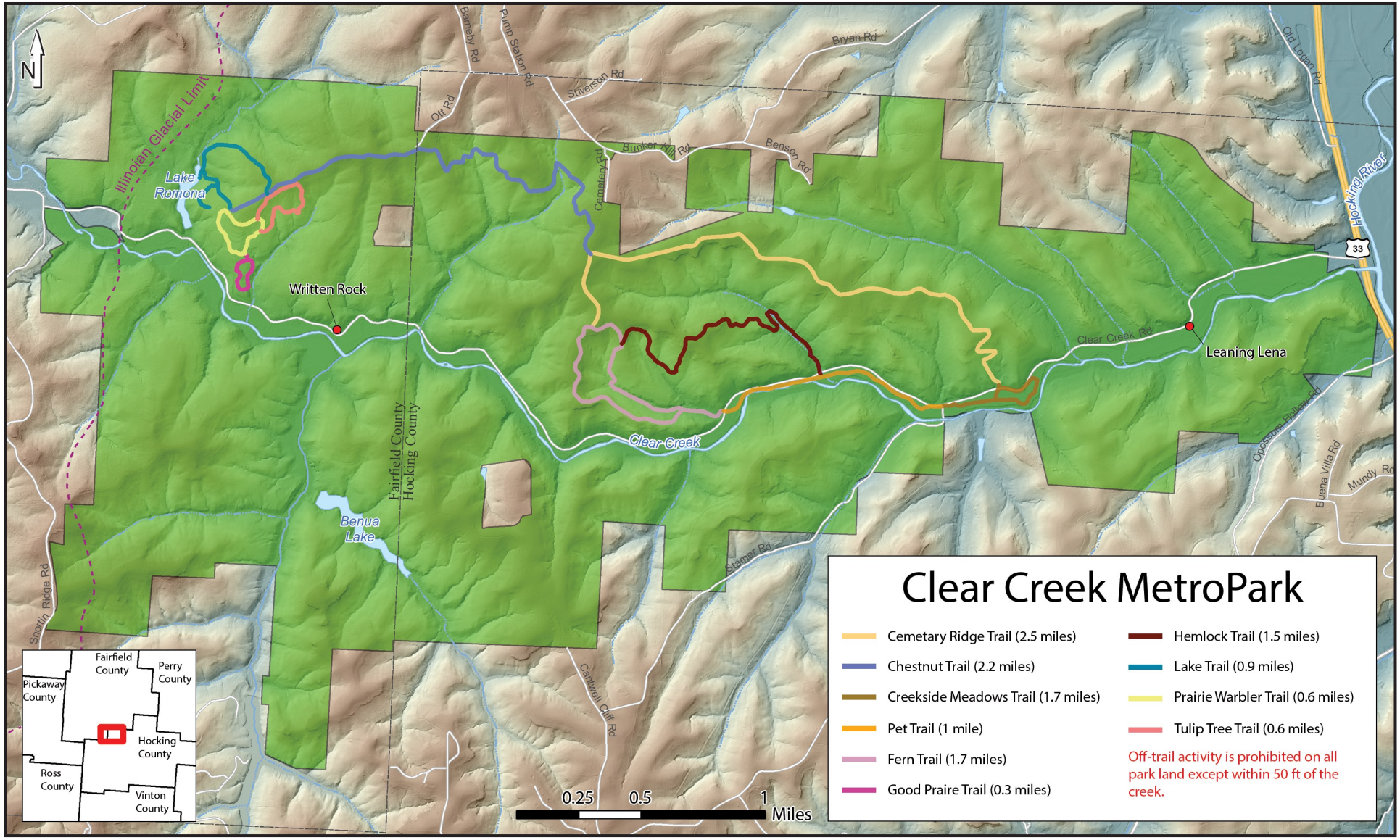

Clear Creek MetroPark trail map showing topography, glacial margin, and notable geologic features.