CUYAHOGA RIVER BASIN

The Cuyahoga River originates in Geauga County in the extreme northern part of the Akron-Canton Interlobate Plateau. From its headwaters area, the river flows southwestward in a relatively long, narrow basin toward Akron. Downstream of Cuyahoga Falls, the river turns abruptly northward and flows in a wide, deep preglacial valley to Cleveland and its mouth in Lake Erie. The peculiar shape of the basin with its long eastern arm is the result of drainage changes brought about by glaciation. The map in figure 9 shows the outline of the basin and flow paths of the main watercourses.
In the upper part of the eastern basin near Burton, the East Branch, West Branch, and Bridge Creek converge to give the Cuyahoga River a drainage area of about 150 square miles. Downstream at Kent, Congress Lake Outlet adds about 79 square miles of drainage area. At Akron, the Little Cuyahoga joins the Cuyahoga River contributing 62 square miles of drainage area. North of Akron, a series of smaller tributaries drain into the Cuyahoga from both sides of the basin, the largest of these being, Mud Brook, Yellow Creek, Furnace Run, Brandywine Creek, and Chippewa Creek. Near Bedford, Tinkers Creek joins the Cuyahoga contributing 96 square miles of drainage area. Additional smaller tributaries flow into the Cuyahoga in Cleveland, the largest being Big Creek with 38 square miles of drainage area.

Physiography
The topography of the Cuyahoga River Basin varies from flat lake plain to relatively rough glaciated, dissected plateau. Most of the basin is in the Glaciated Allegheny Plateaus; only the extreme lower part lies in the Erie Lake Plain. Relief is generally moderate except where the river has cut a deep valley, and where there is local steepness created by smaller streams.

The northern part of the Akron-Canton Interlobate Plateau, where the eastern arm of the basin is located, is hummocky and dominated by kames, kame terraces, eskers, bogs, and natural lakes. The river flows in a relatively shallow channel cut in lacustrine deposits and drift at very low gradient of about 3 feet per mile. Kame terraces and outwash exist along most of the channel. The channel reach in Geauga County cuts through lacustrine deposits.

Congress Lake Outlet and the Little Cuyahoga River are in the central part of the interlobate area where considerable amounts of outwash material exists. The river flows north of the outwash area in a deep narrow gorge cut in Pennsylvanian-age sandstone dropping about 220 feet in 1.5 miles through a series of steep rapids and falls.
Along the northward course, the river flows in a wide, deep preglacial valley that contains Pleistocene lacustrine deposits and alluvium of more recent time. The river meanders at moderately low gradient of about 6 feet per mile. Upland areas draining to the valley of the lower Cuyahoga are in areas of ground moraine and end moraine. Tinkers Creek gathers in lacustrine areas with extensive wetlands and flows northward along the Defiance End Moraine atop a buried valley before turning westward at Bedford and descending at steep gradient to the Cuyahoga River.

The Cuyahoga River flows across the Erie Lake Plain in a deep wide valley at Cleveland. Most of the lake plain tributary to the Cuyahoga on the west side of the river in Cleveland is drained by Big Creek.

Geology

The surface rocks in the Cuyahoga River Basin range in age from Devonian to Pennsylvanian. Devonian-age shales outcrop along the lower Cuyahoga Valley and lake plain area. Upland areas along the lower reach of the Cuyahoga are underlain with Mississippian sandstones and shales. Berea sandstone outcrops along Tinkers Creek just downstream of Bedford. Pennsylvanian-age sandstones and shales underlie much of the basin along the upper Cuyahoga. The narrow gorge at Cuyahoga Falls is cut in Sharon Conglomerate of Pennsylvanian age. As a whole, ground water from the rock strata has little effect on stream flow except locally where streams have cut through sandstone formations.

The glacial drift in the basin varies greatly in thickness and character, ranging from a few feet to as much as 200 feet in thickness and consisting of deep impermeable till in some places to highly permeable sand and gravel in other places. Deep buried valleys are present throughout the basin, but it is ground water from outwash material in high-level terraces, kames, and kame terraces that support the dry-weather flow of the Cuyahoga River.

The shales underlying the lake plain at Cleveland are thinly mantled with till and clayey lacustrine deposits. Uplands tributary to the lower reach of the Cuyahoga are generally covered with moderate amounts of clayey till except along the moraines where till thickness is greater and contains some permeable deposits. The Cuyahoga Valley is hundreds of feet deep to bedrock. The buried valley along the Cuyahoga between Newburg Heights and downtown Cleveland contains permeable deposits that yield substantial amounts of ground water to wells.

Pennsylvanian- and Mississippian-age sandstones and shales are covered with till and extensive amounts of sand and gravel deposits in the upper basin. Large deposits of permeable outwash material exist in the interlobate area between the Grand River and Killbuck Lobes of the Wisconsinan glaciation. Depths of these deposits vary from a few feet to as much as 100 feet in some places.

Soils

The Glaciated Allegheny Plateaus part of the Cuyahoga River Basin that comprises the vast majority of the basin is in Soil Region 6. The narrow Erie Lake Plain part of the basin at Cleveland is in Soil Region 2.

Soils on the Erie Lake Plain at Cleveland are largely urban land complexes wherein imperious surfaces constitute a large percentage of the complex. Mahoning urban complex dominates the lake plain with lesser amounts of Oshtemo urban complex. The Mahoning soil developed from clay loam and clayey till and is slowly permeable. Oshtemo developed on sandy beach ridges and has rapid permeability.

The ground moraine and end moraines in the Killbuck-Pittsburgh Glaciated Plateau part of the basin are dominated by Mahoning and Rittman soils. Rittman developed from medium to fine textured till and has a fragipan that is slowly permeable. Soils developed from lacustrine deposits amid the end moraines have slow permeability.
Chili-Canfield soil associations dominate the interlobate area in the upper basin. Chili soil developed from loamy outwash on kames, kames terraces, and outwash fans common in the interlobate area. Chili is underlain with sand and gravel and has rapid permeability. Canfield soil developed from medium-textured till and has a fragipan that is slowly permeable.

Soil developed in alluvium along the lower Cuyahoga and upper reaches of Tinkers Creek are mostly Chagrin silt loams with moderate permeability. Permeability of soils on high-level terraces along the lower Cuyahoga vary from rapid to slow depending on the texture of the sediments.

Permeable outwash soils in the Cuyahoga Basin are limited in extent but highly significant ground water recharge areas for the ground water aquifers of the Cuyahoga Basin. Overall, however, most of the soils in the basin are slowly permeable.

Land Use
The Cuyahoga River Basin contains the cities of Cleveland and Akron and is a very heavily industrialized area. Most of the undeveloped land in the lower basin is confined to areas of steep terrain along the Cuyahoga River and tributaries draining into it. The Cuyahoga Valley National Recreation Area is located between Cleveland and Akron. Many metropolitan parks occupy areas of steeper terrain in Cleveland. The upper eastern basin is much less intensely developed than the lower basin and contains several large reservoirs.

The lake plain at Cleveland is part of the Erie Fruit and Truck Resource Area. Most of the commercial vegetable production in the Cleveland area takes place in green houses, and there are a sustainable number of these enterprises. Open space accounts for a relatively small percentage of land use as most of the land is developed. Land in the Glaciated Allegheny Plateaus part of the basin is in the Eastern Ohio Till Plain Resource Area. Although much of the basin has been developed, dairy and cash grain farms are still common in more rural parts especially in Portage and Geauga Counties. Development in the lower basin includes intensive industrial and commercial development from Bedford Heights to Solon and wide expanses of housing along the western side of the lower basin between Akron and Cleveland. Much of the land in the basin that was farmland is now urban or idle land being held for development.

Water Development
The City of Akron has several water supply reservoirs in the upper Cuyahoga River Basin. These include East Branch Reservoir, LaDue Reservoir, and Lake Rockwell. Water is released from East Branch and LaDue to maintain water levels in Lake Rockwell where the city water supply intakes are located. Wastewater return flows from Akron enter the Cuyahoga below Old Portage several miles downstream of the

confluence with the Little Cuyahoga.

Kent and Cuyahoga Falls obtain water supply from well fields located in sand and gravel deposits along the upper Cuyahoga. Some smaller communities in the upper basin including Burton obtain water supply from wells, but most obtain supply from either Akron or Cuyahoga Falls. Individual supply is generally available from sandstones of the Pottsville Group, mainly the Sharon Conglomerate, and from permeable deposits in buried valleys.

The city of Cleveland obtains water from Lake Erie and distributes it throughout Cuyahoga County and to some communities in neighboring counties. All of the communities in Cuyahoga County except Berea obtain supply from Cleveland. Return flows enter the Cuyahoga though the Cleveland Southerly Wastewater Treatment Plant at Cuyahoga Heights.

Some water is diverted from the Tuscarawas River Basin to the Cuyahoga River Basin through the Ohio-Erie Canal system at Akron. Water from Portage Lakes is diverted to the Ohio Canal for industrial use and discharged through Summit Lake to the Little Cuyahoga River. Mogador Reservoir on the Little Cuyahoga River was built for industrial supply and recreation.

Flow Characteristics

Mean annual flows of streams in the Cuyahoga River Basin range from about 12 inches to 21 inches. Upper reaches of the Cuyahoga in Geauga County are in an area that receives some of the greatest amounts of mean annual precipitation in the state. This accounts for the relatively high mean annual flow of 20.2 inches at Hiram Rapids.

Tinkers Creek is also in an area receiving relatively high amounts of mean annual precipitation. This largely but not entirely accounts for the 21.7 inches of runoff recorded at Bedford. The flow of Tinkers Creek at the gage site is augmented by wastewater originating from wells and imported waters. The Little Cuyahoga River is in an area of lower mean annual precipitation averaging about 36 inches at Akron. Mean annual runoff of the Little Cuyahoga is correspondingly lower at about 12 inches. Mean annual flow of 14.9 inches for the Cuyahoga River at Old Portage excludes water diverted from Lake Rockwell for use at Akron and returned downstream of Old Portage. This diversion is partly offset by canal diversions from the Portage Lakes into the Cuyahoga River. On balance, mean annual flow at Old Portage without the diversions should be closer to 17 inches. Mean annual flow of the Cuyahoga at Independence of 16.4 inches represents the composite of mean annual flows of streams in the basin. The relatively high mean annual flow of Big Creek at Cleveland is due to industrial wastewater discharge and shorter, wetter period of record.

Base flows of the Cuyahoga River at all of the gaging stations are affected by regulation. Base flows at Hiram Rapids are affected by evaporative losses and releases from East Branch and LaDue. Base flows at Old Portage are largely a function of releases from Lake Rockwell and flows from Congress Lake Outlet and the Little Cuyahoga.

The gaging records for Yellow Creek give some insight to the affect of permeable deposits on base flows. The basin upstream of Ghent is situated in an area of kames and outwash deposits. This accounts for the relatively high mean base-flow index of 68 and 90-percent duration flow of 0.213 cfs per square mile for Yellow Creek at Ghent. North Fork at Bath Center includes areas of ground moraine containing much less permeable material. The mean base-flow index of 44 and 90-percent duration flow of 0.072 cfs per square mile reflects this difference in geology. Yellow Creek at Boltzum with 90-percent duration flow of 0.16 cfs per square mile and mean base-flow index of 54 represents a composite of basin characteristics.

Tinkers Creek with mean base-flow index of 48 and 90-percent duration flow of 0.24 cfs per square mile contains some permeable deposits along the Defiance End Moraine but not to the same degree as Yellow Creek. Base flows in Tinkers Creek are augmented significantly by wastewater discharges from municipal and industrial plants.

The base-flow record for Cuyahoga River at Independence excludes water diverted into the Ohio Canal upstream at Brecksville. The 90-percent duration flow of 0.184 cfs per square mile and the 7-day, 2-year low-flow index of 0.153 are lower than they would be if the diversions were included. The relatively high base-flow indices for Big Creek are due to industrial wastewater discharge upstream of the gaging station.

The median flow or 50-percent duration flow of 0.69 cfs per square mile for the Cuyahoga River at Independence is representative of flow conditions at gaging sites along the Cuyahoga and its major tributaries. This median flow rate is at the high end of the range for Ohio streams and reflects the combination of relatively large amounts of ground-water storage, substantial artificial and natural surface-water storage, and significant flow regulation from water supply and wastewater operations in the basin. The 10-percent duration flows of streams in the Cuyahoga River Basin are at the high end of the range for streams in Ohio. This indicates that although significant storage exists in the basin, it is limited as far as attenuation of larger floods. Relatively low 2-year recurrence interval flood-peak discharges characteristic of the streams in the basin indicate that basin storage nevertheless provides some attenuation of flood flows. The 10-percent duration flows at stations along the Little Cuyahoga River are relatively low because of the large reservoirs located upstream of the gaging sites.

Figure 47: Cuyahoga River Watershed

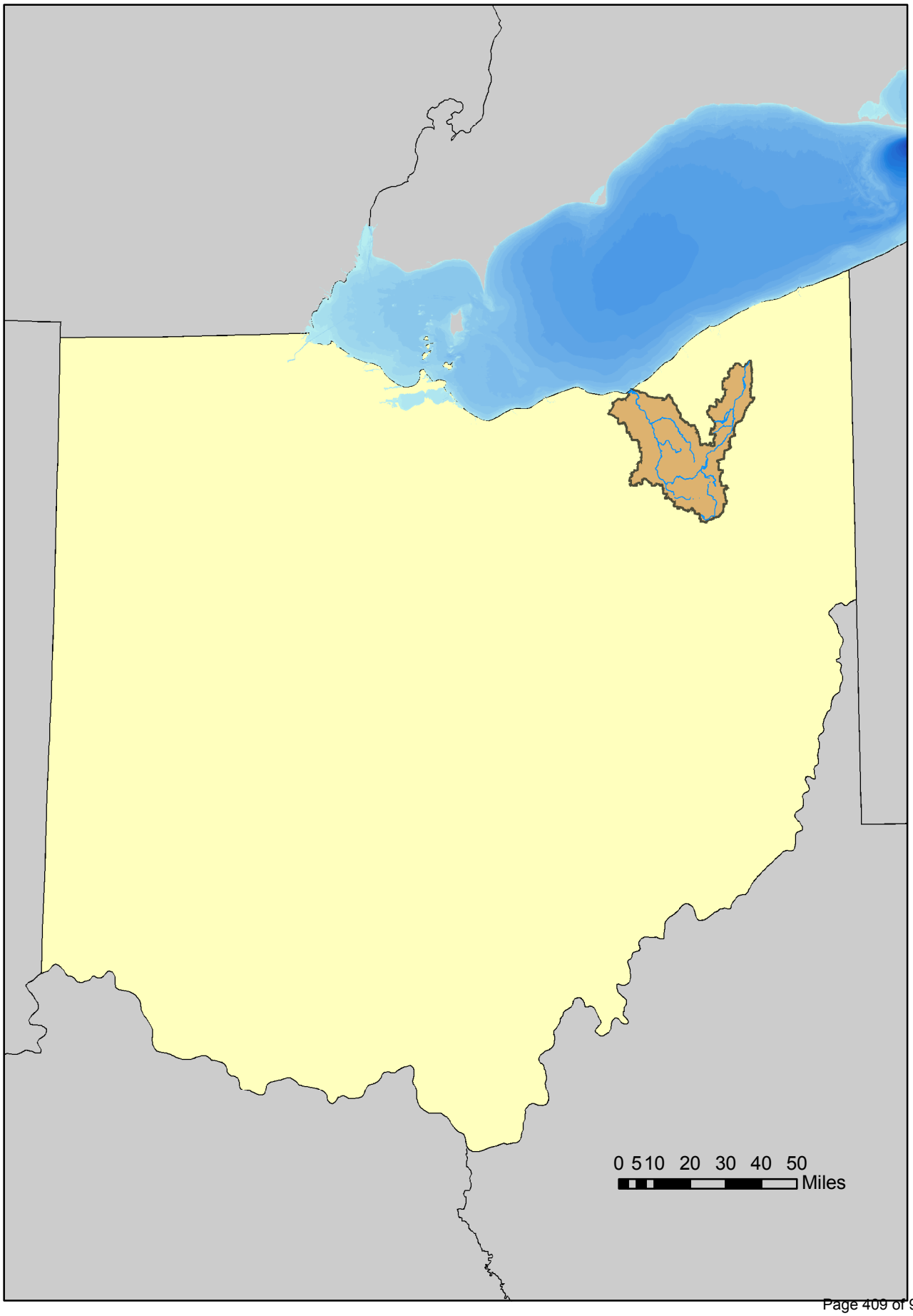

Figure 48: Cuyahoga River Watershed Land Cover

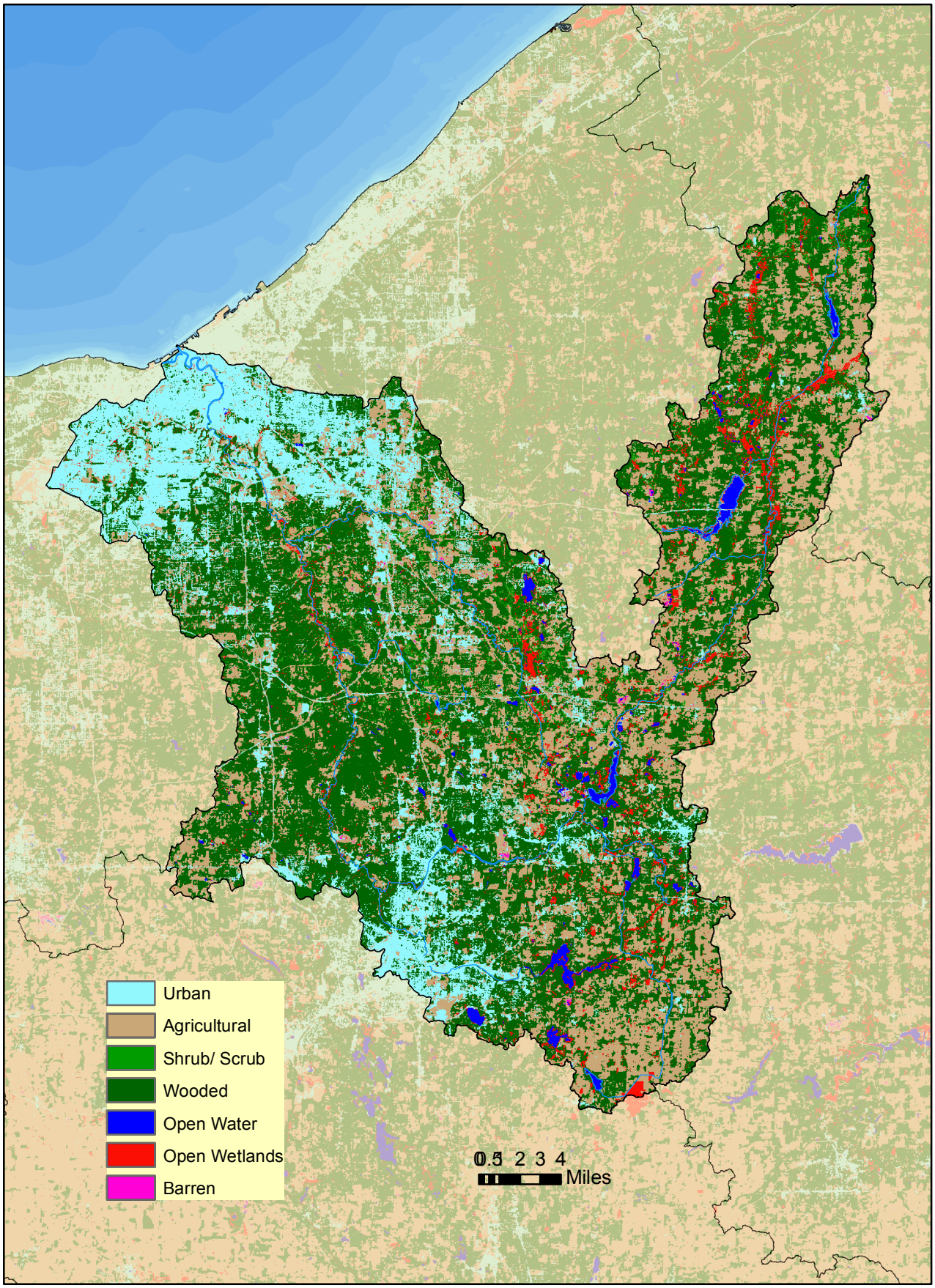
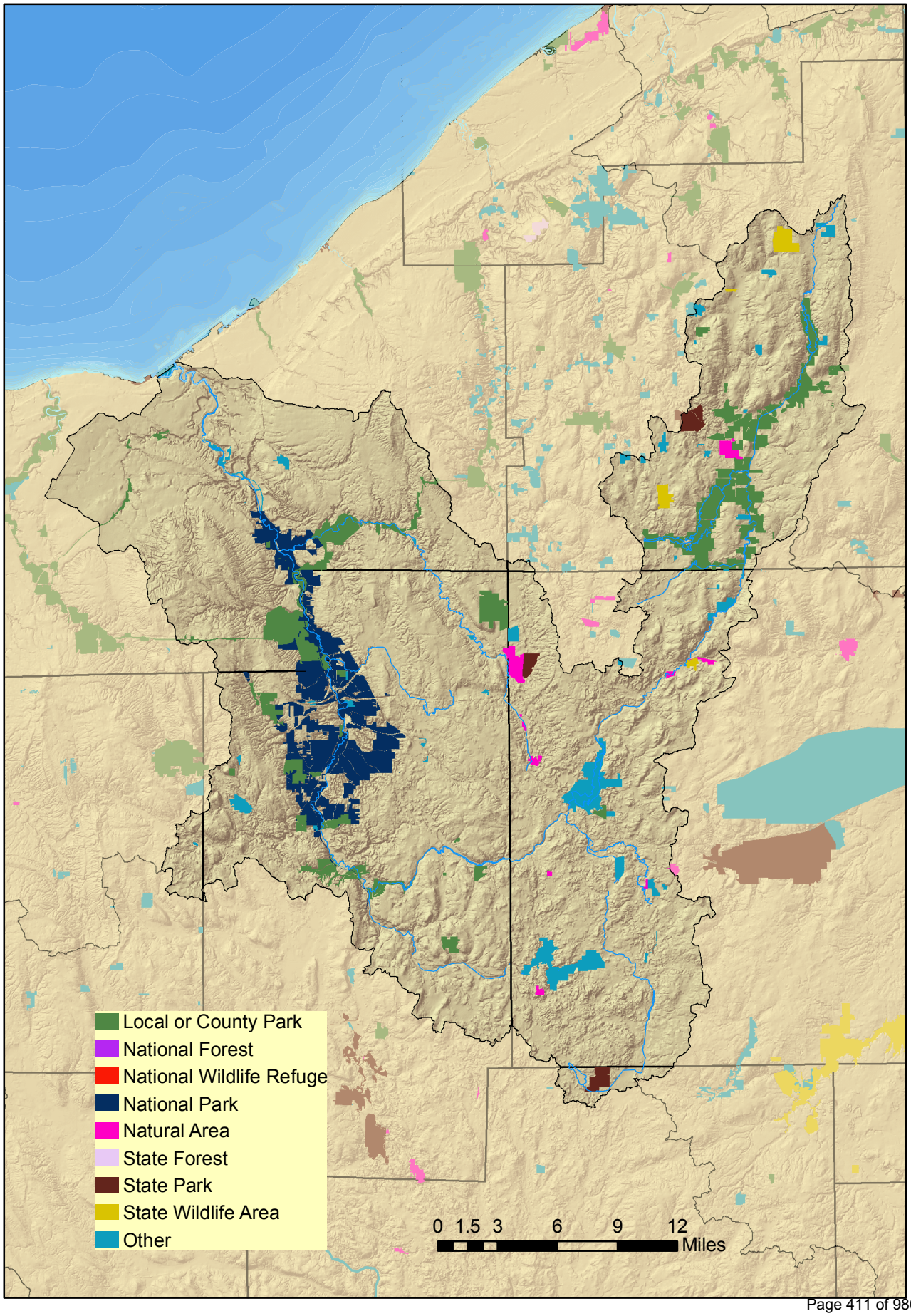
Figure 49: Cuyahoga River Watershed Protected Lands