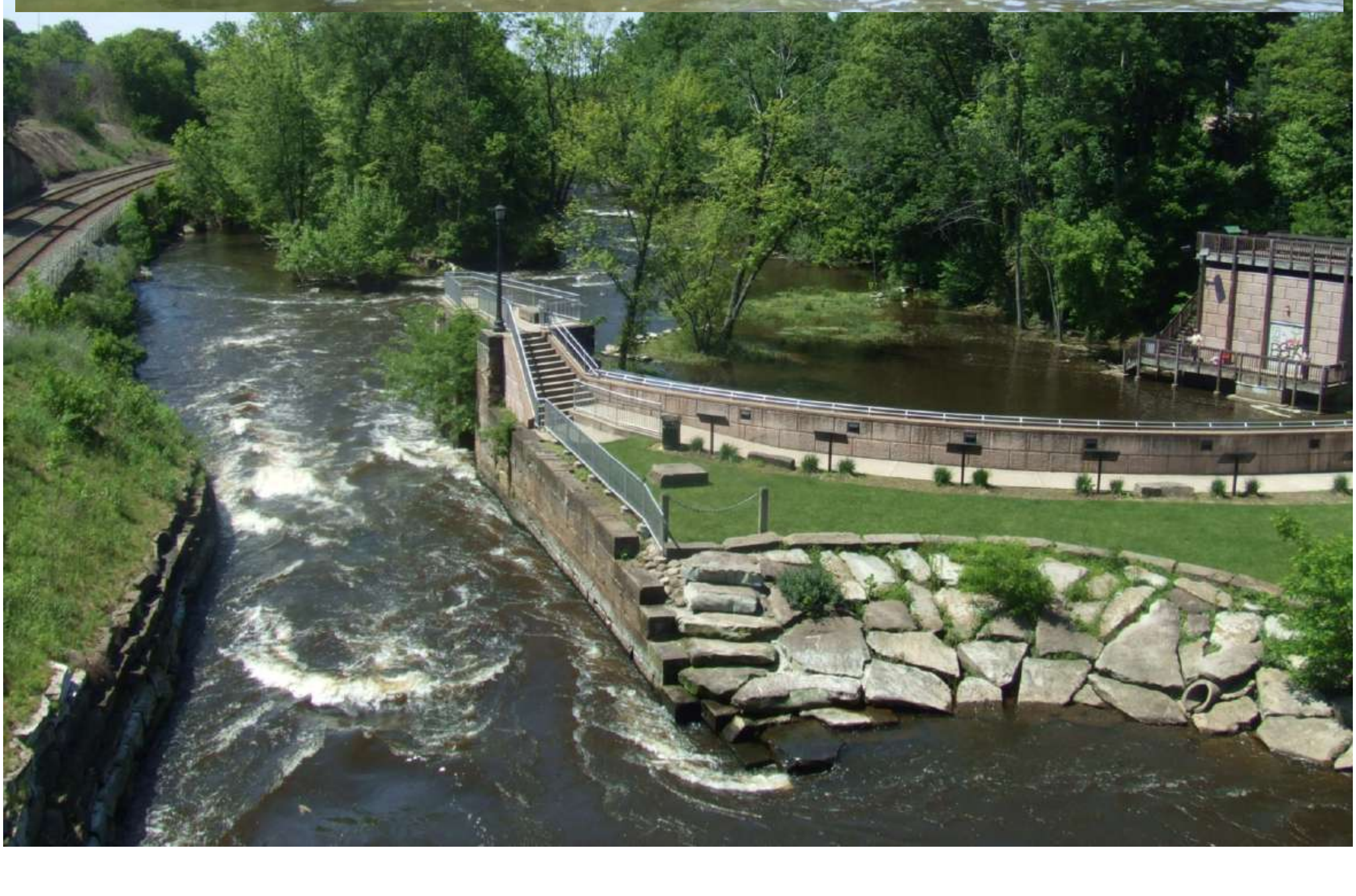
Middle Cuyahoga River Watershed Action Plan

December, 2012

Northeast Ohio Four County Regional Plan and Development Organization

Production of this draft report has been funded by the Ohio Department of Natural Resources through the Watershed Coordinator Program, with additional financial and technical assistance from watershed partners. If you wish further information, please contact the Middle Cuyahoga River Watershed Coordinator, NEFCO, 180 E. South St., Akron, OH 44311, 330-252-0337.



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Middle Cuyahoga River Watershed Action Plan 2012

Partner Community/ Organization	Title	Endorsement	Date
NEFCO			
City of Akron			
City of Cuyahoga Falls			
City of Hudson			
City of Munroe Falls			
Silver Lake Village			
City of Stow			
City of Tallmadge			
Summit County Planning Dept.			
Summit County Dept. of Environmental Services:			
Summit Soil and Water Conservation District			
Village of Hartville			
Lake Township			
Marlboro Township			
Stark County Regional Planning Commission:			
Stark County Health Dept.			

Middle Cuyahoga River Watershed Action Plan 2012

Partner Community/ Organization	Title	Endorsement	Date
Brady Lake Village			
Brimfield Township			
Franklin Township			
City of Kent			
Randolph Township			
Ravenna Township			
Rootstown Township			
City of Streetsboro			
Suffield Township			
Village of Sugar Bush Knolls			
Portage County Regional Planning Commission:			
Portage Soil and Water Conservation District:			
Portage County Health Dept.:			
Portage County Engineer:			
Portage Parks:			

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Middle Cuyahog River Watershed Action Plan
Acronyms and commonly used abbreviations

Acronym	Term
ACOE	Army Corps of Engineers
ALU	Aquatic Life Use (Ohio water quality category)
AMATS	Akron Metropolitan Area Transportation Study
AOC	Area of Concern (designation applied to impaired areas of Lake Erie/tributaries)
AWS	Agricultural water supply (Ohio EPA water quality designation)
BMP	Best Management Practice
BOD	Biological oxygen demand
CCAP	Coastal Change Analysis Program
CF	Cuyahoga Falls
cfs	cubic feet per second
COD	Carbonaceous oxygen demand
CSO	Combined sewer overflow
DERR	Division of Environmental and Remedial Response
DNR	Department of Natural Resources
DO	Dissolved Oxygen
DRP/SP	Dissolved Reactive Phosphorous/soluble phosphorous
DST	downstream
EOLP	Erie Ontario Lake Plain (ecoregion)
EPA	Environmental Protection Agency
FEMA	Federal Emergency Management Agency
GIS	Geographic Information System
HIT2	High Impact Target sediment loading model
HSTS	Home sewage treatment systems
HUC	Hydrologic Unit Code
IBI	Index of Biologic Integrity
ICI	Invertebrate Community Index
IWS	Industrial water supply (Ohio EPA water quality designation)
LRW	Limited Resource Water (Ohio Water Quality Designation)
LTCP	Long Term Control Plan (for controlling combined sewer overflows)
MF	Munroe Falls
mg/l	milligrams per liter
mgd	million gallons per day
MIWb	Modified Index of Well Being (Ohio EPA water quality indicator)
mpn	most probable number (relates to monitoring for colonies of *E. coli* bacteria)
MS4	Municipal Separate Storm Sewer System
MWH-C	Modified Warmwater Habitat (Ohio Water Quality Designation)
NOAA	National Oceanographic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service
ORAM	Ohio Rapid Assessment Method (wetland assessment)
ORC	Ohio Revised Code
PAH	Poly-aromatic hyrdocarbons
PCR	Primary contact recreation (Ohio water quality designation)
PWS	Public water supply (Ohio EPA water quality designation)
QHEI	Qualitative Habitat Evaluation Index (Ohio EPA water quality indicator focused on habitat)
RAP	Remedial Action Program (federal program to bring impaired portions of L. Erie into attainment)
RM	River Mile
RUSLE	Revised Uniform Soil Loss Equation

Acronyms and commonly used abbreviations

Acronym	Term
STEPL	spreadsheet tool for estimating pollutant loading
TMDL	Total Maximum Daily Load
TP	Total Phosphorous
TSD	Technical support document (Ohio EPA documents)
TSS	Total suspended solids
USDA	U.S. Department of Agriculture
USGS	U.S. Geological Survey
UST	upstream
WC	Watershed coordinator
WRLC	Western Reserve Land Conservancy
WTP	water treatment plant
WWH	Warm Water Habitat (Ohio Water Quality Designation)
WWTP	Waste water treatment plant

1. Purpose

The purpose of this watershed plan is to build a framework for the long-term protection and improvement of the Middle Cuyahoga River, its tributaries, and watershed. A major focus of Watershed Action Plans is to achieve the goal of the Clean Water Act, i.e., to

> "Restore and protect the chemical, physical, and biological integrity of the nation's waters."

In evaluating, protecting, and improving the health of the Middle Cuyahoga River and its watershed, it is necessary to understand how the physical, chemical, and biological components are related, and how impacts to one aspect may affect another. This document addresses water quality as a function of the interrelated elements of a stream system.

This document :

- Presents a watershed inventory, describing physical, social/land use, historic, biological, and hydrologic conditions;
- Identifies problem areas within the stream network, such as water quality impairments, nuisance algae, degraded stream morphology, or areas where flooding or erosion problems may be occurring due to stresses in the stream system;
- Identifies key landscape features protecting the water quality and related stream system;
- Identifies potential risks to water quality and the health of the system;
- Identifies and prioritizes opportunities for protection or restoration;
- Provides a prioritized list of tasks or efforts for watershed partners to implement to improve and protect the waters of the Middle Cuyahoga.

Part of the guide plan is the establishment of a long-term collaboration to implement the measures recommended in this plan. This document describes the framework that the partners are adopting to ensure the plan is implemented.

This document is being submitted for endorsement by the Ohio Department of Natural Resources and Ohio Environmental Protection Agency.

2. Introduction

2a Middle Cuyahoga River Watershed

The Middle Cuyahoga River watershed is in northeast Ohio, in the Lake Erie basin, immediately east of Akron and approximately 25 miles south of Cleveland. (See Figure 2a-1). The middle portion of the Cuyahoga River extends from the Lake Rockwell dam in Kent west to the Ohio Edison dam in Cuyahoga Falls. The watershed extends west to Ravenna and south to Hartville. (See Figure 2a-2.) The watershed includes portions of Summit, Portage, and Stark Counties and covers 137 square miles. Breakneck Creek is the largest tributary.

The United States Geological Survey designates watersheds by Hydrologic Unit Code (HUC). The most inclusive, largest drainage areas have the fewest digits; sub-watersheds have additional digits indicating that they are part of larger systems. The designations for the Middle Cuyahoga River are shown in Table 2a-1.

Table 2a-1 Middle Cuyahoga River Sub-watershed HUC Designations

Level of HUC Designation	HUC Designation	Description
2-digit	04	Great Lakes Basin
4-digit	0411	Southern Lake Erie (northeast Ohio)
8-digit – rivers and creeks	04110002	Cuyahoga River
10-digit – river between major tributaries	04110002 02 04110002 03	Cuyahoga River between Black Brook and Breakneck Creek Cuyahoga River between Breakneck Creek and Little Cuyahoga River
12-digit –subwatersheds tributaries and mainstem between tributaries	04110002 02 03 04110002 02 02 04110002 02 01 04110002 03 01 04110002 03 05 04110002 03 05	Lake Rockwell dam to Breakneck Cr. Feeder Canal/Potter Cr. Breakneck Creek/Potter Cr. Plum Creek Fish Creek Main Stem to Little Cuyahoga

It should be noted that the area adopted as the Middle Cuyahoga River watershed differs slightly from designated HUC 10 or HUC 12 watersheds, as follows:

- The watershed working group chose the Ohio Edison dam as the lower extent of the Middle Cuyahoga, because the Cuyahoga River Area of Concern extends upstream from Lake Erie to the Ohio Edison dam. It should be noted that removal of the Ohio Edison dam has been contemplated during recent years. To address the possibility that this artificial boundary may be removed in the future, the mapping at the lower end of the watershed has been extended to the confluence with the Little Cuyahoga, but mapped as a separate sub-watershed.

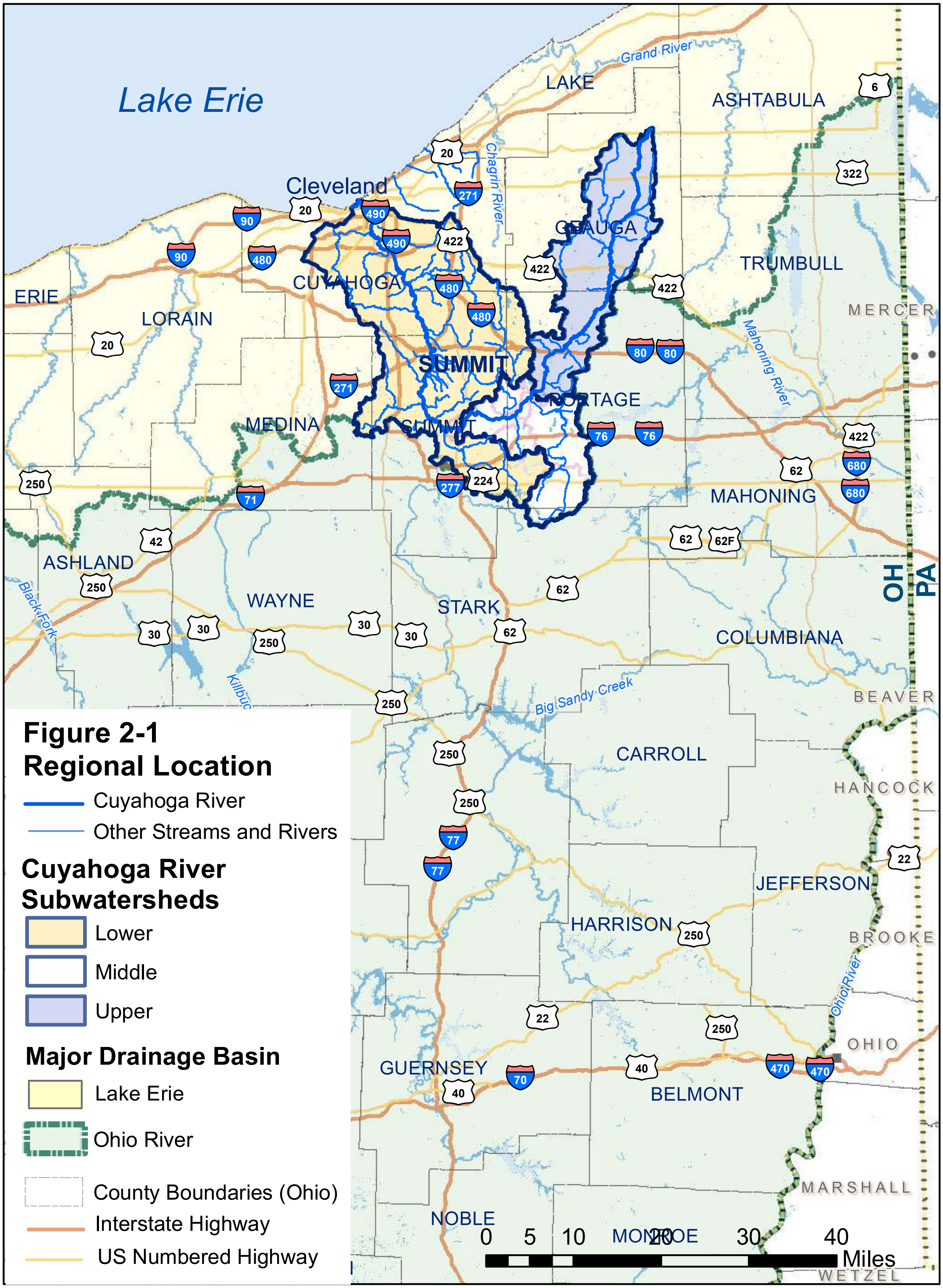

Figure 2-1 Regional Location

Sources: Ohio DNR GIS Mapping 2012, NEFCO 2012

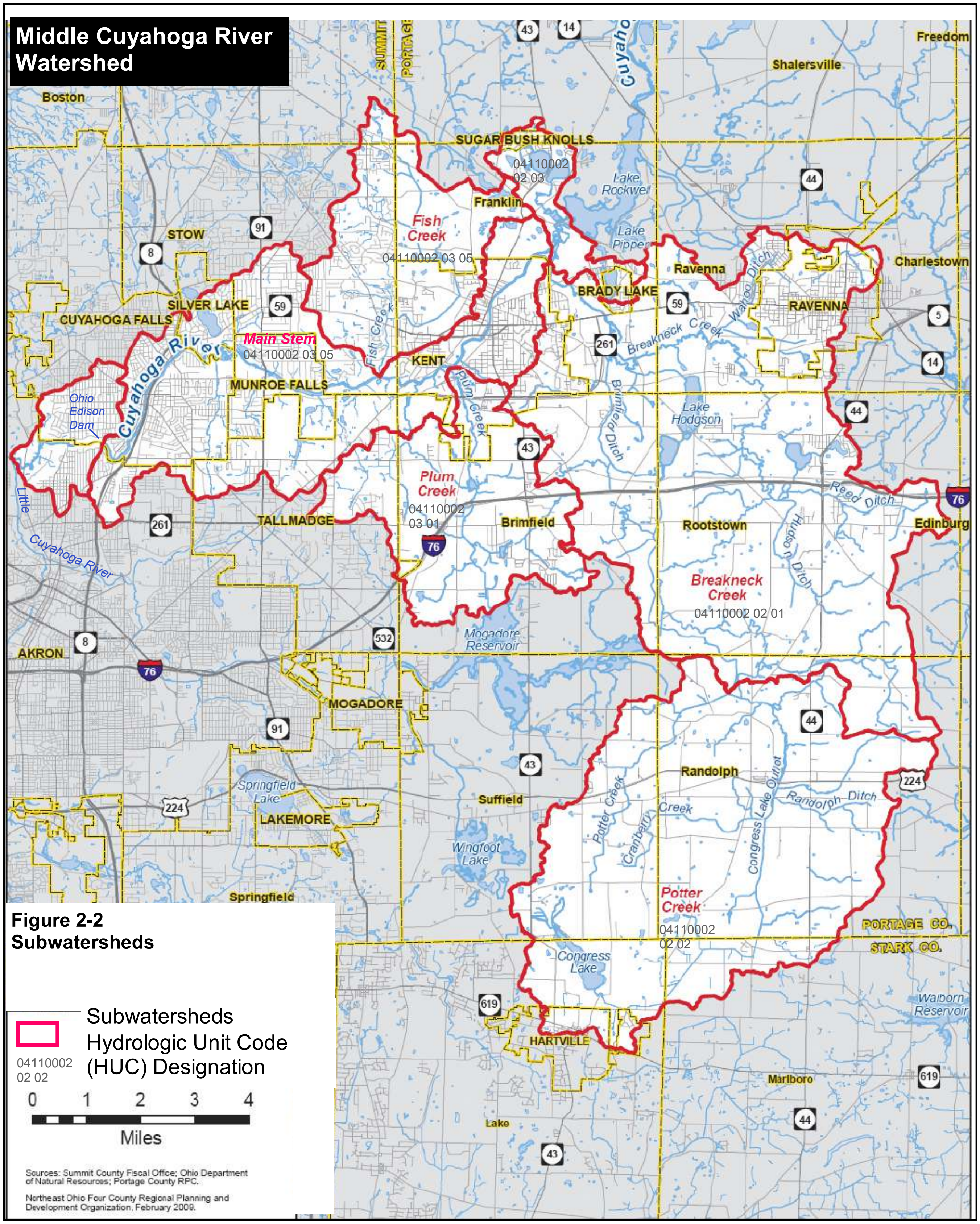

Figure 2-2
Subwatersheds

The Upper Cuyahoga is generally accepted as the watershed upstream of the Lake Rockwell dam and had been the subject of coordination by the Upper Cuyahoga River Task Force. The HUC-10 and HUC 12 designations include the portion of the river between the Lake Rockwell dam and Breakneck Creek as Upper Cuyahoga. However, since this portion of the watershed is within the city of Kent and downstream of an obvious boundary (the Lake Rockwell dam), the watershed group has included this small portion of the Upper Cuyahoga HUC 10 watershed as part of the management unit.

- Fish Creek, once designated as its own subwatershed, has been incorporated into the newly revised HUC 12 boundaries as part of the main stem subwatershed. Because Fish Creek has a distinctive character and identity, this report continues to include mapping for the Fish Creek watershed as a separate unit.

The Middle Cuyahoga River watershed includes portions of Stark and Summit Counties, but is predominantly in Portage County. The following entities are within the watershed.

Table 2A-2 Entities in the Middle Cuyahoga River Watershed

Summit County

- City of Akron*
- City of Cuyahoga Falls
- Village of Silver Lake
- City of Munroe Falls
- City of Hudson*
- City of Stow
- City of Tallmadge
- Summit Soil and Water Conserv. Dist.
- Summit County Health District
- MetroParks, Serving Summit County

Stark County

- Village of Hartville
- Lake Township
- Marlboro Township
- Stark Soil and Water Conservation Dist.
- Stark Health District
- Stark Parks District

Portage County

- City of Kent
- Brady Lake Village
- Franklin Township
- City of Streetsboro*
- Village of Sugar Bush Knolls
- City of Ravenna
- Ravenna Township
- Brimfield Township
- Rootstown Township
- Suffield Township
- Randolph Township
- Portage Soil and Water Conservation Dist.
- Portage County Health District
- Portage Park District

*Very small portions of these communities are within the watershed.

All cities in urbanized areas and certain counties are required to obtain permits under the National Pollutant Discharge Elimination System (NPDES) stormwater permitting program to operate their Municipal Separate Storm Sewer System (MS4). All communities in the watershed except Randolph and Marlboro townships require NPDES permits. Portage County has created a county-wide stormwater district to manage stormwater throughout the county.

Special designations affecting the Cuyahoga River include:

- Wild and Scenic River – Upper Cuyahoga River
- American Heritage River, National Heritage Corridor– entire Cuyahoga River
- Great Lakes Area of Concern – Lower Cuyahoga River to upstream of the Ohio Edison Dam.

2b. Population, Demographic, and Economic Characteristics

Water quality in a watershed is affected by land use, which is reflected in and related to population, housing, and economic data. Factors such as population, age, family status, location and type of employment, and income affect housing demand, retail development, and other land uses. Furthermore understanding these characteristics of a watershed can help develop an understanding of its use, functioning, trends, and potential concerns and opportunities.

The demographic and economic profile of the Middle Cuyahoga River watershed reflects the varied nature of its communities:

- The older urban centers of Akron, Cuyahoga Falls, Kent, and Ravenna;
- Surrounding older suburban areas that developed during the last 10-50 years;
- Recently developed or currently developing areas; and
- Rural communities in the outlying areas in Portage and Stark Counties, with villages and largely agricultural communities.

Population and household totals reflect 2000 and 2010 Census data. Economic data, which also include residence of employees, were available from the U.S. Census for 2002-2011. These were compared with known areas of growth and recent land use mapping/aerial photography, discussed further in Chapter 4.

<u>Watershed Population Density, and Housing: 2010 Census</u>

Table 2b-1 indicates that the overall population of watershed communities is almost the same as it was in 2000. However, there has been an increase in households by nearly 4,000, mostly in the communities of Stow, Tallmadge, Twinsburg, Streetsboro, Brimfield, Kent, Rootstown, and Lake Township. Akron experienced a substantial population loss, and in Hudson, Munroe Falls, Silver Lake, Brady Lake, Randolph, Ravenna City and Township, Sugar Bush Knolls, and Suffield Township population declined by approximately 47 to 500 people in the various communities. Some of the population declines in townships may be attributed to annexation. It is likely that the population change did not occur as a consistent trend over the decade. Communities outside the older urban centers grew rapidly until 2007, when a major multi-year recession began, with stalled housing development, excess housing stock, and possibly population loss.

Figures 2-3a and 2-3b present the 2010 and 2000 Census population density of the watershed by census block groups.[*] These often allow population patterns to be determined on a finer resolution than community-level mapping. Mapped census data from 2000 and 1990 were compared visually to determine areas of population change during the 1990s.

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[*] Census blocks are the smallest area for which census counts are reported. Their boundaries may be streets in urban areas. Their population can range from zero to several hundred. Census block groups are grouped census blocks, the smallest unit for which census sampling results are reported. Census blocks may change with shifts in population.

Table 2b-1 Population and Household Change 2000-2010

Community	*Total Population*		*2000-2010 Population Change*		*Households*		*2000-2010 Change Household Total*		*Persons per Household*	
Community	**2010**	**2000**	**Change**	**Percent**	**2010**	**2000**	**change**	**% change**	**2010**	**2000**
Akron city, Summit County, Ohio	199,110	217,074	-17,964	-8%	83,712	90,116	-6,404	-7%	2.38	2.41
Cuyahoga Falls city, Summit County, Ohio	49,652	49,374	278	1%	22,250	21,655	595	3%	2.23	2.28
Hudson city, Summit County, Ohio	22,262	22,439	-177	-1%	7,620	7,357	263	4%	2.92	3.05
Munroe Falls city, Summit County, Ohio	5,012	5,314	-302	-6%	2,086	1,955	131	7%	2.40	2.72
Silver Lake village, Summit County, Ohio	2,519	3,019	-500	-17%	1,004	1,235	-231	-19%	2.51	2.44
Stow city, Summit County, Ohio	34,837	32,139	2,698	8%	14,226	12,317	1,909	15%	2.45	2.61
Tallmadge city, Summit County, Ohio	17,257	16,180	1,077	7%	6,939	6,210	729	12%	2.49	2.61
Brady Lake village, Portage County, Ohio	464	513	-49	-10%	201	202	-1	0%	2.31	2.54
Brimfield township, Portage County, Ohio	10,376	7,963	2,413	30%	3,996	2,959	1,037	35%	2.60	2.69
Franklin township, Portage County, Ohio	5,527	5,276	251	5%	2,447	2,174	273	13%	2.26	2.43
Kent city, Portage County, Ohio	28,904	27,906	998	4%	10,288	9,772	516	5%	2.81	2.86
Randolph township, Portage County, Ohio	5,298	5,504	-206	-4%	2,007	1,958	49	3%	2.64	2.81
Ravenna city, Portage County, Ohio	11,724	11,771	-47	0%	5,055	4,980	75	2%	2.32	2.36
Ravenna township, Portage County, Ohio	9,209	9,270	-61	-1%	3,817	3,739	78	2%	2.41	2.48
Rootstown township, Portage County, Ohio	8,225	7,212	1,013	14%	3,128	2,624	504	19%	2.63	2.75
Streetsboro city, Portage County, Ohio	16,028	12,311	3,717	30%	6,562	4,908	1,654	34%	2.44	2.51
Suffield township, Portage County, Ohio	6,311	6,383	-72	-1%	2,481	2,411	70	3%	2.54	2.65
Sugar Bush Knolls village, Portage County, C	177	227	-50	-22%	69	79	-10	-13%	2.57	2.87
Tallmadge city, Portage County, Ohio	280	210	70	33%	87	63	24	38%	3.22	3.33
Hartville Village, Stark County	2,944	2,174	770	35%	1,154	900	254	28%	2.52	2.42
Lake Twp, Stark County	29,961	25,892	4,069	16%	10,809	9,166	1,643	18%	2.77	2.82
Marlboro Twp., Stark County	4,356	2,287	2,069	90%	1,585	1,452	133	9%	2.75	1.58
total	470,433	470,438	-5	2.046088	191,523	188,232	3,291	2%	2.46	2.50

Source: American Fact Finder, 2010 Census, 2000 Census.

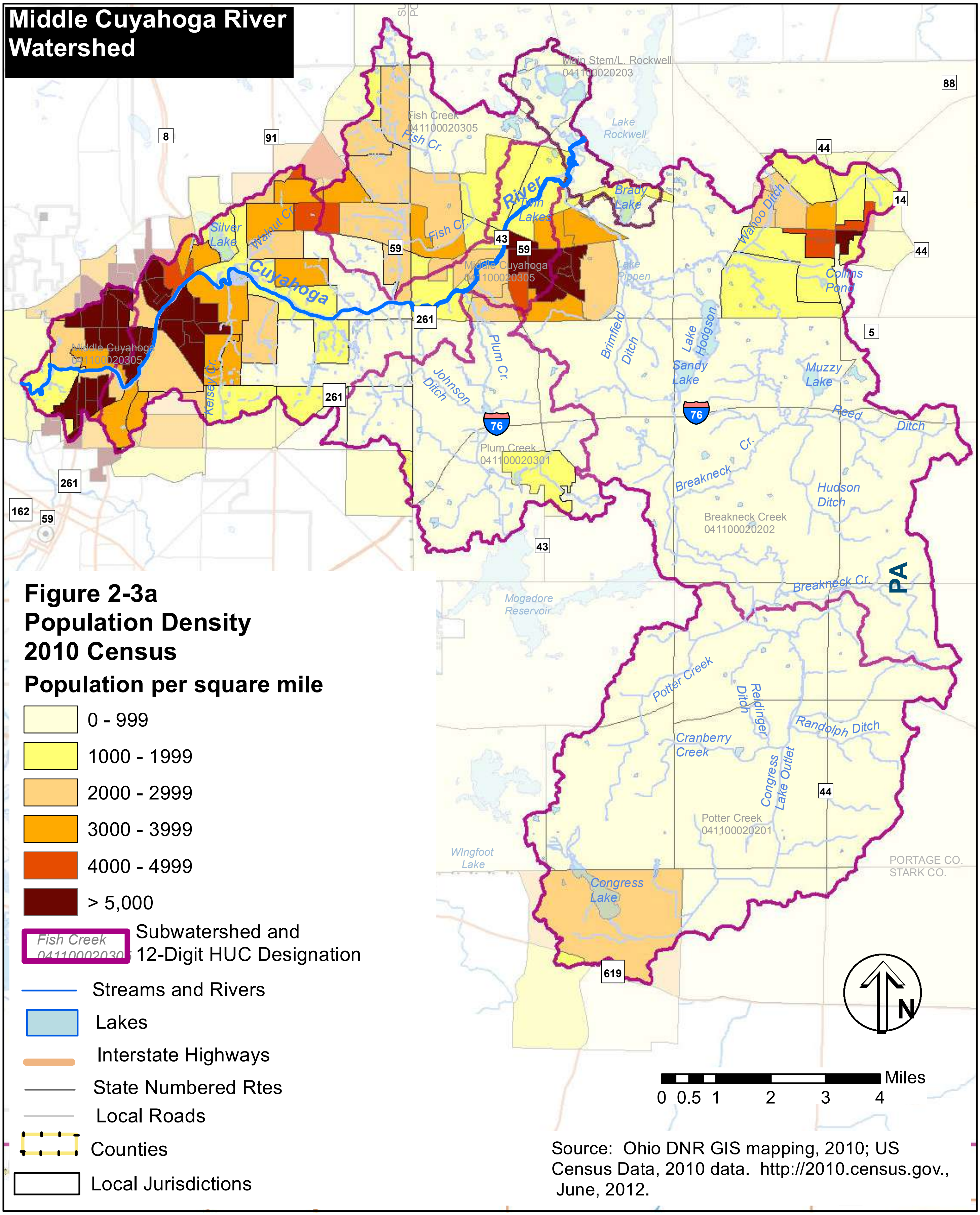


Figure 2-3a
Population Density
2010 Census

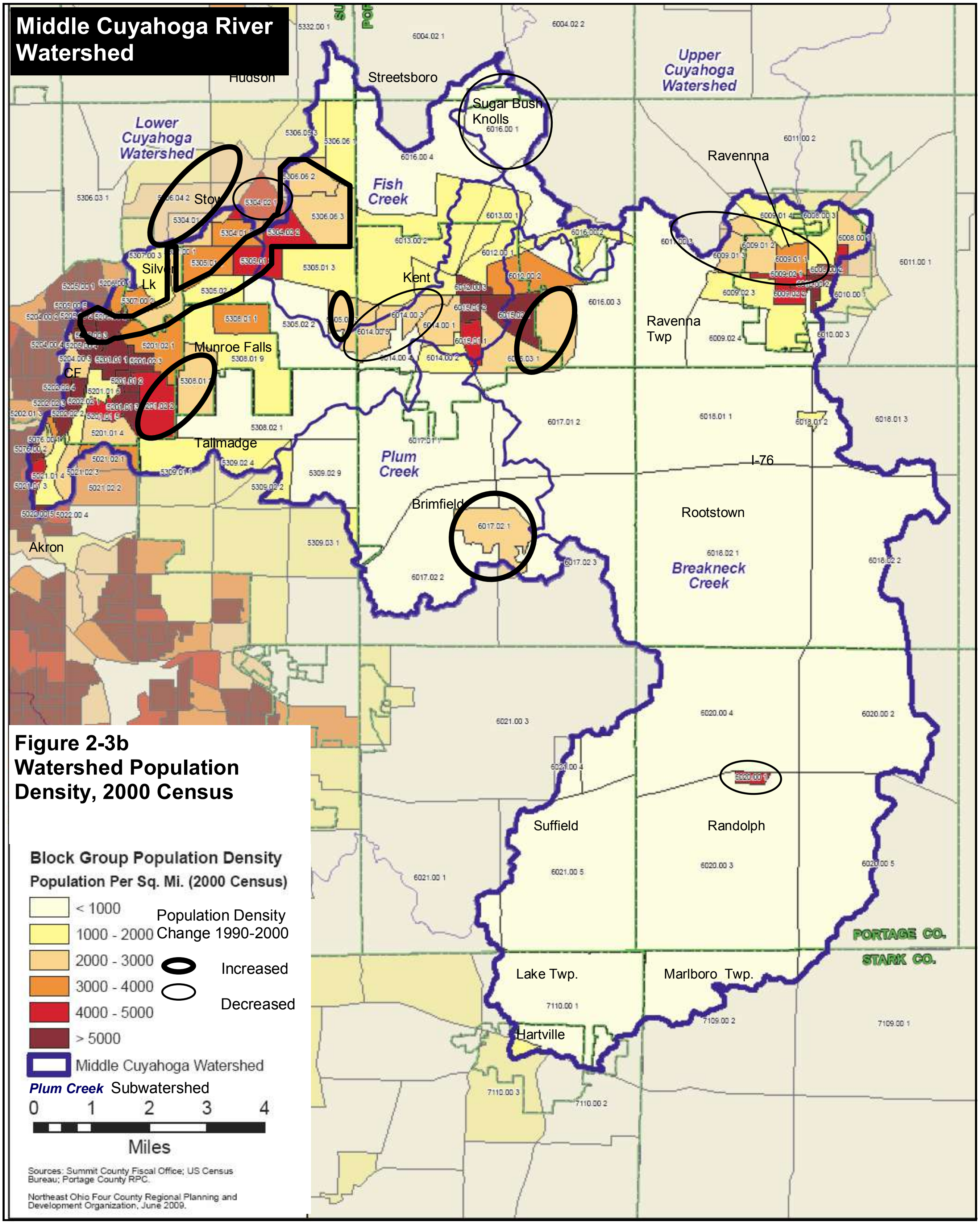


Figure 2-3b
Watershed Population Density, 2000 Census

In 2000, the population of the watershed census block groups was pproximately156,000, and in 2010, the population of the watershed census block groups was approximately 165,000. One likely reason that the census block group estimate shows more growth than the community figures is that only a small portion of Akron is in the watershed, and most of the population loss from Akron occurred outside the watershed. Figures 2-3a and b show the highest population density in the watershed area in the urban areas of Cuyahoga Falls, Akron, Kent, and Ravenna, and the lowest population density in Portage and Stark Counties.

Between 1990 and 2000, the watershed population had increased by nearly 13,000 with the most prominent growth occurring in portions of Cuyahoga Falls, Munroe Falls, Stow, Kent, and Brimfield. Portions of Kent, Ravenna City, Randolph Township, and Sugar Bush Knolls decreased in population density, possibly due to smaller household sizes in built-out communities or migration.

Between 2000 and 2010, growth continued in the areas between Stow and Munroe Falls, and Kent, Ravenna, Brimfield, Ravenna Township, and Rootstown. Brimfield has not visibly increased in density, but the population data indicate an increase in total, which, because it is distributed across a large area, does not appear to increase in density.

Housing demand is related to household size. As household sizes decrease, more housing is needed to accommodate the same level of population. In recent decades, household sizes nationwide have tended to decrease, due to factors such as the increasing age of the population, number of children or other relatives in the same household, number of single-parent households or individuals living alone. As shown on Table 2b-1, in 2010 the household sizes in watershed communities averaged 2.46, lower than the average household size in 2000 of 2.57. In almost every community, the average household size has declined, contributing to the demand for additional housing to accommodate the population.

The 2000 census provides more information than the 2010 census, as the “long form” data sampling was eliminated during the most recent census. The 2000 Census data indicate that most of the housing units in the watershed (ranging from 77 to 97 percent in 2000) were built before 1990. (See Table 2b-2.) With the exception of Kent, the percent who reported living in the same house in 2000 as in 1995 ranged from 55 to 78 percent within the watershed communities, indicating that 22 to 45 percent of the population in these areas had moved within five years. Since most structures were built before 1990, most of the population who moved did so into existing houses. The recent ACS data suggest that in the survey communities, approximately 50 percent of residents moved to their current home since 2000.

The population and housing data discussed in this section refer to entire communities, many of which are only partially in the watershed. For instance, most of Akron, Streetsboro, and Hudson are outside the watershed, as are substantial portions of Tallmadge, Stow, Cuyahoga Falls, and Lake Twp. In understanding the watershed, it is helpful to understand where growth seems to be occurring within each community.

Table 2b-2 Length of Residence versus Age of Housing

Community	% in Same Housing 1995	% of Housing Built before 1990
Ohio	57	87
Summit County	58	88
Akron*	55	94
Cuyahoga Falls	57	88
Silver Lake	71	97
Hudson*	57	84
Munroe Falls	66	90
Stow	55	77
Tallmadge	65	82
Portage County*	56	82
Kent	35	92
Franklin Twp	61	89
Streetsboro*	49	60
Brady Lake Village	62	92
Sugar Bush Knolls	74	79
Ravenna City	52	93
Ravenna Twp	59	78
Brimfield Twp*	63	92
Rootstown Twp	68	79
Suffield Twp	78	87
Randolph Twp	69	83
Stark County	62	90
Lake Twp	61	81
Hartville	51	84
Marlboro Twp	72	84

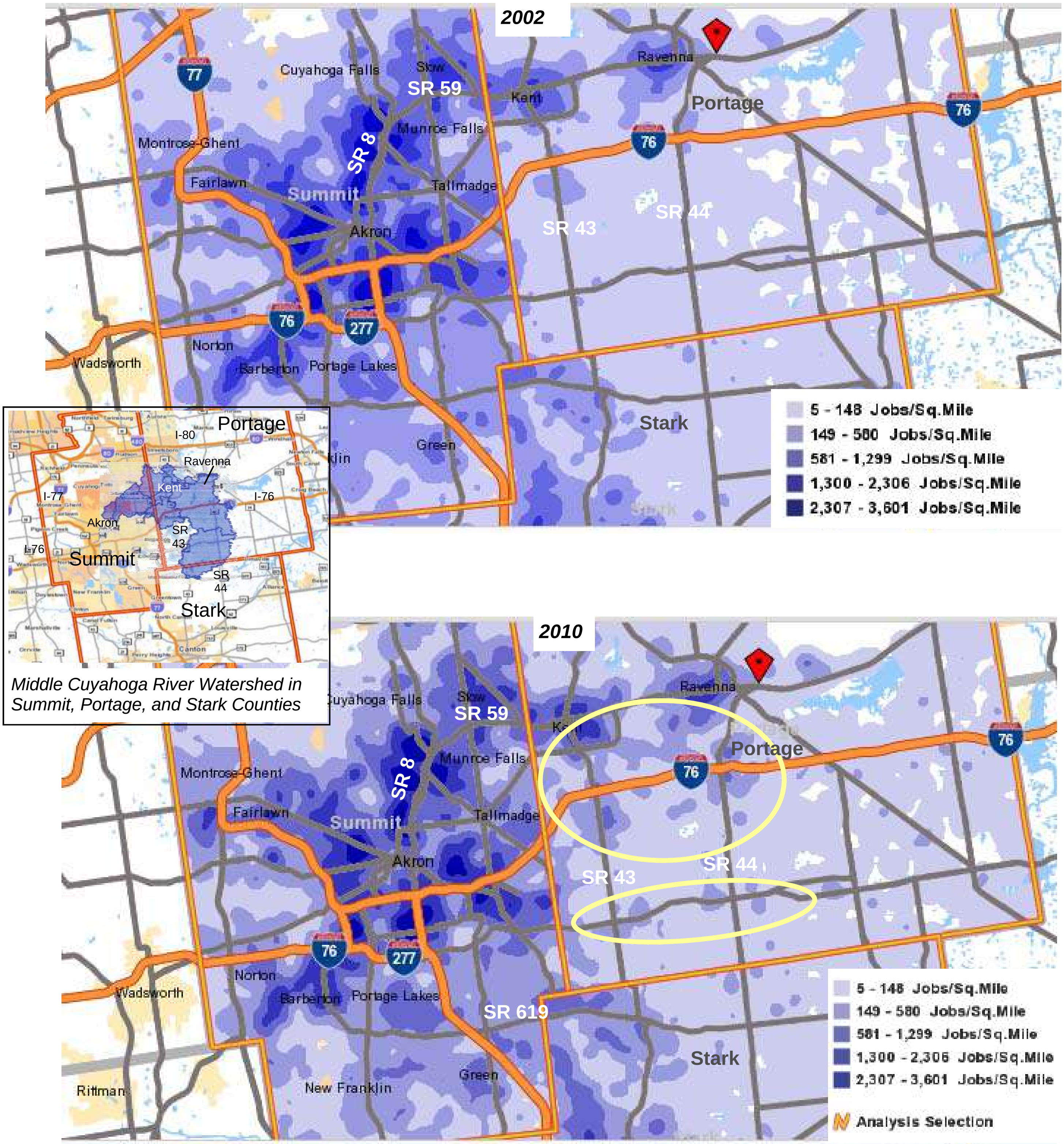
**Only a small portion of these communities is in the watershed. Source: 2010 Census American Fast Facts.*

Figure 2-4 presents changes in housing patterns based on reported numbers of employees in each county by residence for 2002 and 20010. Because these data are aggregated at the census block level, the mapping shows housing distribution within communities and clearly reflects the growth patterns described in this section, with growth occurring in areas of Portage County that previously were sparsely developed.

Potential Future Growth Areas

In the recent economic downturn, which began in late 2007-2008, little housing development has occurred. However, the past trends suggest which areas are likely to experience growth in population and housing once the market is more favorable for development. While there is still undeveloped land in some of the watershed communities in Summit County, future growth in these communities is likely to taper off over time as the vacant land in these communities dwindles. The Cities of Kent and Ravenna are surrounded by unincorporated areas. While these cities are quite built up, they could still expand through annexation. Since 2000, Brimfield Township entered into Joint Economic Development District agreements with the neighboring cities of Tallmadge and Kent. Brimfield is located along Interstate 76 with short travel time to the Akron area and has ready access to sewer and water providers. Brimfield experienced rapid growth in residential, commercial, and industrial development and is likely to continue doing so once development starts occurring in the region again. Recent development in other outlying areas, especially with highway access, such as Rootstown, suggest that these areas will experience future development pressure as well.

Figure 2-4 Employed Residents, Summit, Portage, and Northern Stark Counties, 2002 and 2010



Middle Cuyahoga River Watershed in Summit, Portage, and Stark Counties

Notes:
OnTheMap put a red marker at approximately the NE edge of the watershed.
Yellow ovals indicate growth areas (increase in number of residents with jobs) from 2002-2010.

Source: U.S. Census Bureau, OnTheMap Application and LEHD Origin-Destination Employment Statistics (Beginning of Quarter Employment, 2nd Quarter of 2002-2010). US Census OnTheMap http://onthemap.ces.census.gov/

Economic Characteristics

Watershed residents' occupation and income may affect their ability or willingness to undertake certain improvements or projects, the tax base of communities supporting the projects, and eligibility for certain grants. Watershed residents' occupation relates directly to their use of and relationship to the land.

The employment characteristics and trends in a watershed and its region affect land use patterns, growth pressures, regionally important employment centers, and the potential for out-migration and vacancies. Land use pressure is often greatest near good access to employment centers. Substantial changes in certain employment sectors can affect migration patterns, development pressure, and vacancies in an area. The type of employment in a region is related to income, housing price people are willing to pay, education level of residents, how far employees are willing to travel from their homes to work, and conversely, how far from the employment centers they are willing to live.

Data from the 2011 U.S. Census American Community Survey indicates that the median income of communities in the watershed varies widely (See Table 2b-3.) Ravenna, Kent and Akron are older urban centers, with older and more densely developed residential areas. Akron and Kent also contain resident student populations who attend the universities in each city, which may skew income data. A comparison of median household income data for communities versus the state for 2007 and 2011 indicates that, during that period, the median income in the cities decreased relative to the state, while median income in the outlying communities increased relative to the state.

Employment data of residents from the 2007-2011 American Community Survey, and Census employment data for counties and county subdivisions from 2002-2010 were reviewed. A useful tool was the Census OnTheMap interactive mapping program, which maps data from selected years, aggregated to the census block level.

As shown on Figure 2-5, the employment centers in the watershed counties focus on the population centers and corridors between Canton, Akron, Twinsburg (and north), and Kent. This distribution has been constant since 2002, the first date included in OnTheMap.

As shown on Table 2b-4 the industries employing the most residents included manufacturing, wholesale/retail, and education/health care/social assistance.   Portage County had higher proportions of residents employed in manufacturing and education/ health care fields, and Summit County had higher proportions of people employed in information and professional industries. The construction employment may be low compared to other time periods, due to the economic downturn that began in 2007. Between 2002 and 2010, health and education industries expanded, while many others declined, especially manufacturing. This trend may reflect in part the economic downturn but may also reflect longer term trends in employment.

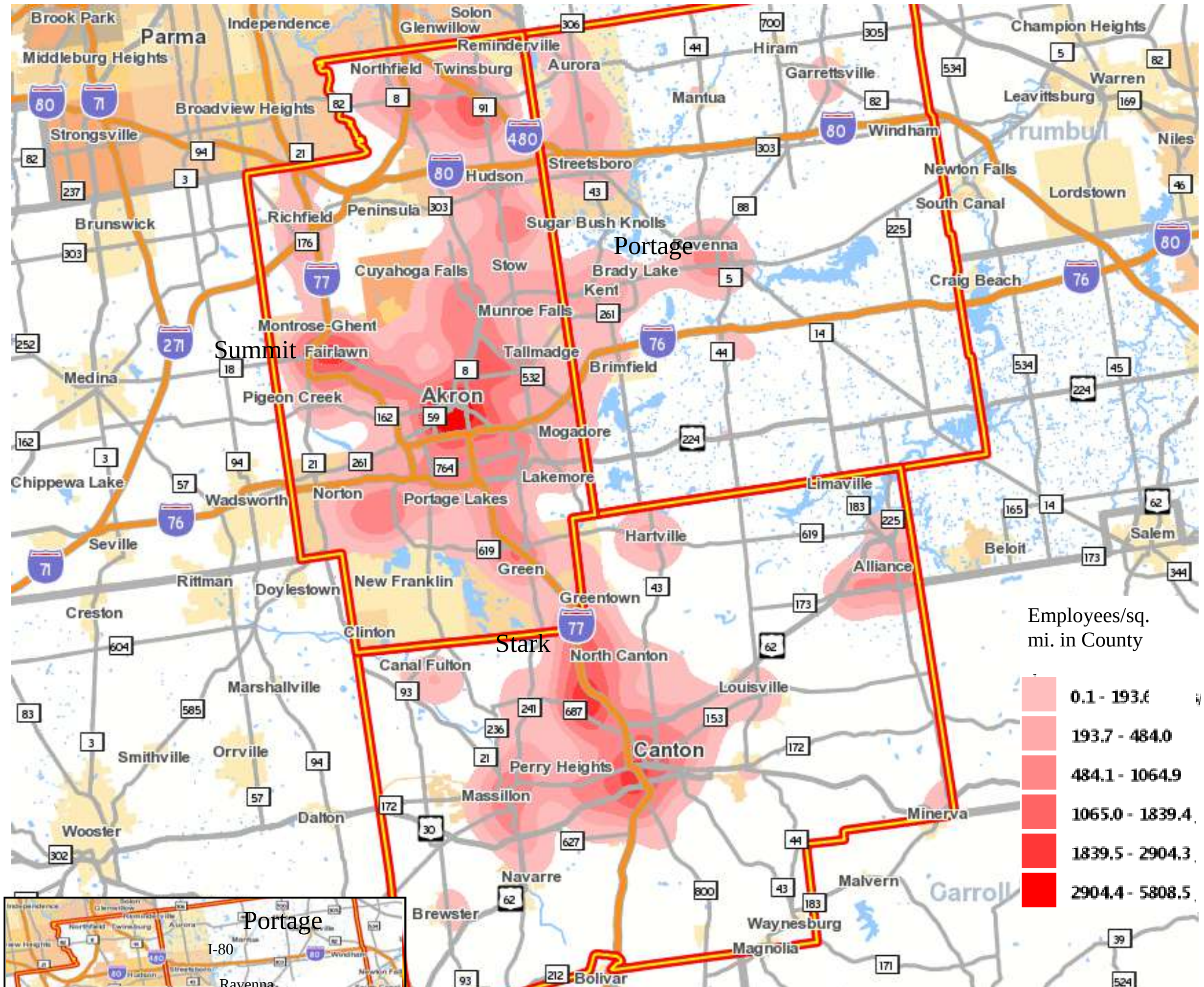
Table 2b-5 indicates that the number of residents employed in manufacturing and construction declined from 2002 to 2010, and those employed in health care and professional fields increased. Some of the construction decline may be related to the economic downturn, which affected the real estate market heavily, but the other trends reflect longer-term patterns.

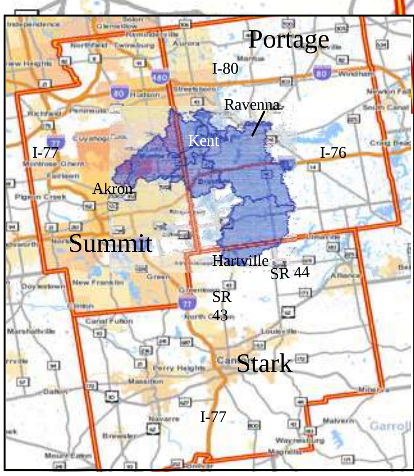
Table 2b-3 Income and Poverty Levels

	Median Household Income		Percent Difference from State		Percent below Poverty 2011	
	2000	2011	2000	2011	People	Families
Ohio	**40,956**	**45,749**	**0.0**	**0.0**	**14.8**	**10.8**
Summit County, Ohio	***42,304***	***48,790***	***3.3***	***6.6***	***10.4***	***14.5***
Akron	31,835	34,190	-22.3	-25.3	19.9	19.9
Cuyahoga Falls	42,263	46,450	3.2	1.5	8.2	8.2
Hudson	70,875	144,523	73.1	215.9	3.1	2.1
Munroe Falls	61,169	65,970	49.4	44.2	3.6	3.6
Silver Lake Village	70,875	96,250	73.1	110.4	1.3	4.3
Stow	57,525	64,577	40.5	41.2	4.6	1.6
Tallmadge	49,381	58,391	20.6	27.6	8.5	8.5
Portage County, Ohio	***44,347***	***51,441***	***8.3***	***12.4***	***8.9***	***14.3***
Brady Lake Village	36,406	47,188	-11.1	3.1	27.4	23.8
Brimfield Twp	46,973	55,976	14.7	22.4	12.9	7.9
Franklin Twp	47,750	53,176	16.6	16.2	19.1	8.0
Kent	29,582	26,923	-27.8	-41.2	35.3	18.5
Randolph Twp	49,665	64,100	21.3	40.1	7.6	7.1
Ravenna	35,650	34,825	-13.0	-23.9	21.8	16.9
Ravenna Twp	38,325	47,842	-6.4	4.6	11.2	6.7
Rootstown Twp	48,931	60,382	19.5	32.0	7.1	6.7
Suffield Twp	51,495	55,625	25.7	21.6	5.0	5.4
Streetsboro	48,661	62,183	18.8	35.9	4.7	7.2
Sugar Bush Knolls	129,555	79,107	216.3	72.9	4.2	4.7
Stark County, Ohio	***39,824***	***45,347***	***-2.8***	***-0.9***	***10.0***	***13.6***
Lake Twp	57,347	69,081	40.0	51.0	2.3	2.3
Hartville	41,012	30,707	0.1	-32.9	7.8	5.7
Marlboro Twp	53,351	65,744	30.3	43.7	2.9	2.9

*Poverty Threshold, reported here, is statistical tool used by US Census, reflecting previous year's income compared to nationwide levels determined by the US Census. Eligibility for federal programs is determined by the Poverty *Guidelines* developed by the Dept. of Health and Human Services.

Sources:
2011 data - US Census 2007-2011 American Community Survey Table DP03, Economic Characteristics, American FactFinder web page, 2012. factfinder2.census.gov
2000 data - US Census Bureau Profile of General Demographic Characteristics, 2000.





Source: *U.S. Census Longitudinal Employer Household Dynamics, OnTheMap http://lehd.did.census.gov/led/*

Middle Cuyahoga River Watershed in Summit, Portage, and Stark Counties

Figure 2-5
Employment Centers, Summit, Portage, and Stark Counties, 2007

Table 2b-4 Employment of Residents, 2011

	Civilian employed population 16+	Ag, forestry, fishing, hunting, mining		Construction		Manufact.		Wholesale/ Retail		Transport., Warehouse, Utilities		Information, Finance, Insurance, Real Estate		Professional, Scientific, Mgmt, Admin, Waste mgmt		Educ., Health Care, Social Assistance		Arts, Recreation, Entertainmt, Accomm, Food svc		Other service except public admin		Public Admin	
		No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Summit County, Ohio	***258,042***	***601***	***0.2***	***13,615***	***5***	***42,173***	***16***	***37,809***	***15***	***11,440***	***4***	***22,367***	***9***	***25,719***	***10***	***61,276***	***24***	***22,361***	***9***	***12,299***	***5***	***8,382***	***3***
Akron*	87,966	138	0.2	4,478	5	12,840	15	12,947	15	3,907	4	6,242	7	7,807	9	22,474	26	9,148	10	4,735	5	3,250	4
Cuyahoga Falls	25,024	84	0.3	1,443	6	3,988	16	4,092	16	1,077	4	2,192	9	2,605	10	5,549	22	2,061	8	949	4	984	4
Hudson*	10,486	88	0.8	240	2	1,721	16	1,592	15	284	3	1,348	13	1,360	13	2,601	25	759	7	339	3	154	2
Munroe Falls	2,768	0	0	166	6	520	19	310	11	133	5	392	14	183	7	740	27	118	4	85	3	121	4
Silver Lake Village	1,153	5	0.4	70	6	197	17	127	11	57	5	121	11	188	16	245	21	39	3	75	7	29	3
Stow	17,962	40	0.2	927	5	2,755	15	2,619	15	641	4	1,639	9	2,189	12	4,493	25	1,525	9	750	4	384	2
Tallmadge	7,978	2	0	320	4	1,481	19	1,033	13	404	5	719	9	698	9	2,219	28	670	8	266	3	166	2
Portage County, Ohio	***80,821***	***504***	***0.6***	***4,887***	***6***	***15,661***	***19***	***12,612***	***16***	***3,213***	***4***	***5,136***	***6***	***6,301***	***8***	***18,475***	***23***	***8,045***	***10***	***3,433***	***4***	***2,554***	***3***
Brady Lake Village	246	7	2.8	36	15	41	17	21	9	3	1	6	2	31	13	65	26	7	3	19	8	10	4
Brimfield Twp	5,205	64	1.2	272	5	1,095	21	838	16	285	6	464	9	419	8	774	15	534	10	178	3	282	5
Franklin Twp	2,954	0	0	165	6	449	15	401	14	65	2	178	6	367	12	950	32	210	7	116	4	53	2
Kent	14,904	38	0.3	549	4	1,114	8	2,217	15	368	3	972	7	1,054	7	4,977	33	2,854	19	484	3	277	2
Randolph Twp	2,578	0	0	105	4	630	24	392	15	73	3	119	5	146	6	682	27	140	5	20	1	271	11
Ravenna	5,288	20	0.4	191	4	1,126	21	880	17	123	2	376	7	397	8	1,106	21	691	13	243	5	135	3
Ravenna Twp	4,761	41	0.9	346	7	1,409	30	740	16	130	3	244	5	296	6	802	17	307	6	263	6	183	4
Streetsboro*	8,739	71	0.8	425	5	1,828	21	1,419	16	340	4	762	9	774	9	1,719	20	704	8	476	5	221	3
Rootstown Twp	4,220	29	0.7	235	6	647	15	843	20	318	8	269	6	240	6	826	20	310	7	232	6	271	6
Suffield Twp	3,185	44	1.4	290	9	627	20	580	18	255	8	157	5	264	8	592	19	187	6	105	3	84	3
Stark County, Ohio	***172,484***	***1,148***	***0.7***	***9,378***	***5***	***31,621***	***18***	***25,271***	***15***	***7,901***	***5***	***11,669***	***7***	***14,794***	***9***	***42,307***	***25***	***15,640***	***9***	***8,374***	***5***	***4,381***	***3***
Lake Twp	14,323	125	0.9	856	6	2,136	15	2,346	16	894	6	1,022	7	1,422	10	3,419	24	966	7	657	5	480	3
Hartville Village*	1,603	27	1.7	99	6	277	17	278	17	123	8	126	8	172	11	296	19	159	8	79	5	12	1
Marlboro Twp	2,173	104	4.8	313	14	374	17	329	15	120	6	116	5	132	6	490	23	78	4	85	4	32	2

*Only small portions of these communities are in the watershed.

Source: US Census 2007-2011 American Community Survey Table DP03, Economic Characteristics, as reported on American FactFinder web page, 2012. factfinder2.census.gov

Table 2b-5 Employment trends Watershed Counties, 2002 to 2010

Jobs by NAICS Industry Sector* in Summit, Portage, and Stark Counties

	2010		2002	
	Count	**Share**	**Count**	**Share**
Agriculture, Forestry, Fishing and Hunting	626	0.1%	740	0.2%
Mining, Quarrying, and Oil and Gas Extraction	870	0.2%	770	0.2%
Utilities	2,459	0.6%	2,775	0.6%
Construction	14,855	3.5%	20,428	4.4%
Manufacturing	61,959	14.5%	83,508	18.1%
Wholesale Trade	22,498	5.3%	25,346	5.5%
Retail Trade	48,565	11.4%	54,661	11.9%
Transportation and Warehousing	12,498	2.9%	12,571	2.7%
Information	7,813	1.8%	9,824	2.1%
Finance and Insurance	15,550	3.6%	18,623	4.0%
Real Estate and Rental and Leasing	4,771	1.1%	5,788	1.3%
Professional, Scientific, and Technical Services	21,416	5.0%	19,375	4.2%
Management of Companies and Enterprises	14,641	3.4%	13,368	2.9%
Administration & Support, Waste Management and Remediation	23,151	5.4%	23,231	5.0%
Educational Services	39,796	9.3%	41,329	9.0%
Health Care and Social Assistance	70,666	16.6%	59,513	12.9%
Arts, Entertainment, and Recreation	5,276	1.2%	5,694	1.2%
Accommodation and Food Services	33,333	7.8%	34,620	7.5%
Other Services (excluding Public Administration)	13,224	3.1%	14,698	3.2%
Public Administration	12,574	2.9%	13,747	3.0%
Total	426,541		460,609	

*U.S. Census North American Industry Classification System
Source: CensusOnTheMap

The increase in people who are willing to travel to work from their homes in outlying areas in Portage County is likely to increase the demand in Portage County for housing, a trend that has been observed during the recent decade. Interstate 76 passes through two rapidly growing watershed communities, providing good access for Portage County residents to the employment centers in Akron and elsewhere.

During the past two years, 2010-2012, the potential for oil and gas extraction from the Utica shale has generated numerous permits for wells that use hydrofracturing ("fracking"). There is the potential that installation of wells and manufacturing of parts will affect employment in the watershed counties.

Demographic Conditions, Summary

Canton, Akron, Kent, and Ravenna are the older urban centers in the watershed, where jobs and residences are concentrated. Older suburbs include Tallmadge, Munroe Falls, and Cuyahoga Falls. More recently, rapid development has occurred in Stow and portions of Portage County. Housing and economic data suggest that development is expanding out from the core into previously undeveloped areas of Portage County. The region will bear watching as the current economic downturn is resolved, to determine whether the patterns that became apparent over recent decades continue, resulting in further development pressure in areas like Brimfield, or whether the economy is shifting in such a major way that previous patterns of economic activity, population, and housing are changed substantially.

2c. Watershed management background

Communities and organizations within the Middle Cuyahoga watershed have been involved in watershed planning efforts to some degree for over 30 years. Planning efforts in the watershed that preceded development of this plan included:

- NEFCO, as the Areawide Planning Agency for Summit, Portage, Stark, and Wayne Counties, has compiled the region's Section 208 water quality improvement plans since the inception of the program.
- Breakneck Creek watershed management study – inventory – NEFCO partnered with Breakneck Creek Coalition
- Middle Cuyahoga River Comprehensive Watershed Management Plan –Inventory
- In the 1990s NEFCO convened a Middle Cuyahoga River task force to develop a watershed plan. The collaborative effort resulted in an inventory with goals and objectives, but it was interrupted by lawsuits involving the City of Akron and communities downstream of the Lake Rockwell dam concerning releases of water from the Akron public water supply at Lake Rockwell.
- Portage County has developed a watershed plan with input from a variety of stakeholders and experts.
- The three counties, park districts, soil and water conservation districts, and numerous communities are actively seeking to restore and protect watershed features. Many watershed communities have or are considering riparian setbacks, are installing rain gardens, bioinfiltration, and permeable pavement, and many have been involved in restoring stream morphology. The Cities of Kent and Cuyahoga Falls have removed two low-head dams from tributaries in their cities (Plum and Kelsey Creeks), and Cuyahoga Falls will be removing two low head dams along the Cuyahoga River within a year.
- Kent and Munroe Falls have sponsored annual River Day festivals to celebrate the Cuyahoga River during May. Portage Parks holds Breakneck Creek Day on the same day. The City of Cuyahoga Falls holds clean-ups from Earth Day to River Day annually and has recently been coordinating autumn clean-ups with the Kent State University Outdoor Adventure Center.
- Portage County has adopted a countywide stormwater utility, and Summit County is evaluating the feasibility of a countywide approach to stormwater management.

Middle Cuyahoga River TMDL and Dam Alteration/Removal

The Ohio EPA published the state's first Total Maximum Daily Load study for the Middle Cuyahoga River in 2000 to address non-attainment of water quality standards in this portion of the river. The TMDL found that the major causes of impairment were low oxygen, poor habitat, and flow alteration in dam pools along the Middle Cuyahoga River due to dams along the river at Kent, Munroe Falls, and Cuyahoga Falls. The TMDL recommended removing the dams at Kent and Munroe Falls, or, alternatively, placing extremely stringent limits on permits for wastewater treatment plant effluent.

The Kent and Munroe Falls dams were altered or removed in 2004-2005. Riverbank restoration upstream of the Munroe Falls dam was a collaborative effort between the County of Summit, NEFCO, MetroParks, Serving Summit County, Summit County Soil and Water Conservation District, and the cities of Kent, Stow, and Munroe Falls.

Water quality monitoring following removal/alteration of the two dams indicated that the biological communities between Munroe Falls and Lake Rockwell were either in attainment of water quality standards or were approaching attainment, expected to recover fully within the near future. The impairments identified by the TMDL along the mainstem of the Middle Cuyahoga have been largely addressed. However, some of the tributaries remain impaired, and land use practices contributing to impairment continue.

NEFCO approached the partners from previous collaborative efforts with a proposal to obtain a watershed coordinator grant for the watershed, in order to safeguard the progress that had been made and continue to make improvements in the watershed. The partners indicated that they had been attempting watershed management in the past but were unable to devote staff time consistently and had difficulties working across county and municipal boundaries. The partners expressed immediate and enthusiastic support for a watershed coordinator and for developing a state-endorsed watershed action plan.

3. Watershed Plan Development

3a. Watershed Group

At the beginning of this planning process, in January, 2009, invitations were sent to the communities, park, health, and soil and water conservation districts within the watershed to participate in development of a Watershed Action Plan. The e-mail contact list grew to over 100 people representing communities, land trusts, individuals, university faculty, county and local government, and special districts. The watershed coordinator met with individuals from communities and Kent State University, spoke at various other groups to raise awareness and solicit comments and suggestions, including Kent Environmental Council, Summit and Portage NPDES Phase II Stormwater Information and Public Education groups; Akron-Summit Homebuilders Association; Rotary Club of Portage County. Outreach efforts will continue following endorsement of the plan.

During four years of preparation, perhaps 60 different people came to meetings that were held approximately monthly, but the partners who frequently attended represented the following interests:

- City of Kent
- Portage County Regional Planning Commission
- Portage Park District
- City of Ravenna
- Akron Water Supply and wastewater management
- Summit County Environmental Services
- City of Cuyahoga Falls
- Summit and Portage Soil and Water Conservation Districts
- Local environmental consulting firm
- Citizens from the watershed (Kent, Akron, Cuyahoga Falls), who are involved in environmental advocacy and promotion of recreational paddling

In addition to participating in meetings, Kent State University Recreational Services and the City of Cuyahoga Falls have coordinated autumn river clean-ups, with assistance from Summit County Department of Environmental Services.

In addition, as the need for comments or information arose, the watershed coordinator contacted other partners, or others from the mailing list or those with related interests. Agency officials from Ohio EPA and DNR attended meetings occasionally.

During river clean-ups, which has already become an annual event, a slightly different group of partners would come together to accomplish those events. This approach seems to define the group for the time being: As partners' interests coincide, they work together on shared efforts.

The partners are a relatively new group of collaborators, although many had worked together on other efforts in the region. They joined in this effort because they shared interests in protecting and promoting water quality in the watershed, and they recognized the benefits of collaboration and developing a common framework. In the two and a half years of working as a partnership, they have demonstrated and further developed a strong ability to collaborate.

The group was initially conceived as a loose partnership to develop the Watershed Action Plan, and so far, has been able to accomplish a great deal collaboratively through consensus. Having reached the milestone of an endorsed plan, the partners wish to continue as a loose collaboration for the short-term future. The need for a separate organization with officers and rules of operation will be assessed as time and implementation work progresses.

NEFCO has agreed to provide initial funding to continue the watershed coordinator position, as funds allow for the short term, to allow the coordinator to work with partners on starting projects and obtaining funding. The first year will be used to establish momentum and funding to carry the partnership forward for several years. The partners perceive this as an interim period until the group has successfully carried out some activities and has had a chance to develop an understanding of how they would like to proceed in the longer term. This informal approach should be successful for the near-term, because the partners, who have invested substantial amounts of time and match funds, wish to start accomplishing some of the efforts they have identified. The action tables in Section 7 were developed based on the interests of the partners who were participating in the plan development. A variety of tasks have been identified, which would allow some collaboration where appropriate, but would also allow individual partners to, alone or together, work with the Watershed Coordinator to accomplish certain efforts.

During the last few months of the planning grant, the partners did not meet as frequently as initially, as much of the work was focused on document production. Once the plan is endorsed, the watershed coordinator will be working with individual partners on raising awareness of the plan, writing grant proposals, and starting implementation projects. The coordinator will hold less frequent but regular meetings with the partners to provide some continuity, most likely two to four times per year, depending on the need expressed by the partners.

Mission statement

The partners agreed that the following represents the mission of this group:

Protect, restore, and improve Middle Cuyahoga River, its tributaries, and watershed by protecting the elements that are achieving a high quality, improving, enhancing, or restoring degraded systems, and reducing the effects of the altered watershed.

3b. Plan Outline

This plan largely follows the Appendix 8 outline for Watershed Action Plans. The Problem Statements, Goals, Objectives, and Actions, which are in four separate separate sections in the Appendix 8 outline, have been combined into a single section, 7, in a separate volume. The remainder of the document is organized as follows:

<u>Section</u>	**<u>Descripton</u>**
4	Watershed Inventory
4a	Description of the watershed (geology, biological features, water resources
4b	Cultural Resources
4c	Previous and complimentary efforts
4d	Physical Aspects of Streams
4e	Designated use/attainment, threats
5	Impairments, Concerns, Problem Statements
5a	Impairments
5b	Habitat and hydrologic concerns
6	Implementation Considerations
Volume II	
7	Problem Statements, Goals, Objectives, Actions
8	Monitoring/Evaluation
9	Plan Revision

A separate photographic section, 4P, is included with appendices.

3c. Endorsement

The Watershed Coordinator has met with representatives of various communities during development of this plan. Endorsement will be sought individually from the partners that participated in plan development.

3d. Information component

In addition to the elements noted above, implementing the watershed action plan relies on outreach, education, and stewardship that involves a wide range of people. Several of the actions listed in Section 7 focus on outreach and information, including developing a website to serve as a center of watershed-related information; producing flyers; continuing to organize clean-ups of the Cuyahoga River, increasing stewardship activities to lakes or tributaries, conducting workshops for local officials, and developing demonstration projects.

Following plan endorsement, the watershed coordinator will be meeting with stakeholders who did not regularly attend meetings. It is anticipated that the watershed coordinator, along with select partners, will present at forums of interested officials and the public. Because meetings focused on watershed planning tend not to attract large audiences, the watershed coordinator has been having discussions with groups at their own meeting venues, in order to increase awareness, and will likely continue doing so.

4. Watershed Inventory

4a Description of the Watershed
-i Geology

The landscape affects the nature and health of water resources. Topography affects stream energy and morphology; soils affect drainage; and land use affects stream integrity, runoff, groundwater recharge, and habitat. Wetlands and floodplain access are important components of healthy hydrologic systems, and stream morphology affects stream stability over time and response to storm events and flooding. The presence or absence of vegetated riparian (streamside) corridors plays a crucial role in water quality, habitat, flooding and erosion.

In order to provide a framework for identification of problem areas and opportunities, Sections 4 presents an inventory of watershed conditions, literally from the ground up. Sections 4a-c first describe the physical and biological characteristics of the watershed, then hydrology, land use and historical resources, and previous related efforts. Section 4d examines many of the physical conditions of the stream corridors. The last section of the inventory, 4e, examines alterations to the watershed and how these changes affect the quality of the resources. The intent is to use the inventory of conditions to help identify areas to protect or improve, and existing or potential causes of water quality impairment or related concerns within the watershed system.

Geology (Bedrock and Surficial), Topography, Soils, and Ecoregion

The bedrock and surficial materials of an area provide the foundation for the landscape – its topography, soils, drainage patterns, and surface and ground-water hydrology. The bedrock and surficial materials in the watershed have a substantial affect on the landscape of the watershed and the functioning of the waters.

Bedrock Geology

The Middle Cuyahoga River watershed is in the glaciated Allegheny Plateau. This region is characterized by broad bedrock uplands of sedimentary rock separated and incised by deep river channels, all of which have been subsequently modified by glaciers. In Northeast Ohio, the Allegheny Plateau generally ranges from 1,050 to 1,200 feet in elevation and is dissected by valleys as much as 500 feet deep, which have since been filled by as much as 200 feet of glacial deposits.

The bedrock at the surface in the watershed is primarily the Pottsville group of early Pennsylvanian age (about 300 million years ago). This nearly level assemblage of sandstones, shales (mudstones), and coals formed out of the sediments eroding off uplands in Pennsylvania and Canada. The most prominent member of the Pottsville group is the lowest, oldest member, the Sharon sandstone, a rather uniform sandstone with layers containing noticeable round white (quartz) pebbles. The Sharon is resistant to weathering and tends to erode into ledges, creating some of the most distinctive landscape features in the region: sandstone cliffs, ledges, and waterfalls. Early settlers harnessed waterfalls along the Cuyahoga River to provide water power for mills and factories, creating the nuclei for communities such as Kent, Munroe Falls, and Cuyahoga Falls. Associated with the sandstone units are shale and coa, which formed in quiet environments, such as swamps, lakes, or embayments. Where shaley layers like the Meadville shale underlie the ledge-forming sandstones, the less resistant, less permeable shale weathers out from under the ledges, forming overhangs and caves. The Sharon Sandstone is also one of the major bedrock aquifers of the region, because of its high transmissivity (ability of water to flow between pore spaces).

Prior to the most recent glaciation, which began approximately 2 million years ago, the broad uplands of the Allegheny plateau had been eroded, dissected into deep valleys by rivers over millions of years. The previous drainage system in northeast Ohio, known as the Erigan, drained north toward the present St. Lawrence valley. White, 1982; J. Evans, 2003.

Surficial Geology

Glacial History-Background

Background: Glacial History

The most recent glaciation that covered northeast Ohio from 2 million years ago to 14,000 years ago modified the pre-existing topography. Steep-sided valleys were partially smoothed over and filled in with sediment. The moving ice scraped off portions of bedrock and left deposits on the uplands. Streams and lakes that developed from melting ice left behind deposits that range from flat to hilly, clay to gravel. These modifications created the topography, parent material, and conditions for our current soils and landscape, and left behind deposits through which groundwater flows.

To develop an understanding of the surficial materials, several sources were reviewed. This chapter includes digital mapping that was readily available from the Ohio GIS Internet Management System (GIMS). The background from several previous reports is generally consistent with the available mapping. The various sources combined provide an adequate understanding of how the landscape and surficial materials developed and how they will affect the soils, landscape, surface and ground water hydrology in the watershed.

Glacial Materials and Landforms

As glaciers advance and retreat, they leave behind several types of material and forms. These are generally grouped by whether they were formed in water (outwash) or were left behind by the ice as it retreated (till). The process that formed these landscape features affects the nature of the deposits left behind.

Outwash - sediment left behind by melting water from the ice. Outwash is often stratified (layered) by the flowing water and tends to be well-sorted, with grains relatively uniform in size. (See Figure 4a-1.) Outwash material that is sand or gravel tends to store a great deal of water between pore spaces and allows water to flow through it easily. Outwash material that formed in lakes tends to be very fine-grained and does not allow water to flow through easily. Outwash landforms include:

- Kames - circular or elongate knolls, mounds, ridges, or terraces of outwash material (often sand or gravel) that were deposited by streams in holes or cracks in the ice or along the margins of ice blocks and valleys. The material in kames is variable, ranging from sand to cobbles or boulders. The layering is often tilted.

Typical till in northeast Ohio has a high proportion of clay, with silt, gravel, cobbles, and boulders mixed in. *Source: J Szabo, University of Akron.*

Glacial outwash is often sandy or gravelly. It typically exhibits horizontal or dipping layers, and the sediment is well-sorted by size, with deposits of finer or coarser grains reflecting different flow conditions. *Photo source: J. Peck, University of Akron Geology Dept.*

Figure 4a-1
Glacial Deposits: Till and Outwash

- Kame terraces are stratified deposits along valley sides, which formed where water flowed along the margin of ice that remained in deep bedrock valleys. Where the current was swift, coarser material was deposited. Occasionally, ponds would form along the ice margins, resulting in deposits of fine-grained material.
- Kettles formed where ice blocks from the stagnant or retreating ice margin broke off and were covered by outwash sediment. After the remnant ice blocks melted, deep, steep sided, isolated valleys were left behind, which often formed bogs or lakes. The surficial material at the bottom of kettles is often peat or clay.
- Along outwash valleys, glacial rivers carried and deposited sediment. These were unlike present streams in the region. Glacial streams tend to be high energy with high loads of sediment, leaving extensive deposits of well-sorted sand and gravel. As gravel bars accreted (grew vertically with sediment), streams would shift, flowing along a different path. The tundra climate would allow minimal vegetation to grow, and the severe winds of the tundra would remove most silts from exposed sediment, depositing the silts as loess, uniform deposits of silt. Loess deposits, while present in the middle Cuyahoga watershed, are generally so thin they are not mapped separately.
- At the ice margins, pro-glacial lakes might form. The lake bottoms would be covered with clay and other fine-grained material.

Till – left behind as the ice moves, consists of ground up bedrock and incorporated surface materials, ranging from clay size to boulders. As shown on Figure 4a-1, this material is generally unlayered and poorly sorted. With a range of particle sizes, any pore space between larger particles is often filled with smaller material, resulting in generally poor drainage, low water storage. Water often does not move freely through the limited pore space. Such material is said to transmit water poorly or have low transmissivity.

- As the ice melted back across the landscape, the ground-up sediment melted out, remaining on the landscape as moraines:
- Ground moraine - a relatively thin coating of till deposited across bedrock highs.
- End moraine or recessional moraine - At the extent of the ice sheet or where the glacier paused while melting back, the till was deposited in long, relatively narrow, linear, continuous bands of hummocky topography (i.e., characterized by numerous rounded hills or knolls). Ridges at the furthest extent of the ice margins are end moraines, and ridges formed as the ice paused are recessional moraines.

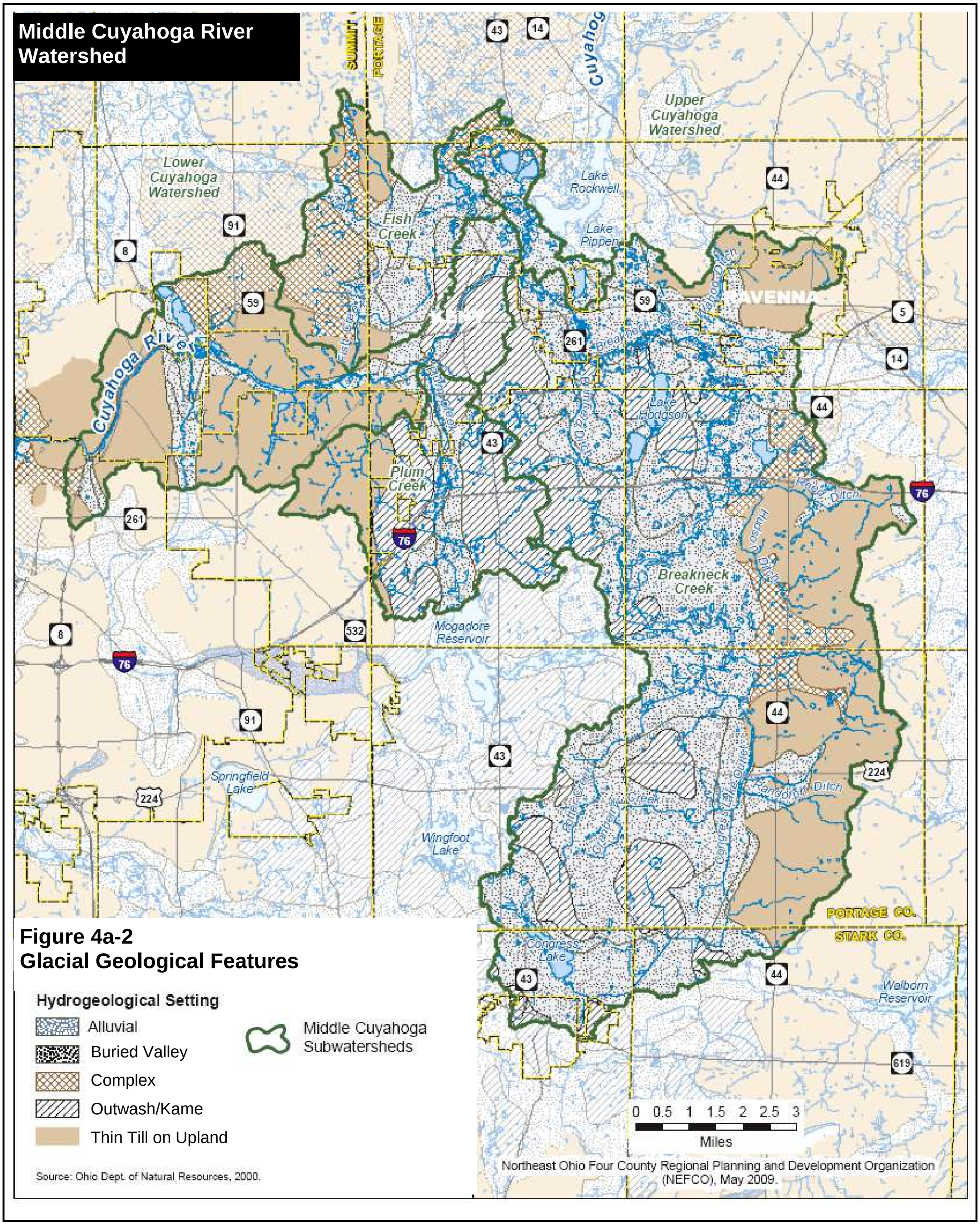
Buried valleys are ancient, often deep, incised river valleys that are now partially filled with glacial materials. The valleys can be filled with outwash from glacial streams, till, lake deposits, or a combination of materials in various layers and lenses.

Findings: Glacial/Surficial Materials of the Middle Cuyahoga River Watershed

Glacial Landscape of the Middle Cuyahoga River Watershed

The incised bedrock of the Middle Cuyahoga River watershed area trapped retreating glacial ice, resulting in deposits that vary widely in composition and topography within a short distance. White (1982) notes that northeast Ohio experienced several glacial advances and retreats, each modifying the previous landscapes. In other areas like central Ohio, where the ice margins fluctuated over a wide area, the glaciers left several distinct linear, narrow end moraines across a north-south distance of about 100 miles. However, in the area of the middle Cuhayhoga watershed, the pre-existing valleys trapped portions of the glacial ice, compressing several moraine ridges into a very narrow band. The glaciers melted more quickly from the neighboring bedrock uplands. The ice within the valleys neither advanced nor retreated, but stagnated. Melting ice and the meltwater deposited kames and kame terraces along the margins of the ice and valleys. Later advances of ice draped these deposits with new till. Kettles formed where ice blocks broke off and melted. The resulting landscape, a kame moraine, is a confused mix of hummocky topography contained by till-covered bedrock uplands, with a mixture of outwash features (such as kames and kettles) and end-moraine or recessional moraine till, all sometimes overlain with till by subsequent glacial advances and retreats.

Figure 4a-2 presents the Ohio DNR mapping of unconsolidated aquifer geology in the Middle Cuyahoga River watershed. The eastern portion of the watershed roughly east of Route 44 is largely composed of thin till on upland. White (1982) described this as Lavery Till ground moraine, a thin silty till deposited as gently rolling topography over bedrock uplands. The central portion of the watershed is mapped as buried valley, outwash, and kames. This corresponds to the Kent Kame Moraine described by White, the narrow, irregular band of hummocky topography with till and outwash features jumbled together over a width of approximately 15 miles in a buried valley. The western portion of the watershed is mapped as thin till overlying bedrock highlands, described as Hayesville Till (in Stow and Munroe Falls) in the northwestern portion of the watershed. Plum Creek and Kelsey Creek flow through buried valleys. The Cuyahoga River flows through till-covered upland and a buried valley, identified in other mapping as outwash valley trains. In many areas, the river has eroded down and into the bedrock. The sandy and gravelly deposits in the Plum Creek buried valley and along the Cuyahoga River near Kelsey Creek have high transmissivity (allow groundwater to flow through easily). The Portage County and Cuyahoga Falls wellfields are located in these deposits. (George W. White, 1982.)



Middle Cuyahoga River Watershed
SUMMIT
PORTAGE
Cuyahoga
Upper Cuyahoga Watershed
Lower Cuyahoga Watershed
Lake Rockwell
Lake Pippen
Fish Creek
Cuyahoga River
RAVENNA
KENT
Breakneck Creek
Lake Hodgson
Plum Creek
Mogadore Reservoir
Springfield Lake
Wingfoot Lake
Congress Lake
Walborn Reservoir
PORTAGE CO.
STARK CO.
Figure 4a-2
Glacial Geological Features
Hydrogeological Setting
Alluvial
Buried Valley
Complex
Outwash/Kame
Thin Till on Upland
Middle Cuyahoga Subwatersheds
Source: Ohio Dept. of Natural Resources, 2000.
0 0.5 1 1.5 2 2.5 3
Miles
Northeast Ohio Four County Regional Planning and Development Organization (NEFCO), May 2009.

Topography

The most visible evidence of the glacial and pre-glacial history is the topography of the landscape. It is also one of the key factors controlling such hydrologic characteristics as gradient, stream power (the energy to move material), and morphology of stream channels, and the presence and extent of wetlands and floodplains.

Figure 4a-3 shows the elevation patterns of the Middle Cuyahoga River watershed, and Figures 4a-4.1 through 4a-4.5 show the topography of the subwatersheds. The watershed ranges in elevation from 900 feet at the Ohio Edison dam (840 feet immediately downstream of the dam) to approximately 1,269 feet on knolls in the Breakneck Creek watershed. Most of the watershed ranges between 1,100 and 1,200 feet.

The landscape of Middle Cuyahoga River watershed reflects the underlying geologic features. The eastern portion of the watershed has thin till on broad, gently undulating uplands. (See Figure 4a-5 for typical landscapes.) The central portion of the watershed, the Kent Kame Moraine, exhibits much more uneven, hummocky topography, with the higher glacially deposited uplands separated by valleys. The areas noted on Figure 4a-2 as buried valleys tend to be low in elevation and relief. The western portion exhibits broad uplands, steep-sided stream and river valleys, and the low-relief buried valleys. The till-covered uplands (pale-colored on the map) are apparent in eastern Summit County and portions of western Portage County. As the Cuyahoga River flows through Cuyahoga Falls, the river enters a steep-walled gorge.

Soils

Developing a general understanding of the soils of the watershed important, as the soils are key factors in the hydrology and drainage of an area. Through weathering, biological activity, and the addition of organic matter, soils in the watershed have evolved from the parent glacial material left in area and more recent deposits left by streams and lakes. The characteristics of the soils reflect their parent material.

General Soils Associations

The Natural Resources Conservation Service (NRCS) has developed large-scale maps of soil units maps based on field mapping. These have been generalized to show repeatable patterns of soil associations, which provide a broad overview of the types of soils most prevalent in an area. It is important to note the generalized areas contain many different soil units, each with its own characteristics. For instance, outwash derived soils can range from clay soils formed in lakes to coarse gravels formed in kame deposits, including everything in-between. Even individually mapped units contain components of other soil types. Mapping at either the unit or regional scale serves as a guide – conditions at specific sites must be field verified.

Figure 4a-6 and Table 4a-1 illustrate how the soils reflect the parent glacial material. Two rather mixed soil assemblages in the southeastern part of the watershed in Portage County reflect a landscape with outwash (Chili soils) and till combined. This combination may reflect the varied deposits of the buried valley, with kames interspersed among till.

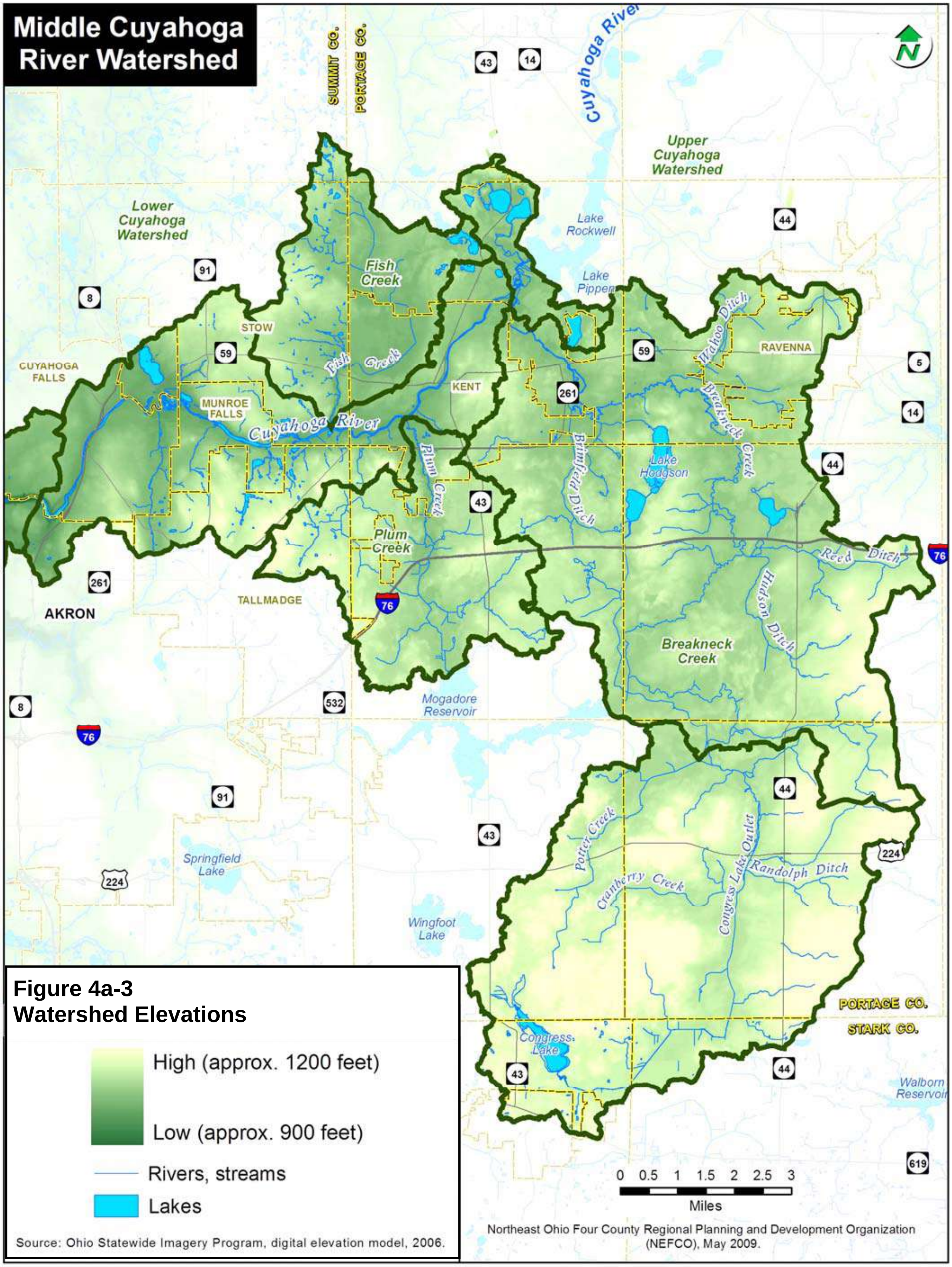


Figure 4a-3
Watershed Elevations

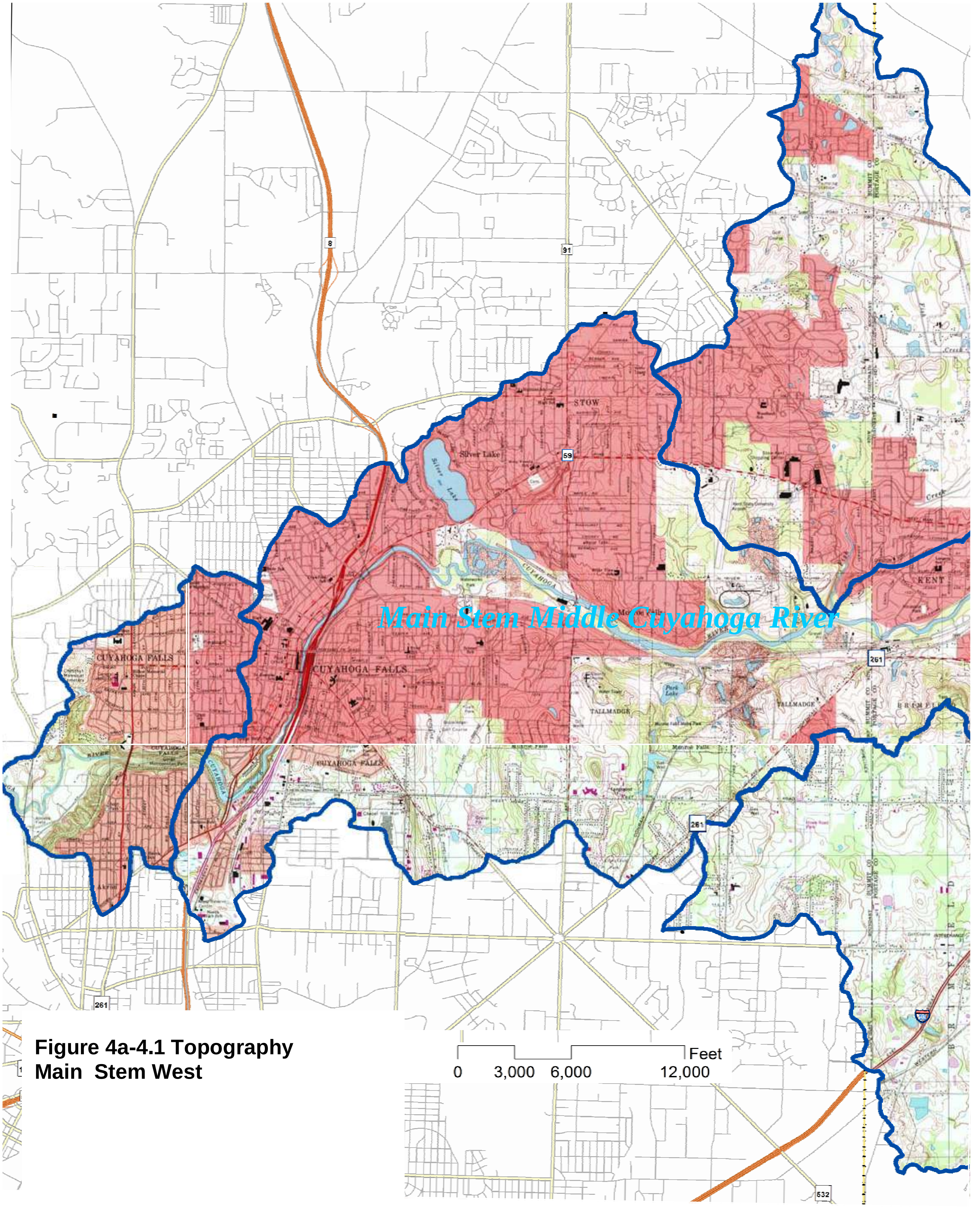


Figure 4a-4.1 Topography
Main Stem West

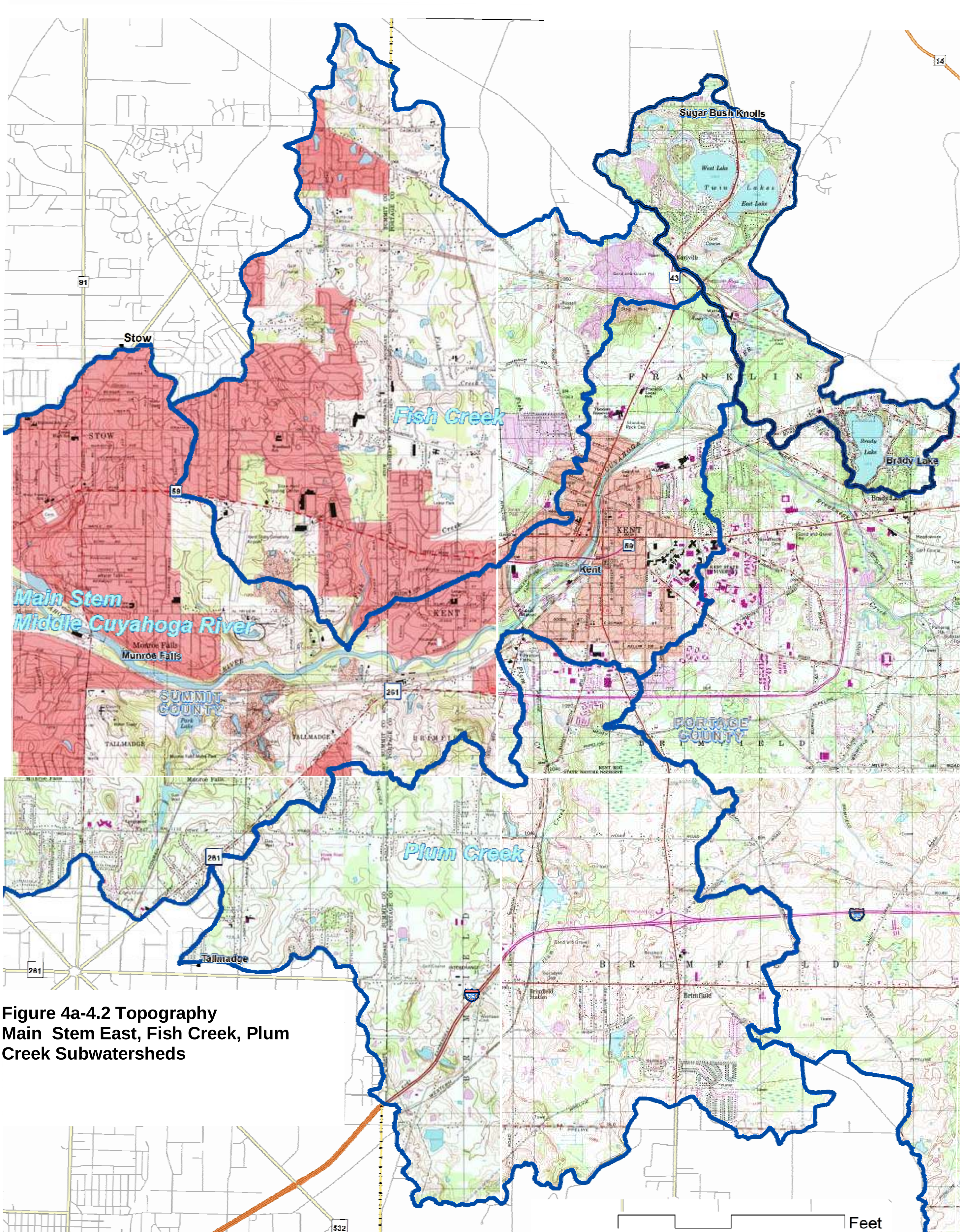


Figure 4a-4.2 Topography Main Stem East, Fish Creek, Plum Creek Subwatersheds

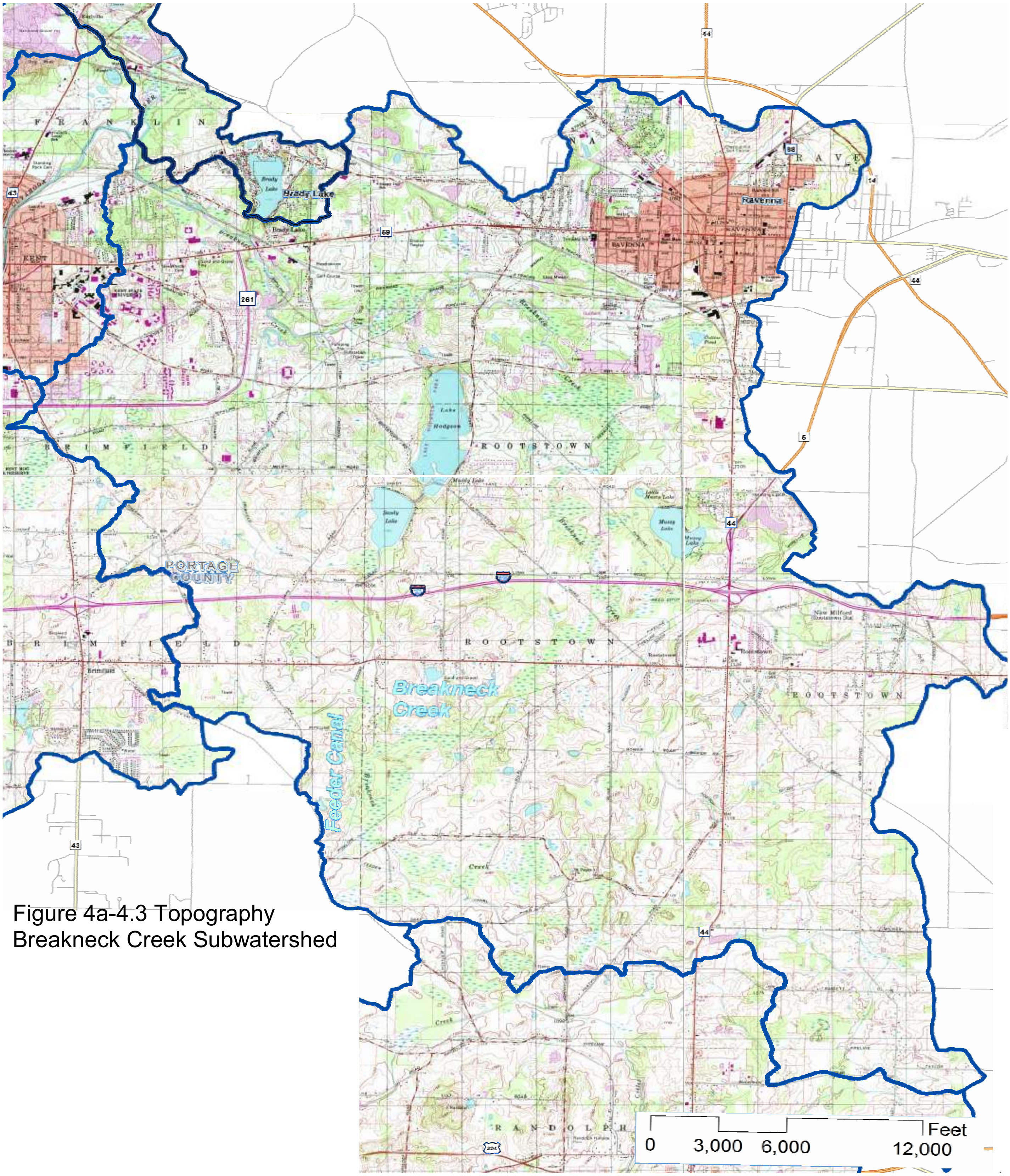


Figure 4a-4.3 Topography
Breakneck Creek Subwatershed

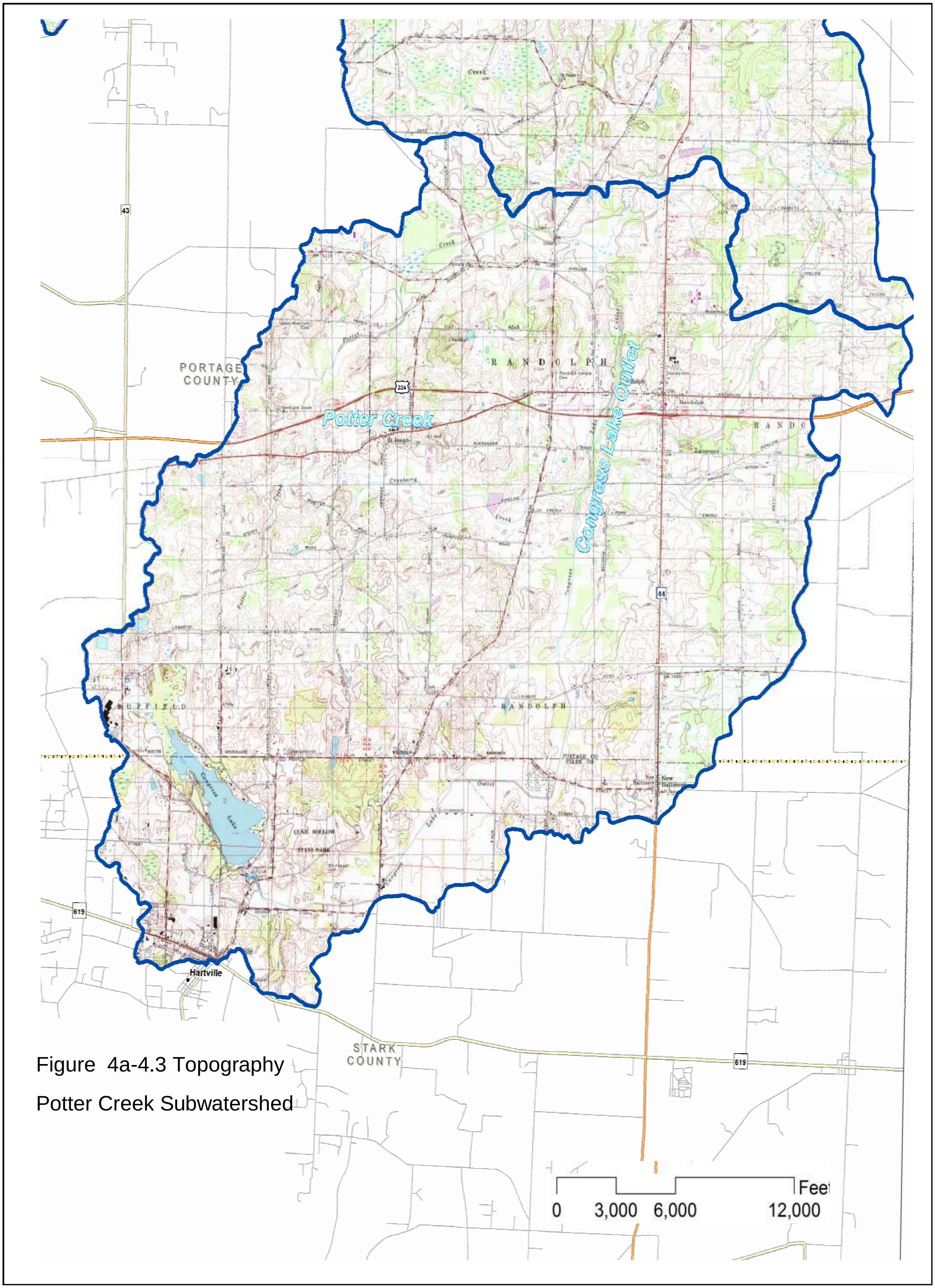


Figure 4a-4.3 Topography

Potter Creek Subwatershed

Broad till-covered uplands, eastern watershed.

Hummocky Topography Kame-Moraine

Breakneck Creek wanders through a landscape of glacial uplands and extensive wetlands.

Walnut Creek tributary cuts through steeply sloping till-covered bedrock to incised bedrock valley, main stem subwatershed.

Steep till-covered bedrock slopes confine much of the Middle Cuyahoga River

Cuyahoga River Gorge, Front St., Cuyahoga

Figure 4a-5
Typical Topography in the Middle Cuyahoga River Watershed

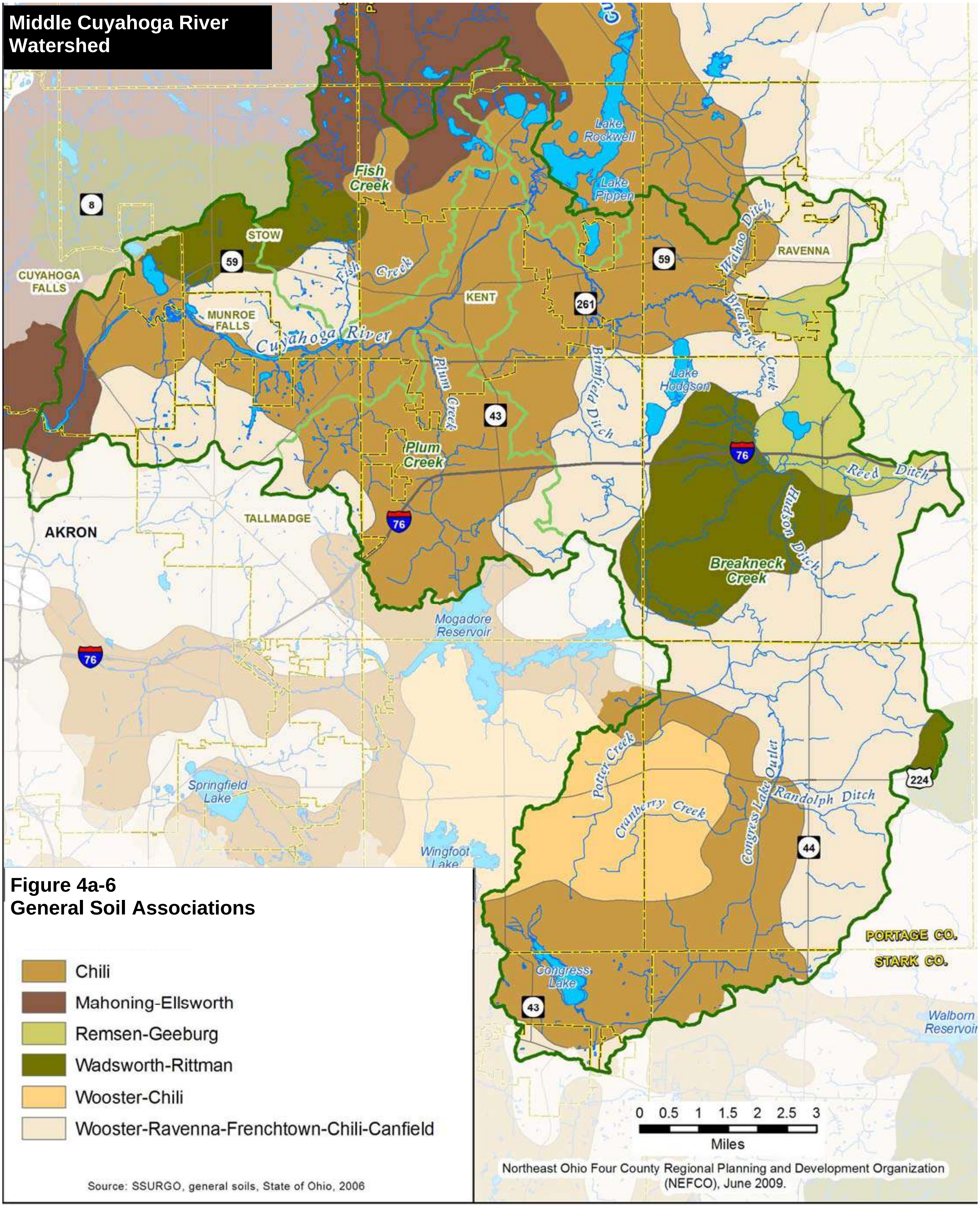


Figure 4a-6
General Soil Associations

In the central portion of the watershed, where the kames and kame terraces dominate the glacial deposits, much of the soils associations are Chili associations, well-drained, nearly level to steep. In the western portion of the watershed are found till-based soils, such as Canfield associations, which are somewhat poorly drained to moderately well drained, nearly level to sloping loam/silt-loam. Scattered throughout the watershed are soils that form in depressions, lakes, bogs, marshes, floodplains, and stream channels, which formed either in glacial lakes and kettles or more recent streams and ponds. These tend to be nearly level and poorly drained.

Table 4A-1 Soil Association Characteristics

Name	Characteristics	Slope	Formed in
Chili	Well drained	Nearly level to steep	Sand and gravelly glacial outwash, possibly covered by loamy material.
Mahoning-Ellsworth	Somewhat poorly drained and moderately well drained	Nearly level to sloping	Fine textured glacial till
Remsen-Geeburg	Moderately well-drained to somewhat poorly drained	Nearly level to gently sloping	Fine textured glacial till
Wadsworth-Rittman	Somewhat poorly drained and moderately well drained	Nearly level to sloping	Medium- and Moderately fine-textured glacial till
Wooster-Chili	Well drained soils	Sloping to very steep	Sandy or loamy material overlying sand or gravel or both. Wooster formed in till, Chili in outwash.
Wooster-Ravenna-Frenchtown-Chili-Canfield	Somewhat poorly drained and well-drained.	Sloping to steep	Canfield-Ravenna-Wooster is described in county Soil Surveys as a medium textured glacial till. Frenchtown formed in low elevations. Chili formed in outwash.

Soil Mapping Units – Select Characteristics

As shown in Table 4a-2, over 70 percent of the watershed is represented by seven soil series. The predominant soil series in the watershed are the outwash-derived Chili soils, followed by Canfield and Wooster. Two of the most prevalent groups are considered "hydric," or soils saturated long enough to develop distinct characteristics reflecting saturation. These tend to develop in depressions, bogs and marshes, drainageways, glacial lakes, floodplains, and areas that flood. Hydric soils tend to be used as key indicators of the presence of wetlands and are mapped in the hydrology section.

Soils may be grouped according to a variety of characteristics, slope, potential for runoff or erosion, limitations to use such as septic systems or development, and potential for crop production. This section summarizes the general nature of the soils in the watershed in terms of: slope, runoff potential, prime farmland soils, and erosion potential. The purpose of this discussion is to present an overview of the general characteristics within the watershed. Soil characteristics that reflect hydrology (e.g., hydric soils and flood-prone soils) will be further addressed in the Hydrology section. Characteristics that can affect water quality, such as erodibilty and steep slopes, will be addressed more specifically in Section 4E, which addresses potential causes of impairment.

Slope

As shown in Table 4A-3, soils of a moderate slope (2-6%) are the most prominent in the watershed, making up 42 percent. Soils mapped with no slope designation, many of which are hydric or urbanized soils, make up 25 percent. Soils with slopes greater than six percent (C, D, and E) are considered steep slopes for the purposes of assessing erosion potential. Steep slopes make up approximately 22 percent of the watershed.

Table 4A-2 Middle Cuyahoga River Watershed Predominant Soils

Soil groups	Soil names and symbols*	Percent	Area (acres)	Hydrologic Soil Group	K Factor (erodibility)	Prime Farmland	Characteristics
Chili		*25.2%*	*21,263*				*Deep, well-drained, nearly level to very steep loamy soils that formed in loamy outwash material underlain by sand and gravel. May have silt mantle 8-24 inches thick. These soils are on outwash terraces and kames.*
	Chili loam (Cn A, CnB, CnC);	7.9%	6,649	B	0.37	Cn A & B prime CnC local importance	
	Chili Gravelly loam (CoC,CoC2, CoD2, CoE2)	2.3 %	1,912	B	0.43	CoC2 local imp.	
	Chili silt loam (CpA, CpB, CpC, CpC2)	6.2%	5,189	B	0.37	CpA & B prime CpC local	
	Chili-Oshtemo complex (CtD, CtE, CtF)	2.4%	2,062	Chili (55% of unit) B Oshtemo (45%) A	0.37 0.24	CtD local imp.	
	Chili-Urban land complex (CuB, CuC, CuF)	4.2%	3,501	Chili (40% of map unit) B	0.37		
	Chili-Conotton gravelly loams (CvF2)	.003%	3	Chili (55% of unit) B Oshtemo A	0.37 0.24		
	Chili-Wooster complex (CwC2, CwD2, CwE, CwE2)	2.3%	1,948	Chili (50% of unit) B Wooster (30%) C	0.37 0.43	CwC2 local imp.	
Canfield		*14.3%*	*12,058*				*Deep moderately well drained nearly level to sloping soils, formed in loam and fine sandy loam glacial till. On uplands in southern Summit County, SE and north central Portage County. These contain fragipan (loamy brittle subsurface horizon low in organic matter and clay, rich in silt, very hard. Ruptures rather than deforms when moist).*

[1]

[1] *Because soils maps were developed for each county, the names or symbols may differ across county boundaries. The capital letters and numbers at the end of each soil type reflect slope: A = 0-2%, B = 2-6%, C = 6-12%, D = 12-18%, E = 18-25%, and F = 25-75%. Numbers indicate eroded soils: 2 indicates the soil is moderately eroded.

Table 4A-2 Middle Cuyahoga River Watershed Predominant Soils (cont'd)

Soil groups	Soil names and symbols*	Percent	Area (acres)	Hydrologic Soil Group	K Factor (erodibility)	Prime Farmland	Characteristics
	Canfield silt loam (CdA, CdB, CdC, CdD2)	11.3%	9,496	C in Portage D in Summit	0.43	CdA & B prime CdC &C2 local	
	Canfield silt loam (CfB, CfC) urban land complex.	3.0%	2,495	C in Portage D in Summit	0.43		
Wooster		*5.9%*	*4,997*				*Deep, well-drained gently sloping to very steep soils that fomed in loam glacial till. These soils are on uplands mainly in southern Summit County, southwestern and north-central parts of Portage County. Fragipan. Formed in outwash.*
	Wooster silt loam (WuB, WuC, WuC2, WuD, WuD2, WuE2)	5.8%	4,921	C	0.43	WuB prime WuC & C2 local imp.	
	Wooster silt loam, sandstone substratum (WvC2, WvD2)	0.08%	68	C	0.43		
	Wooster urban land complex, hilly (Wu)	.009%	8	C	0.43		
Ravenna		*5.5%*	*4,630*				*Medium textured (loam or silt loam) glacial till on uplands, somewhat poorly drained. Inclusions in ReA formed in depressions and drainageways are hydric. Fragipan.*
	Ravenna silt loam (ReA, ReB)	5.3%	4,304	D	0.43	ReA & B if drained	
	Ravenna urban land complex (Rn)	0.2%	126				
Carlisle		*4.9%*	*4,150*				*Very poorly drained organic soils formed in muck and peat deposits more than 51 inches thick. These are in depressions, broad low bogs, marshes, or kettles mostly in western Portage County. Hydric soils.*
	Carlisle Muck (Cg, Ch)	4.9%	4,150	*A/D**	--		

Table 4A-2 Middle Cuyahoga River Watershed Predominant Soils (cont'd)

Soil groups	Soil names and symbols*	Percent	Area (Acres)	Hydrologic Soil Group	K Factor (erodibility)	Prime Farmland	Characteristics
Sebring		*4.6%*	*3,914*				*Deep, poorly drained, nearly level soils that formed in silty sediments. These soils are on stream terraces throughout Portage County. Formed on terraces, depressions, glacial lakes. Hydric soils.*
	Sebring silt loam (Sb, Sv)	4.6%	3,866	C/D	Sb 0.37 Sv 0.32	Sb prime if drained	
	Sebring silt loam, till substratum (Se)	0.6%	48	C/D	0.37		
Rittman		*4.2%*	*3,502*				*Deep, moderately well drained, gently sloping to steep soils, formed in clay loam and silty clay loam glacial till. Drainageway units (RsB and RsC2) have hydric inclusions. Fragipan*
	Rittman silt loam (RsB, RsC, RsC2, RsD, RsD2, RsE2)	3.8%	3,205 ac	D	0.43	RsB prime RsC/C2 local imp.	
	Rittman silt loam, sandstone substratum (RtB)	0.04%	33 ac.	D	0.43	RtB	
	Rittman urban land complex (RuB, RuC)	0.3%	264 ac.				
Other Soils in Associations							
Mahoning	Mahoning silt loam (MgA, MgB, MdB, MnB)			C/D	0.43	Prime if drained	*Formed on till plains, somewhat poorly drained. MgA and MnB have 10% inclusions of hydric Trumbull in depressions.*
Ellsworth	Ellsworth silt loam (ElB, ElB2, ElC, ElC2, ElD2, ElE2 EsB, EuB Urban)			C	0.43	ElB, ElB2, EsB Prime	*Gently sloping to sloping deep, moderately well drained soil developed on till plains. EsB has a sandstone substratum.*
Remsen	Remsen silt loam (RmA, RmB)			D	0.43	Local imp.	*Somewhat poorly drained. Formed on till plains.*
Geeberg	Geeburg silt loam (GbB, GbB2, GbC2, GbD2, GcB, GcB urban, GeF)			D	0.43	GbB, GbB2, GbC2 Local imp.	*Moderately well drained. Formed on till plains and moraines.*
Wadsworth	Wadsworth Silt Loam (WaA, WaB, WbB)			D	0.43	Prime if drained	*Formed on till plains, somewhat poorly drained. WaA/B have 5-10% inclusions of hydric Frenchtown in drainageways.*
Frenchtown	Frenchtown silt loam			D	0.37	Prime if drained	*Hydric. Poorly drained. Formed on till flats..*

Table 4A-3 Middle Cuyahoga River Watershed Soil Slope Characteristics

Slope Designation	Percent in Watershed	Acres in Watershed
No designation	25.1	21,186
A (0-2%)	9.7	8,160
B (2-6%)	42.4	35,744
B2 (2-6% moderately eroded)	.02	15
C (6-12%)	10.0	8,407
C2 (6-12% moderately eroded)	6.5	5,479
D (12-18%)	2.2	1,842
D2 (12-18% moderately eroded)	2.7	2,276
E (18-25%)	0.7	629
E2 (18-25%) moderately eroded	0.3	238
F (25-75%)	0.4	297
F2 (25-75% moderately eroded	0.003	3

Hydrologic Soil Group

Figure 4a-7 depicts how soils characteristics generally relate to underlying geology. One measure of drainage characteristics in soils is the hydrologic soil group, which reflects the potential for storm water to run off the land or infiltrate into the ground, i.e., how well water moves (transmits) through the soils when they are wet. It is related to other drainage characteristics and illustrates how well water moves through the soils.

The hydrologic groups are generally determined based on the layer with the lowest transmissivity (how freely water moves through the soil, lowest means water does not move through easily). The hydrologic groups range from A to D as follows:

- A - Soils with low runoff potential, water is transmitted freely through soil even when thoroughly wetted. These consist chiefly of deep, well drained to excessively well-drained sands or gravels.
- B - Soils having moderately low runoff potential, transmission of water through soils is unimpeded, even when thoroughly wetted. These consist chiefly of moderately deep to deep, moderately well drained to well drained soils with moderately fine to moderately coarse textures.
- C - Soils having moderately high runoff potential, transmission of water through the soils is somewhat restricted, even when thoroughly wetted. These consist chiefly of soils with a layer that impedes downward movement of water, or soils with moderately fine to fine textures.
- D - Soils with high runoff potential. Water transmission is restricted or severely restricted when wetted. These consist chiefly of clay soils with a high swelling potential, soils with a permanent high water table, soils with a dense clay layer at or near the surface, and shallow soils over material that allows only minimal water movement through it. Many D soils are considered wetland (hydric) soils or contain inclusions of hydric soils.
- Some soils were mapped as C In Portage County and D in Summit County.

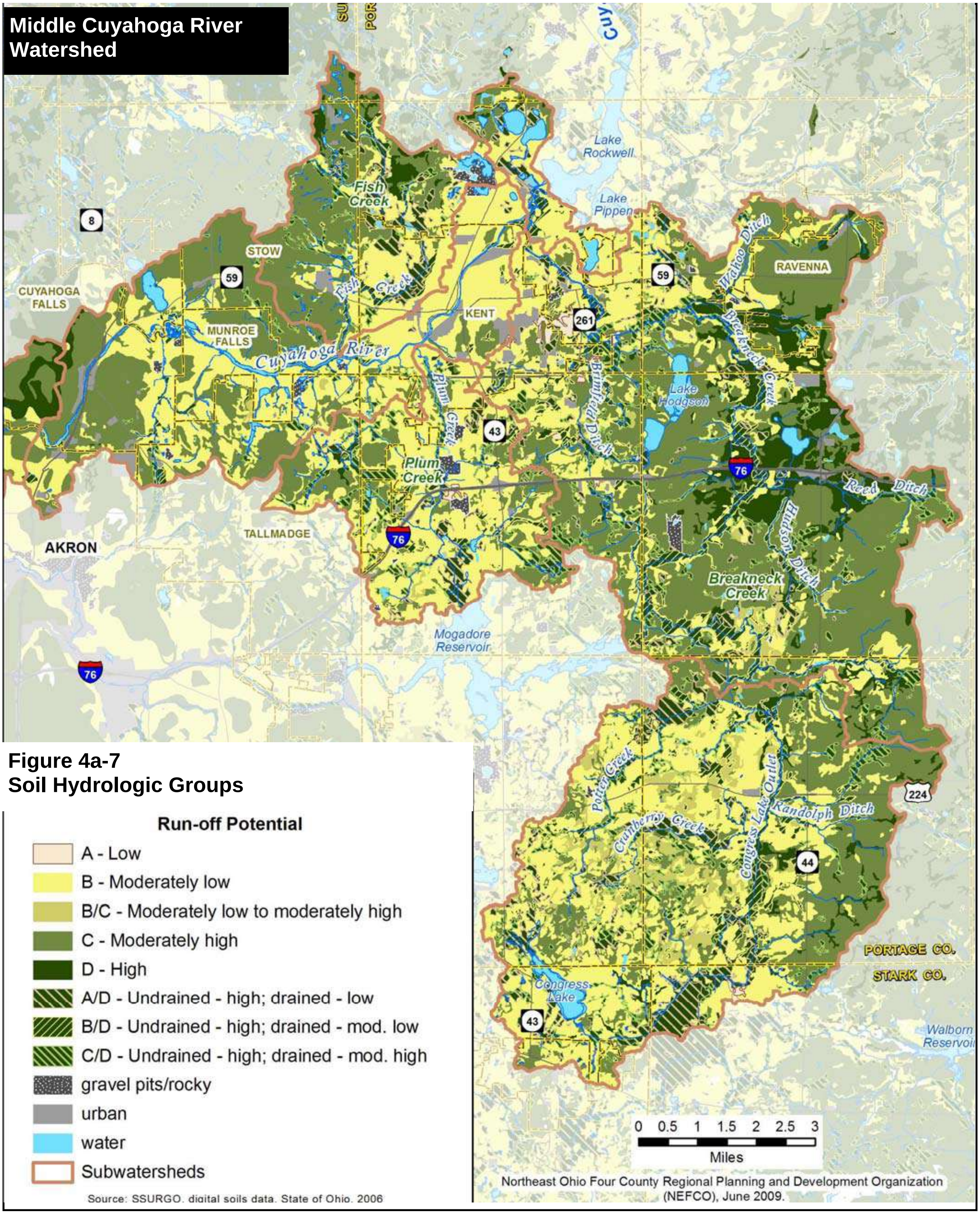


Figure 4a-7
Soil Hydrologic Groups

- A/D, B/D, C/D– Certain soils are placed in the D category because the water table is within 24 inches of the surface. If these soils can be adequately drained (increasing the depth of the water table below 24 inches), they exhibit runoff characteristics of the hydrologic group identified by the first letter in the designation.

As shown in Figure 4a-7, the group C soils, which somewhat restrict water flow, coincide in many areas with the till-covered uplands. The group B soils, allowing more rapid water movement, occur along the central band of outwash. In the southern portion of the watershed, the soils reflect the varied nature of the hummocky kame-kettle and kame-moraine landscape. This area is predominantly group B soils, but there are many small areas of group C and D soils, which are likely to occur in lake bottoms and bogs. The path of certain streams and rivers are also quite apparent in the patterns of the floodplain/drainageway-derived soils (linear group D soils). The broad patterns of soil drainage characteristics generally reflect the underlying parent material; however, at a more local scale, the characteristics vary widely.

As shown in Table 4a-4, the predominant hydrologic group in the watershed is C, and another third is the higher transmissivity group B soils. Nearly one-fifth of the watershed is classified as hydric soils, and over one-fourth of the watershed contains inclusions of hydric soils. It should be noted that the large amount of mapped hydric soils may not accurately reflect the existing soil conditions. While these areas are generally unsuitable for development due to their saturated condition, sites with hydric soils have been altered and developed. Certain hydric soils can be highly productive agricultural soils when drained. Hydric soils are discussed further in the hydrology section, as they are often indicators of wetlands.

Table 4A-4 Middle Cuyahoga River Watershed Soil Hydrologic Groups

Hydrologic Group	Percent in Watershed	Acres in Watershed
A	0.3	287
B	33.8	28,475
C	35.8	30,193
D	5.7	4,778
A/D	5.7	4,800
B/C	2.3	1,948
B/D	4.9	4,857
C/D	5.5	4,611
85-100% Hydric	18.4	15,527
Contains 5-10% hydric inclusions	30.7	25,847

While general patterns in elevation and soil characteristics coincide with the broad distinctions of till versus outwash, at a local level, the soil conditions vary widely. Such variability is characteristic of this portion of northeast Ohio, reflecting the different types and episodes of glacial modification within a relatively small area. Conditions can range from well-drained to poorly drained, nearly level to steeply sloping within a small area.

Because of this great degree of variability, soil conditions must be carefully evaluated at a site level when considering problems, sources, and implementation projects.

<u>Erodibility</u>

Soil erodibility is characterized by a “k” factor, which designates the susceptibility of each soil to erosion by shallow, broad sheet flow of water or rills, the small channels that form on the landscape as water just becomes channelized as it flows across the land. The “k” factor, which is based on particle size and soil-water characteristics, is used in the uniform soil loss equation (or revised uniform soil loss equation) as a multiplier in calculating soil erosion. The higher the “k” factor, the greater the potential for erosion of unprotected soils. Highly erodible soils, another category of soil erodibility, are mapped later in Section 4e as a potential risk to water quality. The overview presented in this chapter indicates that much of the soils of the watershed have a “k” value of 0.37 to 0.43 out of a possible range of 0.02 to 0.69. Muck soils are not assigned erodibility factors.

<u>Important Farmland Soils</u>

This document focuses on the watershed characteristics related to water quality. However, much of the land use in Portage and Stark Counties is agricultural. The U.S. Department of Agriculture defines prime farmland soils as those with the best combination of physical and chemical properties for use in producing food, feed, forage, fiber, or oilseed crops. Some soils become prime farmland soils if drained. “Farmland of local importance” is designated by local agencies as important for the same purposes as prime farmland.

As shown in Table 4a-2, over half of the watershed soils are of prime or local importance for farmland. Some of the hydric soils and silt loams are prime farmland soils if drained. This presents a potential conflict between wetland preservation (important for watershed health) and the desire to drain certain hydric soils (wetlands) for economic use as farmland.

Ecoregion

One of the ecological classification systems that embodies the interrelationships between landscape, hydrology, and biota, is that of ecoregions. Ecoregions denote areas of general similarity in ecosystems and environmental resources. They are designated to provide an overall, integrated framework for understanding and managing the natural resources of a region. Ecoregions are used in developing biological criteria and water quality standards as well as the establishment of management goals for nonpoint-source pollution.

The classification is a hierarchical system, designated by Roman numerals. The U.S. includes 15 Level I regions, 52 Level II regions, and 99 Level III regions, based on geology, physiography, vegetation, climate, soils, land use, wildlife, and hydrology. Ohio has been divided into 4 Level III ecoregions, which have been further subdivided into Level IV sub-regions.

The Middle Cuyahoga River Watershed is within the Level III Ecoregion 61, Erie and Ontario Lake Plain Level, which is characterized by low-lime glacial and lake deposits over rolling to level topography. The ecosystem description notes that lakes, wetlands, and swampy streams occur in flat, clayey areas and where drainage patterns are not well defined. Soils tend to be lower in carbonate and less fertile than other glaciated areas. The Cuyahoga River occupies the Level IV ecoregion, No. 61e, the Summit Interlobate Area, representing the area between two lobes of the most recent glacier, with the landscape deriving from outwash and till features. The ecoregion description notes that this area is distinctive for its numerous lakes and wetlands, kame and kettle topography, sphagnum bogs, and sluggish streams. The landscape of this ecoregion is a mosaic of urban/suburban development, agricultural land, peatland, gravel quarries, and forest.

Source: Woods, et al. ftp://ftp.epa.gov/wed/ecoregions/oh_in/ohin_front.pdf

4a-ii Biological Resources
- ii.1 Rare, Threatened and Endangered Species, Important Habitats

The Ohio DNR maintains a database of sightings of rare, threatened, and endangered species. Some of these records are decades old, and recent development may have affected the resources. In addition, the Western Reserve Land Conservancy held workshops in the summer, 2010, where resource management professionals identified important habitat areas based on field experience and knowledge of the area.

Figure 4a-8 shows the rare, threatened, and endangered species and important habitats in the Middle Cuyahoga River watershed. The habitats are shown as “polygons” (filled-in shapes), lines, and points (used in geographic information system – GIS – mapping) on a map of wetlands and developed areas. (The numbers on the map refer to Table 4a-5 by polygon, line, or point.) Species of concern are often clustered in wetlands, especially the kettle bogs of Portage County, and also in the cliffs of the Gorge in Cuyahoga Falls. In some locations, such as along the river in Kent, areas with older sightings have since become developed. Areas with species of concern or important habitats include:

- Portions of the Plum Creek corridor encompassing Kent bog;
- Bogs along the Cuyahoga River in Kent
- The large wetland complex along Potter Creek
- The Breakneck Creek floodplain/wetland corridor
- Wetlands along Fish Creek
- Potential and Existing Wetland Restoration areas

Table 4a-5
Areas identified in Western Reserve Land Conservancy Workshops as Important Habitats for Conservation

	Resource	Why Important
Polygons 1	Lion's Park wetlands	Wetland
2	Created wetlands	restoration
3	Wetland Restoration Potential	farmed/impacted/restoration potential wetland restoration
4	Muck soils	
5	Headwater	threatened - beaver wetlands
6	Plum Creek/Kent Bog	Habitat
7	Carter Lumber/Gray Birch Bog	Plant species; Bog Adjacent
8	Bird Bog	Bog
9	Macomber Bog	Bog
10	Sand banks	sand/bog
11	Bavan Bog	rare species/habitat
12	Kline Road Bogs	rare species/habitat
13	Muck Sites	Muck wetlands
14	Fish Creek Riparian	muck/wetlands
15	Bog adjacent to golf course	bog
Lines L1	trib to Congress Lake Outlet	threatened quality habitat -vernal pool
L2	Breakneck Creek	Extreme Development Pressure, cat 3 wetland
L3	Breakneck Cr. Franklin Twp.	Development, cat 3 wetland
Points P1	Sandy Lake	rare species
P2	Rookery - Kent Water Plant	Threatened habitat

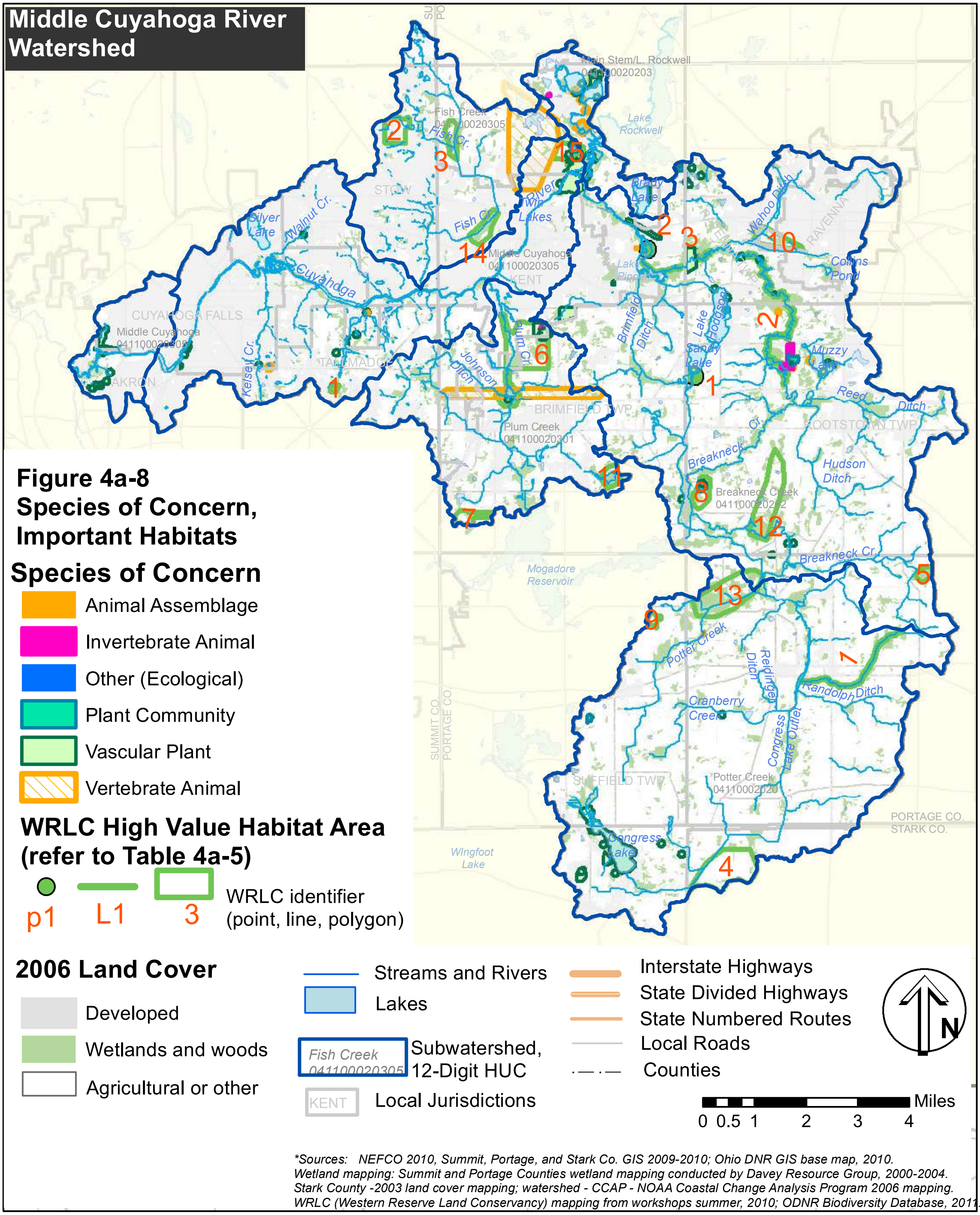


Figure 4a-8
Species of Concern, Important Habitats

Table 4a-6 lists the habitat areas identified by Ohio DNR as likely sites of species of concern, and the general type of resource. Table 4a-7 lists the sightings of species of concern included in the Ohio Biodiversity Database.

Table 4a-6 Managed and Resource Areas with Species of Concern

Managed Area	Resource Area	Category, No. of occurrences
ADELL DURBIN PARK		Vascular Plant
BATTAGLIA BOG		Plant Community 2
BATTAGLIA BOG		Vascular Plant 12
CASCADE VALLEY METRO PARK		Vascular Plant 12
GORGE METRO PARK		Other (Ecological) 3
GORGE METRO PARK		Vascular Plant 7
KENT BOG STATE NATURE PRESERVE		Invertebrate Animal 2
KENT BOG STATE NATURE PRESERVE		Plant Community
KENT BOG STATE NATURE PRESERVE		Vascular Plant 7
LAKE HODGSON PARK		Vascular Plant 4
MUNROE FALLS METRO PARK		Vascular Plant 5
QUAIL HOLLOW STATE PARK		Vascular Plant 2
TOWNERS WOODS		Plant Community 3
TRIANGLE LAKE BOG STATE NATURE PRESERVE		Invertebrate Animal 4
TRIANGLE LAKE BOG STATE NATURE PRESERVE		Plant Community
TRIANGLE LAKE BOG STATE NATURE PRESERVE		Vascular Plant 7
TRIANGLE LAKE BOG STATE NATURE PRESERVE		Vertebrate Animal
	BARNACLE BOG WETLANDS	Animal Assemblage
	BARNACLE BOG WETLANDS	Vascular Plant 3
	BIRD BOG	Invertebrate Animal
	BIRD BOG	Plant Community
	BIRD BOG	Vascular Plant 8
	CATHERINE ROAD SWAMP	Plant Community
	DOLLAR SWAMP	Plant Community
	DOLLAR SWAMP	Vascular Plant 10
	HARTVILLE BOG	Plant Community
	HARTVILLE BOG	Vascular Plant 6
	SHOWALTER BOG/STRATON POND	Plant Community 2
	SHOWALTER BOG/STRATON POND	Vascular Plant 10

Table 4a-7
Species of Concern Sightings, Ohio Biodiversity Database

Scientific Name, No. of sightings	Common Name	Category	Last Observed	STATE STAT
Breeding Amphibian Site		Animal Assemblage	2000-06-23	
Great Blue Heron Rookery 2		Animal Assemblage	1993	
Catocala gracilis 2	Graceful Underwing	Invertebrate Animal	1991-08	E
Cordulia shurtleffii	American Emerald	Invertebrate Animal	2003-06-08	E
Dorocordulia libera	Racket-tailed Emerald	Invertebrate Animal	2006-07-05	E
Epiglaea apiata 2	Pointed Sallow	Invertebrate Animal	1991-10	E
Lasmigona compressa	Creek Heelsplitter	Invertebrate Animal	1996-08-19	SC
Leucorrhinia frigida	Frosted Whiteface	Invertebrate Animal	2000-06-09	E
Ligumia nasuta	Eastern Pondmussel	Invertebrate Animal	1996-08-21	E
Cave or cavern 4		Other (Ecological)	2008-07-09	
Little bluestem prairie		Plant Community	1995-09-22	
Maple-ash-oak swamp		Plant Community	1995-09-05	
Mixed shrub swamp		Plant Community	1996-07-27	
Sphagnum peat bog 8		Plant Community	8/80-6/96	
Aconitum noveboracense	Northern Monkshood	Vascular Plant		E
Adlumia fungosa	Mountain-fringe	Vascular Plant	1997-07-29	T
Arabis hirsuta var. adpressipilis 2	Southern Hairy Rock Cress	Vascular Plant	1998-05-18	P
Calla palustris 1994-2003	Wild Calla	Vascular Plant	1994-2003	P
Carex alata 3	Broad-winged Sedge	Vascular Plant	1988-1996	P
Carex atlantica ssp. Capillacea 4	Howe's Sedge	Vascular Plant	1982-1996	P
Carex cephaloidea	Thin-leaved Sedge	Vascular Plant	1998-05-18	P
Carex diandra	Lesser Panicled Sedge	Vascular Plant	1989-06	T
Carex disperma	Two-seeded Sedge	Vascular Plant	1989-06	E
Carex echinata	Little Prickly Sedge	Vascular Plant	1983-06	E
Carex limosa	Mud Sedge	Vascular Plant	1996-06-15	E
Carex oligosperma 6	Few-seeded Sedge	Vascular Plant	1993-2003	T
Carex straminea 2	Straw Sedge	Vascular Plant	2001, 2009	P
Castanea dentata 2	American Chestnut	Vascular Plant	1980, 1995	P
Chamaedaphne calyculata 11	Leather-leaf	Vascular Plant	1981-2009	P
Cinna latifolia	Northern Wood-reed	Vascular Plant	2004-07-15	E
Clintonia umbellulata	Speckled Wood-lily	Vascular Plant	2004	T
Corallorhiza maculata	Spotted Coral-root	Vascular Plant	1995-08-14	P
Cornus rugosa	Round-leaved Dogwood	Vascular Plant	2004-09-21	P
Cyperus diandrus 3	Low Umbrella-sedge	Vascular Plant	1988-1997	P
Deschampsia flexuosa 15	Crinkled Hair Grass	Vascular Plant	1958-2004	P
Eleocharis tenuis	Slender Spike-rush	Vascular Plant	2007-09-06	T
Epilobium strictum	Simple Willow-herb	Vascular Plant	1960-08	T
Equisetum sylvaticum	Woodland Horsetail	Vascular Plant	1997-08-25	P
Equisetum variegatum	Variegated Scouring-rush	Vascular Plant	1993-04	E
Eriophorum virginicum 3	Tawny Cotton-grass	Vascular Plant	1980-1994	P
Gentianopsis procera	Small Fringed Gentian	Vascular Plant	1958-09	P
Glyceria acutiflora 3	Sharp-glumed Manna Grass	Vascular Plant	1997-2000	T
Helianthemum canadense	Canada Frostweed	Vascular Plant	1997-07-08	T
Hydrocotyle umbellata 5	Navelwort	Vascular Plant	1988-2004	E
Hypericum boreale	Northern St. John's-wort	Vascular Plant	1996-09-06	T
Larix laricina 7	Tamarack	Vascular Plant	1998-2009	P
Lechea intermedia 5	Round-fruited Pinweed	Vascular Plant	1979-1997	P
Lechea villosa	Hairy Pinweed	Vascular Plant	1997-09-08	P
Ledum groenlandicum	Labrador-tea	Vascular Plant	1995-08-15	E
Liatris squarrosa	Scaly Blazing-star	Vascular Plant	2004-07-15	P

Table 4a-7 *(cont'd)*
Species of Concern Sightings, Ohio Biodiversity Database

Scientific Name, No. of sightings	Common Name	Category	Last Observed	STATE STAT
Lilium philadelphicum	Wood Lily	Vascular Plant	1955-06	E
Lupinus perennis	Wild Lupine	Vascular Plant	1997-07-08	P
Luzula bulbosa 2	Southern Woodrush	Vascular Plant	1960, 1997	T
Luzula bulbosa	Southern Woodrush	Vascular Plant	1960-07-14	T
Myriophyllum sibiricum 2	American Water-milfoil	Vascular Plant	1971, 1980	T
Najas gracillima	Thread-like Naiad	Vascular Plant	1996-07-27	E
Oenothera parviflora	Small-flowered Evening-primro	Vascular Plant	2004-07-15	P
Panicum boreale	Northern Panic Grass	Vascular Plant	1960-07-14	P
Persicaria setacea 2	Bristly Smartweed	Vascular Plant	1991-07-23	E
Phegopteris connectilis 3	Long Beech Fern	Vascular Plant	1997-1998	P
Platanthera flava	Tubercled Rein Orchid	Vascular Plant	1960-07-14	P
Potamogeton friesii	Fries' Pondweed	Vascular Plant	1988-08	X
Potamogeton zosteriformis 6	Flat-stemmed Pondweed	Vascular Plant	1981-1997	T
Potentilla palustris 3	Marsh Five-finger	Vascular Plant	1960, 1995, 1996	P
Rhododendron prinophyllum 2	Northern Rose Azalea	Vascular Plant	1979, 1997	P
Rhynchospora alba	White Beak-rush	Vascular Plant	1996-08-27	P
Sarracenia purpurea 2	Pitcher-plant	Vascular Plant	1997, 2003	P
Silene caroliniana ssp. pensylvanica	Carolina Catchfly	Vascular Plant	1998-04-28	T
Sorbus decora	Western Mountain-ash	Vascular Plant	1997-06-12	E
Sparganium emersum 5	Small Bur-reed	Vascular Plant	1996, 1997	E
Sphenopholis pensylvanica 2	Swamp-oats	Vascular Plant	1997, 1998	P
Utricularia geminiscapa 2	Two-scaped Bladderwort	Vascular Plant	1997, 2010	E
Utricularia intermedia 2	Flat-leaved Bladderwort	Vascular Plant	1960, 2004	T
Vaccinium oxycoccos 2	Small Cranberry	Vascular Plant	1996, 2007	T
Viburnum opulus var. americanum	Highbush-cranberry	Vascular Plant	1995-09-06	E
Viola primulifolia	Primrose-leaved Violet	Vascular Plant	1996-06-01	E
Wolffiella gladiata 2	Wolffiella	Vascular Plant	1988, 2008	P
Xyris difformis	Variable Yellow-eyed-grass	Vascular Plant	1996-08-27	E
Botaurus lentiginosus	American Bittern	Vertebrate Animal	1984-06	E
Erimyzon sucetta	Lake Chubsucker	Vertebrate Animal	1985-05	T
Etheostoma exile 2	Iowa Darter	Vertebrate Animal	2000, 2008	SC
Gallinago delicata	Wilson's Snipe	Vertebrate Animal	1985-06	SI
Haliaeetus leucocephalus	Bald Eagle	Vertebrate Animal	2010	T
Opheodrys vernalis	Smooth Greensnake	Vertebrate Animal	1982-05-15	SC
Porzana carolina 2	Sora Rail	Vertebrate Animal	1983, 1984	SC
Rallus limicola 3	Virginia Rail	Vertebrate Animal	1984, 1987	SC
Terrapene carolina	Eastern Box Turtle	Vertebrate Animal	2004	SC

4a-ii Biological Resources
ii.1 Invasive Non-Native species

Invasive species pose a threat to native habitats, because they often spread rapidly, displacing native species, out-competing for resources, and replacing important elements of habitats with less beneficial species. Often invasive species are non-native and lack natural controls on their population. Some invasive species were brought from elsewhere for landscaping or agriculture. Some aggressively colonize disturbed areas. Some plant species were planted recently as groundcover or for erosion control because of their rapid growth but later were found to threaten native species. Aquatic species may travel in ballast water to the major waterways and on the hulls of smaller craft between smaller water bodies. The Ohio DNR is one of the agencies that maintains lists of non-native, invasive plant species found in Ohio.

Of the 700 non-native plant species, about 60 threaten Ohio's natural preserve areas. These should be controlled and removed as possible and should not be used in new plantings. They are grouped into the following categories:

- Targeted – found throughout the state, they reproduce rapidly. These are the most difficult to control.
- Well-established invasives – found regionally or throughout the state, pose moderate to serious threats to native areas.
- Watch list – these are very invasive in neighboring states but are a potential threat to Ohio natural areas. Their distribution in Ohio is limited but should be monitored.

The Ohio DNR list of invasive plants dates from 2000 is shown on Table 4a-8, which follows.

Aquatic invasive species are frequently carried into lakes and streams in ballastwater, bilgewater or attached to the hulls of boats. Introduction of invasive species from Europe or Asia commonly occurs when freighters empty the ballastwater they take on overseas. Like terrestrial invasives, aquatic invasives they can severely disrupt affected ecosystems and spread rampantly, often due to a lack of natural controls. The Great Lakes Commission notes that since the 1800s, over 160 invasive species have entered the Great Lakes. The Great Lakes Commission notes that aquatic invasive species in Lake Erie and the other Great Lakes, include the zebra mussel, goby, sea lamprey, Eurasian Ruffe, purple loosestrife, eurasian watermilfoil, and spiny and fishhook waterfleas. Asian carp like the bighead carp, black carp, and silver carp have not yet become established in the Great lakes, but they are under surveillance due to their potential to move easily into and through the Great Lakes ecosystems and cause devastating damage to fisheries. The zebra mussel has reproduced so quickly that it is clogging intake mechanisms for water supplies and actually changing the trophic characteristics of Lake Erie by consuming huge volumes of plankton. Potentially even a greater threat, the quagga mussel can utilize soft substrate as well as hard surfaces, placing a much greater proportion of the lakes at risk. (Source: Great Lakes Commission, Aquatic Nuisance Species. http://www.glc.org/ans/)

A USGS list of aquatic invasive species is included in Table 4a-9. The NOAA Great Lakes Aquatic Nonindigenous Species Information System is available at http://nas.er.usgs.gov/queries/greatlakes/SpeciesList.aspx?Group=&HUCNumber=DGreatLakes&Genus=&Species=&ComName=&status=0&pathway=0&Sortby=1&SpeciesCategory=1.

Table 4a-8
Invasive, Non-Native Species

TARGETED SPECIES

Common Name	Scientific Name
Autumn-olive	*Elaeagnus umbellata*
Buckthorn, glossy	*Rhamnus frangula*
Buckthorn, European or common	*Rhamnus cathartica*
Common reed grass ❋	*Phragmites australis*
Garlic mustard	*Alliaria petiolata*
Honeysuckle, amur	*Lonicera maackii*
Honeysuckle, Japanese	*Lonicera japonica*
Honeysuckle, Morrow	*Lonicera morrowii*
Honeysuckle, Tatarian	*Lonicera tatarica*
Japanese knotweed	*Polygonum cuspidatum*
Multiflora rose	*Rosa multiflora*
Purple loosestrife	*Lythrum salicaria*
Reed canary grass ❋	*Phalaris arundinacea*

❋these species may have native and non-native strains

WELL-ESTABLISHED INVASIVES

Common Name	Scientific Name
Air-potato	*Dioscorea batatas*
Asian bittersweet	*Celastrus orbiculatus*
Bouncing bet	*Saponaria officinalis*
Canada thistle	*Cirsium arvense*
Cattail, hybrid	*Typha Xglauca*
Cattail, narrow-leaved	*Typha angustifolia*
Celandine, lesser	*Ranunculus ficaria*
Crown-vetch	*Coronilla varia*
Curly pondweed	*Potamogeton crispus*
Dame's rocket	*Hesperis matronalis*
Day-lily	*Hemerocallis fulva*
European cranberry-bush	*Viburnum opulus* var. *opulus*

Table 4a-8 *(cont'd)* **Invasive, Non-Native Species**

WELL-ESTABLISHED INVASIVES CONT.

Common Name	Scientific Name
Eurasian water-milfoil	*Myriophyllum spicatum*
Field bindweed	*Convolvulus arvensis*
Flowering-rush	*Butomus umbellatus*
Japanese barberry	*Berberis thunbergii*
Johnson grass	*Sorghum halepense*
Meadow fescue	*Festuca pratensis*
Moneywort	*Lysimachia nummularia*
Lesser naiad	*Najas minor*
Periwinkle or myrtle	*Vinca minor*
Poison hemlock	*Conium maculatum*
Privet, common	*Ligustrum vulgare*
Quack grass	*Agropyron repens*
Queen Anne's lace	*Daucus carota*
Russian-olive	*Elaeagnus angustifolia*
Smooth brome	*Bromus inermis*
Sweet-clover, white	*Melilotus alba*
Sweet-clover, yellow	*Melilotus officinalis*
Teasel, common	*Dipsacus fullonum (sylvestris)*
Teasel, cut-leaved	*Dipsacus laciniatus*
Tree-of-heaven	*Ailanthus altissima*
Water-cress	*Rorippa nasturtium-aquaticum*
Willow-herb, hairy	*Epilobium hirsutum*
Willow herb, small-flowered hairy	*Epilobium parviflorum*
Winged euonymus	*Euonymus alatus*
Wintercreeper	*Euonymus fortunei*
Yellow flag	*Iris pseudacorus*

WATCH LIST

Common Name	Scientific Name
Black swallow-wort	*Vincetoxicum nigrum*
Chinese silvergrass	*Miscanthus sinensis*
Dog rose	*Rosa canina*
Giant knotwood	*Polygonum sachalinense*
Honeysuckle, showy pink	*Lonicera Xbella*
Kudzu	*Pueraria lobata*
Leafy spurge	*Euphorbia esula*
Mile-a-minute vine	*Polygonum perfoliatum*
Nepalgrass	*Microstegium vimineum*
Nodding thistle	*Carduus nutans*
Porcelain-berry	*Ampleopsis brevipedunculata*
Privet, border	*Ligustrum obtusifolium*
Spotted knapweed	*Centaurea maculosa*
Star-of-Bethlehem	*Onithigalum umbellatum*

Source: Ohio DNR Invasive Plants of Ohio, http://ohiodnr.com/tabid/2005/Default.aspx
The USGS maintains a database of aquatic invasive species, which lists 36 species for the Cuyahoga River watershed, listed in Table 4a-9.

Table 4a-9
Non-indigenous Aquatic Species of the Cuyahoga River Watershed

Group	Common name	Group	Common name
Algae	Diatom	Plants	Oak-leaved goosefoot
Coelenterates	Freshwater jellyfish	Plants	Birds-foot trefoil
Fish	American eel	Plants	Eurasian water milfoil
Fish	Freshwater sunfish	Plants	Water mint
Fish	Unidentified pacu	Plants	Spearmint
Fish	American shad	Plants	Purple loosestrife
Fish	Common carp	Plants	Brittle naiad
Fish	tench	Plants	Great hairy willow herb
Fish	Round goby	Plants	Small flowered hairy willow herb
Fish	White perch	Plants	Lady's thumb, smartweed, spotted knotweed
Bivalve	Zebra mussel	Plants	Bitter dock
Plants	Smooth field sow thistle	Plants	Curly pondweed
Plants	Oriental lady's thumb	Plants	Money wort
Plants	Field sow thistle	Plants	White willow
Plants	True forget-me-not	Plants	Crack willow
Plants	Water-cress	Plants	Bittersweet nightshade
Plants	California fanwort	Plants	Narrow leaved cattail
		Reptiles	American alligator

Source: USGS Website Non-Indigenous Aquatic Species http://nas.er.usgs.gov/ March, 2011

Listed by the Great Lakes Commission as Current invaders are:

- **Crustaceans:** Rusty Crayfish | Spiny Water Flea
- **Fish:** Goby (Round) | Goby (Tubenose) | Rudd | Ruffe | Sea Lamprey | White Perch
- **Mollusks:** Quagga Mussel | Zebra Mussel
- **Plants:** Curly-leaf Pondweed | Eurasian Watermilfoil | Phragmites (non-native) | Purple Loosestrife
- **Viruses:** Viral Hemorrhagic Septicemia Virus (VHSv)

Potential invaders:

- **Fish:** Asian Carp

4a-iii. Water Resources

4a-iiia Climate and Precipitation

The climate of the middle Cuyahoga River watershed is continental, with a wide range of temperatures over the seasons. The watershed is affected by air masses moving east across the continent, warm, moist maritime air coming up the Mississippi/Tennessee/Ohio River valleys, drier cooler air from Canada, and to a slight degree, moisture and moderating effects from Lake Erie. Summers tend to be humid and warm with frequent convective thunderstorms; winters tend to be cold with colder, lower-snowfall storms coming in from Canada (Alberta Clippers) and large winter storms bringing greater amounts of moisture in from the south. The watershed is considered part of the secondary Lake Effect snow area. Following winter storms, the area often receives Lake Effect snow but to a lesser degree than communities closer to Lake Erie, often an inch or two of snow compared with six to 12 inches nearer the lake. Occasionally the Lake Effect snows bring much greater amounts of snow.

Annual precipitation is approximately 36-40 inches per year for Akron and Ravenna, respectively. Precipitation amounts are distributed relatively evenly throughout the year. The driest months are January, February, and October, averaging between 2.2 and 2.7 inches. The greatest amount of precipitation falls during May, June, July, and August, averaging from 3.7 to 4.1 inches. Nearly one-half of the days per year have 0.01-0.1 inches of precipitation. The Portage County stations tend to report higher amounts of precipitation than Akron or Stark County. The greatest probability of flooding tends to occur when spring storms combine with snowmelt, or locally during intense thunderstorms. Evaporation potential tends to be greater in the summer than the amount of precipitation, so there is often a moisture deficit in the summer.

Average temperatures range from January temperatures of 17 (low) and 34 (high) to 59 (low) and 84 (high) in July. Akron tends to have higher temperatures than the rest of the watershed stations by approximately 2-4 degrees. The median growing season with temperatures above 32 degrees F in Portage County is 173 days, going from late April to mid-October. At Akron, the growing season is about 20 days longer, extending from mid-April until late October.

Within the pattern described above, there can be great variability in temperature, growing season, and precipitation.

Sources: National Climate Data Center, 2011
http://www.geography.osu.edu/faculty/rogers/OOC.pdf

http://starkcountyweather.com/climate-averages.php

4a-iii Water Resources
-iiib. Surface Water

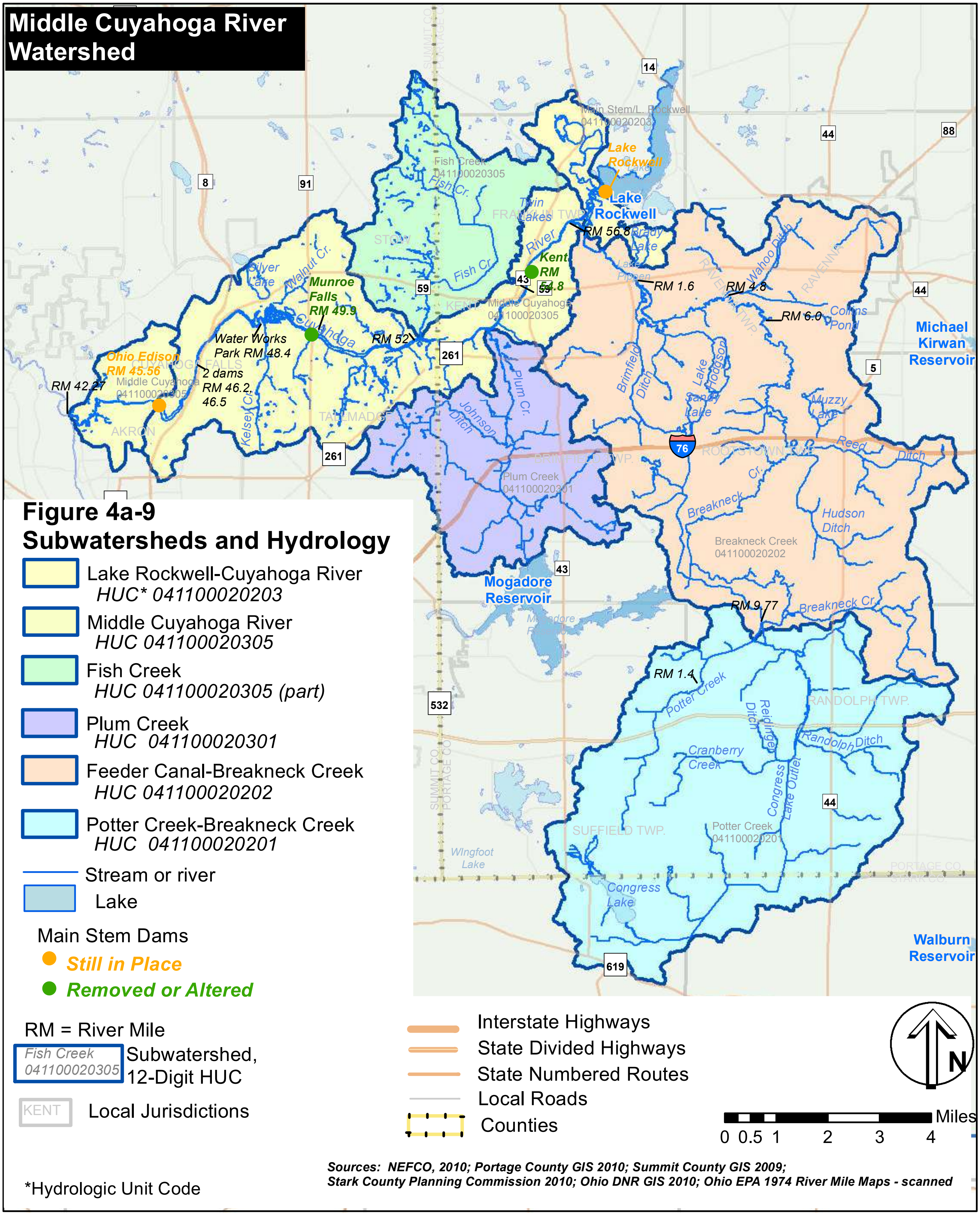
Middle Cuyahoga River Sub-Watersheds and Tributaries

The remainder of Section 4a-iii presents an inventory of surface and groundwater resources. (Water quality and watershed characteristics affecting water quality are discussed in further detail in Sections 4d and 4e.) Table 4a-10 lists the named tributaries in the watershed, and Figure 4a-9 depicts the sub-watersheds, streams, and Cuyahoga River. More detailed maps and discussions are included with each section. Attachment 4P contains photographs of streams from road crossings and various access points, illustrate overall watershed characteristics and examples of features discussed. Each photograph is referenced by number and page on index map and accompanying table, Figure 4P-1 and Table 4P-1. Sections and figures in Sections 4 and 5 refer to these photographs. Figure 4a-10 shows the locations of photographs and certain watershed landmarks.

Table 4a-10
Middle Cuyahoga River Sub-Watersheds and Tributaries

			Watershed Downstream End Coord.*	
Stream/River	**12-Digit HUC Identifier**	**Ohio EPA Identifier**	**Latitude – Decimal Degrees N (deg. minutes seconds)**	**Longitude – Dec. Degrees W (Deg. minutes sec.)**
Main Stem Middle Cuyahoga River	04100020305 04100020203 (Lake Rockwell - Breakneck Cr.)	19-001-000	L. Rockwell dam 41.1819 (41 10 55) Downstream end 41.1195 (41 07 10)	L. Rockwell dam 81.3324 (81 19 57) Downstream End 81.5289 (81 31 44)
• Walnut Creek			41.1488 (41 08 55)	81.4572 (81 27 09)
• Kelsey Creek			41.1453 (41 08 42)	81.4570 (81 27 25)
Fish Creek	04100020305	19-026-000	41.1403 (41 08 25)	81.3989 (81 23 53)
Plum Creek	04100020301	19-027-000	41.1403 (41 22 26)	81.3989 (81 08 32)
• Johnson Ditch			41.1105 (41 06 37)	81.3671 (81 22 01)
Breakneck Creek	04100020202	19-028-000	41.1702 (41 10 13)	81.3381 (81 20 17)
• Wahoo Ditch**		19-028-002	41.1436 (41 08 36)	81.3181 (81 19 05)
• Hommon Rd. Ditch**		19-028-003	41.1436 (41 08 36)	81.3181 (81 19 05)
• Brimfield Ditch			41.1436 (41 08 36)	81.3181 (81 19 05)
• Hudson Ditch**			41.1059 (41 06 21)	81.2569 (81 15 25)
• Reed Ditch**			41.1059 (41 06 21)	81.2569 (81 15 25)
• Feeder Canal			41.1153 (41 06 55)	81.2985 (81 17 55)
Potter Creek	041100020201	19-028-005	41.0538 (41 03 14)	81.2777 (81 16 40)
• Congress Lake Outlet		19-028-004	41.0530 (41 03 11)	81.2722 (81 16 20)
• Cranberry Cr.			41.0204 (41 01 14)	81.2650 (81 15 54)
• Reidinger Ditch			41.0211 (41 01 16)	81.2690 (81 16 09)
• Randolph Ditch			41.0261 (41 01 34)	81.2610 (81 15 14)

* Generally at confluence with next major stream; North American Datum (NAD) 1983
** Coordinates at confluence Wahoo/Hommon; Hudson/Reed; near confluence with Breakneck.


Middle Cuyahoga River Watershed
Figure 4a-9
Subwatersheds and Hydrology
Lake Rockwell-Cuyahoga River HUC* 041100020203
Middle Cuyahoga River HUC 041100020305
Fish Creek HUC 041100020305 (part)
Plum Creek HUC 041100020301
Feeder Canal-Breakneck Creek HUC 041100020202
Potter Creek-Breakneck Creek HUC 041100020201
Stream or river
Lake
Main Stem Dams
Still in Place
Removed or Altered
RM = River Mile
Fish Creek 041100020305
Subwatershed, 12-Digit HUC
KENT
Local Jurisdictions
Interstate Highways
State Divided Highways
State Numbered Routes
Local Roads
Counties
Miles
0 0.5 1 2 3 4
N
Sources: NEFCO, 2010; Portage County GIS 2010; Summit County GIS 2009;
Stark County Planning Commission 2010; Ohio DNR GIS 2010; Ohio EPA 1974 River Mile Maps - scanned
*Hydrologic Unit Code
Lake Rockwell
Michael Kirwan Reservoir
Mogadore Reservoir
Walburn Reservoir
Munroe Falls RM 49.9
Kent RM 54.8
Ohio Edison RM 45.56
Water Works Park RM 48.4
2 dams RM 46.2, 46.5
RM 42.27
RM 52
RM 56.8
RM 1.6
RM 4.8
RM 6.0
RM 9.77
RM 1.4
Fish Cr.
Plum Cr.
Breakneck Cr.
Potter Creek
Cranberry Creek
Hudson Ditch
Randolph Ditch
Congress Lake
Wingfoot Lake
AKRON
TALLMADGE
STOW
CUYAHOGA FALLS
SUFFIELD TWP.
RANDOLPH TWP.
ROOTSTOWN TWP.

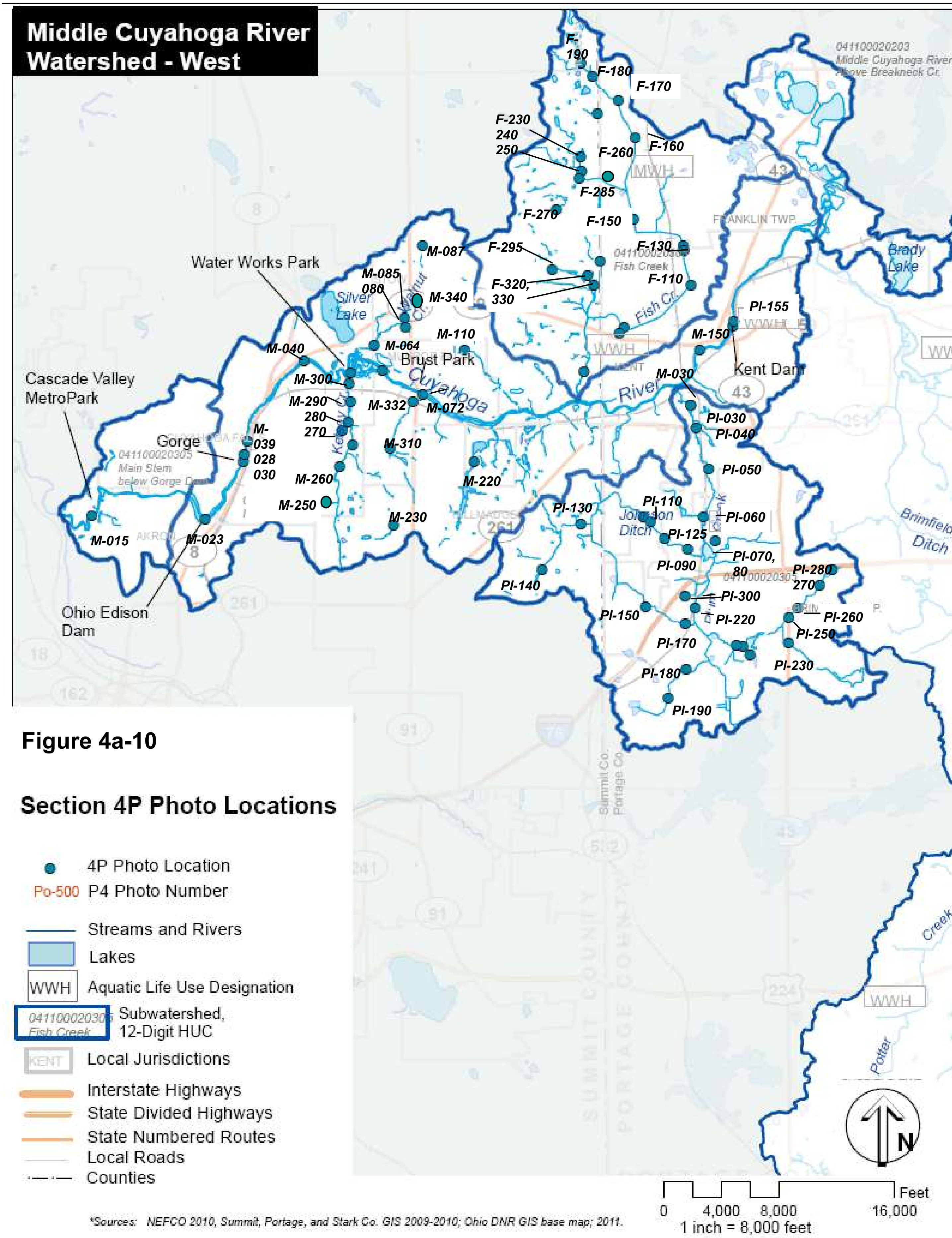


Figure 4a-10

Section 4P Photo Locations

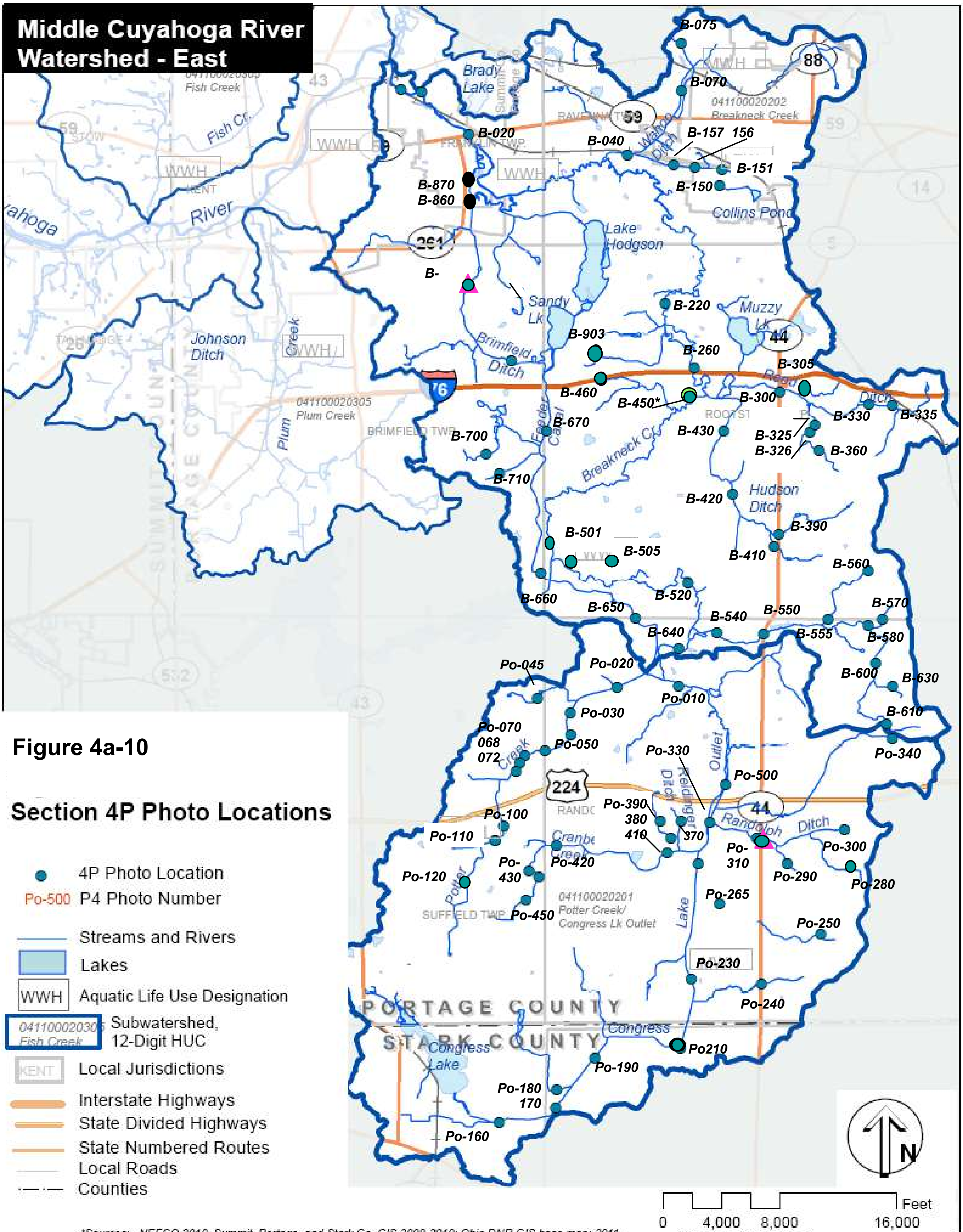


Figure 4a-10

Section 4P Photo Locations

Notes concerning identification of subwatersheds include:

- The Middle Cuyahoga River watershed was identified in a previous study by NEFCO (NEFCO, 2001) as beginning downstream of the area being addressed by the Upper Cuyahoga River Task Force, i.e., the Lake Rockwell dam. The Middle Cuyahoga River watershed thus includes a portion of HUC 04100020203. The earlier Middle Cuyahoga River study incorporated down to the Ohio Edison dam, but since it is likely that the Ohio Edison dam will be removed, the current planning effort has extended the subwatershed to the confluence with the Little Cuyahoga River.

- The Fish Creek subwatershed is considered part of the same 12-digit HUC subwatershed as the Main Stem. However, previously-used 14-digit HUC subwatersheds called out a separate subwatershed for Fish Creek. This document retains that distinction.

- The Breakneck Creek and Potter Creek subwatersheds are identified in the Ohio DNR GIS database as Feeder Canal-Breakneck Creek and Congress Lake Outlet-Potter Creek subwatersheds, respectively. A dug canal (Congress Lake Outlet-Feeder Canal) connects Congress Lake with Lake Hodgson, the public water supply for the City of Ravenna. There is a control structure at the lower end of the Potter Creek subwatershed that currently is used only during dry periods to divert flow away from Breakneck Creek from the Congress Lake Outlet and into the Feeder Canal and Lake Hodgson. During the remainder of the year, Congress Lake Outlet flows directly into Breakneck Creek, and the Feeder Canal is fed only by groundwater and a minimal watershed.

4a-iiib. Surface Waters (cont'd)

-i. Wetlands

Wetlands: Background

Wetlands: Background

What are Wetlands, Functions of Wetlands, Types of Wetlands

Wetlands are features in the landscape where water is at or near the land surface for a substantial part of the year. Wetlands are areas where:

- Water naturally collects,
- Soils have developed that hold water or drain slowly
- The characteristics of the soils reflect long-term saturation; and
- The vegetation is adapted to wet conditions.

Wetlands provide many important functions within watersheds:

- Storage of stormwater – not only in the depressions of the landscape but contained within the soils
- Slowing floodwaters, allowing sediment deposition
- Filtering, adsorbing (binding with) pollutants, uptake of nutrients
- Groundwater recharge and then discharge during dry periods
- Habitat
- Food supply

Wetlands are not simply bowls containing water. Many of the valuable functions they provide arise from the extended residence time of water in the soil and in contact with the roots of vegetation. Because water moves slowly and is stored in the soils, wetlands are especially valuable for flood storage and groundwater recharge/discharge. The extended time of contact between water, soil, and roots allows sediment and pollutants to be filtered, absorbed, and adsorbed.

Wetlands in northeast Ohio include:

- Forested or scrub-shrub swamps, with standing water during a portion of the year, often with a high water table (groundwater level) and trees or shrubs adapted to wet conditions

- Emergent marshes, with standing water all year and vegetation such as cattails, rushes, sedges.

- Fens and bogs. These are unusual habitats with little surface water flowing in, deep pools of standing water, producing peat. They often support rare species. Bogs develop in deep kettle holes left over in glacial outwash. They are often enclosed and support stands of tamarack, sphagnum moss. Bogs are acidic. In contrast, fens, which develop in calcium rich soils, are alkaline.

Wetland Regulation, Mapping

The Ohio EPA, U.S. EPA, and US Army Corps of Engineers regulate filling wetlands and altering water quality. The U.S. Army Corps of Engineers uses a combination of soils, vegetation, and hydrology to identify regulated wetlands:

- Hydric soils - soils that show evidence of saturation or inundation for a long enough time during the growing season to develop anaerobic conditions (lacking oxygen) in the upper part. (USDA NRCS Hydric Soils Introduction, On-line source 2011)

- A predominance of plants that are adapted to saturated conditions during the growing season, i.e., where soil inundation/saturation exerts a controlling influence on the plant community (US ACOE Wetland Delineation Manual, on-line source 2011)

- Hydrology – water regime indicating the soils are saturated or inundated for enough of the growing season to exert a controlling influence on vegetation and soils.

In altered landscapes, it is possible that only one or two of these characteristics is present, and the feature may not be regulated as a wetland. For instance, hydric soils may be left over after the water table is lowered though ditching. The land would have neither wetland vegetation nor hydrology (water at or near the surface), and may not be considered a wetland. Conversely, ditches and storm retention ponds that develop these characteristics often become regulated as wetlands or waters of the state.

Data Sources

Several sources of GIS data were used to map wetland characteristics.

- Hydric soils – soils of Ohio were mapped during the 1970s and have since been incorporated into geographic information systems mapping. The presence of hydric soils generally indicates that wetland conditions are or were present. The soils data indicate that hydric soils in the Middle Cuyahoga River watershed fall into two general categories: soils that are 85-100 percent hydric and those with inclusions of hydric soils that make up approximately 5-15 percent of the mapped unit. The mapping on Figure 4a-11 only shows the soils that are 85-100 percent hydric. A substantial amount of the soils in undeveloped or recently developed areas have 5-15 percent inclusions, these were omitted for clarity of mapping.

- Summit and Portage County wetlands mapping, conducted in 2002 and 2004 using interpretation of aerial photography from 2000 and limited field reconnaissance.

- Coastal Change Analysis Program (CCAP) – the National Oceanographic and Atmospheric Administration (NOAA) has developed mapping of coastal land cover to monitor changes over time. The data are derived from satellite imagery from 1996, 2001, and 2006, with pixels of 30 m per side. Each type of land cover reflects visible, infrared, and ultraviolet light differently. The satellite mapping is based on the reflective characteristics of each land cover type.

- Ohio EPA GIS wetland coverage for Stark County.

- Stark County land cover GIS coverage, 2010.

Findings:
Wetlands of the Middle Cuyahoga River Watershed

Findings: Wetlands of the Middle Cuyahoga River Watershed

The areas shown on Figure 4a-11 and summarized in Table 4a-11 represent likely wetland areas. Mapping wetlands with remote sensing, such as interpretation of aerial photographs or satellite imagery, does not necessarily identify all wetlands, or identify them accurately:

- In aerial photographs and satellite imagery, visual signatures of wetlands may be indistinct. For instance, wooded or scrub-shrub swamps may be misinterpreted as upland habitats, and determining which plant communities are present or predominant from aerial photographs may be difficult.

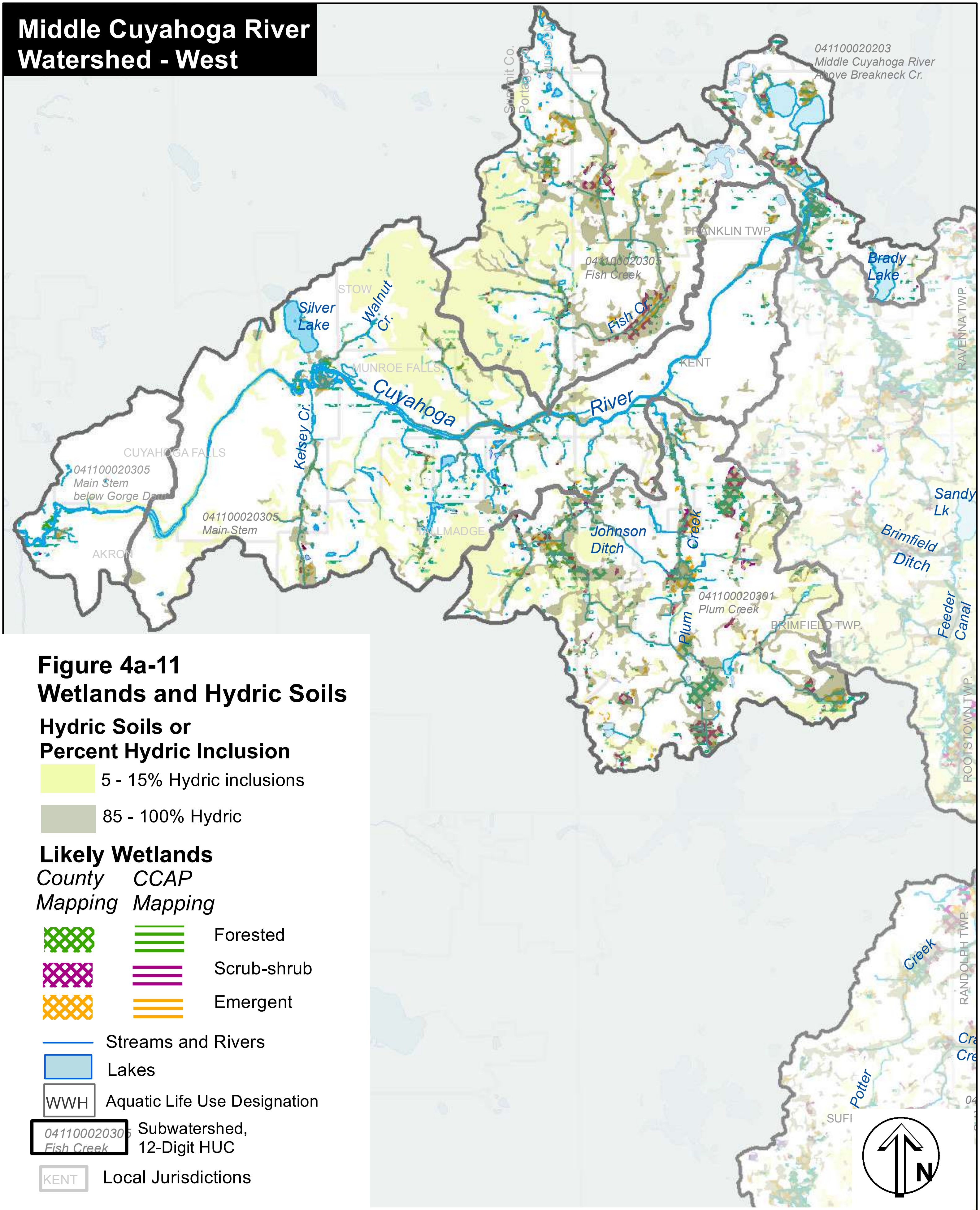
- The resolution of the imagery may prevent smaller wetlands from being identified.

- Identification of regulated wetlands requires field visits to examine soil characteristics, vegetation, and hydrology. Often, even the field delineation involves interpretation of ambiguous data. For instance, the soils and plant communities may change gradually across an area or have inclusions of varying characteristics, and the high water table or surface water may only be present for a portion of the year.

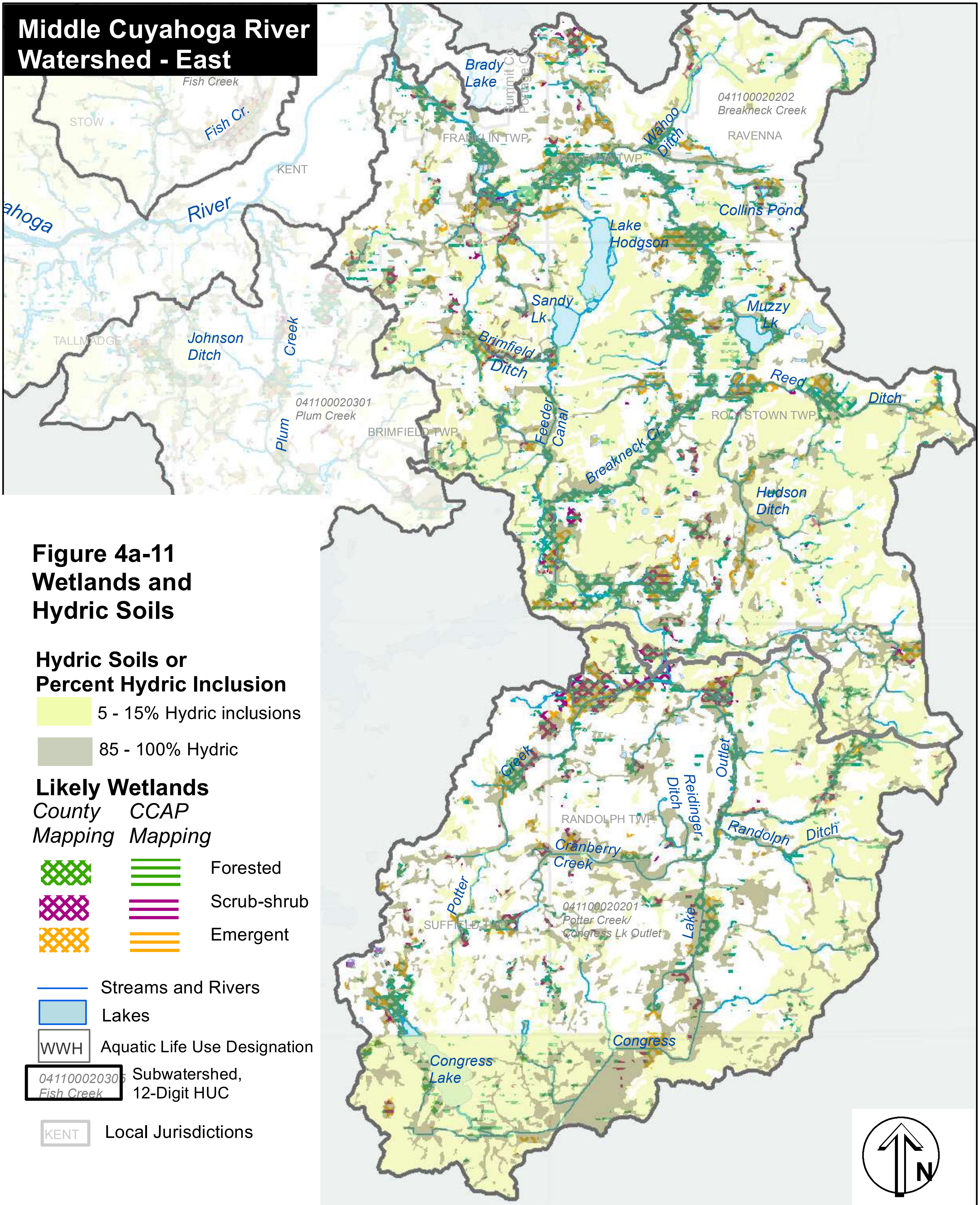
Table 4a-11
Hydric Soils and Wetlands Mapped by Subwatershed

	Main Stem	**Fish Creek**	**Plum Creek**	**Breakneck Creek**	**Potter Creek**	**Total**
Hydric Soils						
▪ 85-100% hydric	1,118	1,401	1,896	5,714	5,127	15,256
% of subwatershed	6.3	20.6	22.9	19.8	23.5	18.3
▪ 5-15% hydric	2,727	1,706	1,288	9,235	4,287	19,243
% of subwatershed	15.3	25.1	15.5	32.1	19.6	23.0
CCAP* mapped wetlands						
▪ Forested	1,203	422	839	3,569	1,599	7,628
▪ Scrub-shrub	69	0	0	108	109	217
▪ Emergent	0	16	0	36	13	134
Total	*1,272*	*438*	*839*	*3,713*	*1,717*	*7,979*
County/State Mapped Wetlands						
▪ Forested	281	85	322	1,988	828	3,504
▪ Scrub-shrub	104	168	314	671	575	1,822
▪ Emergent	133	152	264	112	523	1,194
Total	*518*	*405*	*900*	*2,771*	*1,926*	*6,520*
Total Mapped Wetlands**	1,510	745	1,388	4,598	2,728	10,969
% of subwatershed	8.5	11.0	12.0	16.0	12.5	13.3

*CCAP = National Oceanographic and Atmospheric Administration Coastal Change Analysis Program, using 2006 mapping
** Total does not equal the sum of CCAP and County/State mapped wetlands, due to overlapping data between map sets.



*Sources: NEFCO 2010, Summit, Portage, and Stark Co. GIS 2009-2010; Ohio DNR GIS Database, 2011; NOAA Coastal Change Analysis Program (CCAP) 2006 Land Cover mapping; Portage and Summit County wetland mapping by Davey Resource Group, 2002-2004; Stark County Land cover mapping 2003.



*Sources: NEFCO 2010, Summit, Portage, and Stark Co. GIS 2009-2010; Ohio DNR GIS Database, 2011; NOAA Coastal Change Analysis Program (CCAP) 2006 Land Cover mapping; Portage and Summit County wetland mapping by Davey Resource Group, 2002-2004; Stark County Land cover mapping 2003.

Figure 4a-11 and Table 4a-11 indicate that:

- The Breakneck Creek subwatershed has the greatest amount of wetlands. A nearly continuous band of forested wetlands along Breakneck Creek contributes to the quality of its habitat and provide protection from pollutant loadings and stormwater.

- Forested wetlands are the predominant type overall, but in more urbanized subwatersheds (Main Stem, Plum Creek, and Fish Creek), the County/Ohio EPA mapping suggests that the amount of emergent marshes or scrub-shrub wetlands approach or exceed the amount of forested wetlands.

- In the largest, most diverse wetland areas shown on Figure 4a-10, it is difficult to distinguish the different wetland types, due, in part, to varying interpretations of the data shown in the mapping. However, it is apparent from the mapping that these are large, diverse, and likely high value. Examples include the northwestern portion of Potter Creek and portions of Breakneck Creek.

- In the Potter Creek and Breakneck Creek watersheds, small isolated wetlands and patches of hydric soil may reflect the kame-kettle landscape, which supports wetlands in between kames and at the bottom of kettle ponds.

- The relatively low amount and proportion of hydric/potentially hydric soils in the main stem subwatershed is likely due in part to the steep topography and thin till-covered uplands, but also to development and alteration prior to soil mapping.

The amount and proportion of mapped wetlands is considerably lower than that of hydric soils. This may be due in part to the inability to distinguish wetland from upland habitats (e.g., forest). However, it is likely that some of this represents wetlands that have been altered.

4a-iiib Surface Waters (cont'd)
-ii.1 Streams: Stream characteristics

Cuyahoga River Hydrographs

Cuyahoga River Hydrographs: Background

Background

Three USGS stream gages along the Cuyahoga River near the Middle Cuyahoga River watershed have been in operation since the 1920s. The stream gage upstream at Hiram Rapids, approximate RM 75 (watershed 152 square miles) is in a relatively rural landscape upstream of Lake Rockwell. The Old Portage stream gage, RM 40.18 (watershed 404 sq. mi.), is in a relatively urbanized portion of the Cuyahoga River watershed. The most downstream of the three stream gages is at Independence, RM 13.05 (watershed 707 sq. mi.), further into the urbanized portion of the Cuyahoga River watershed.

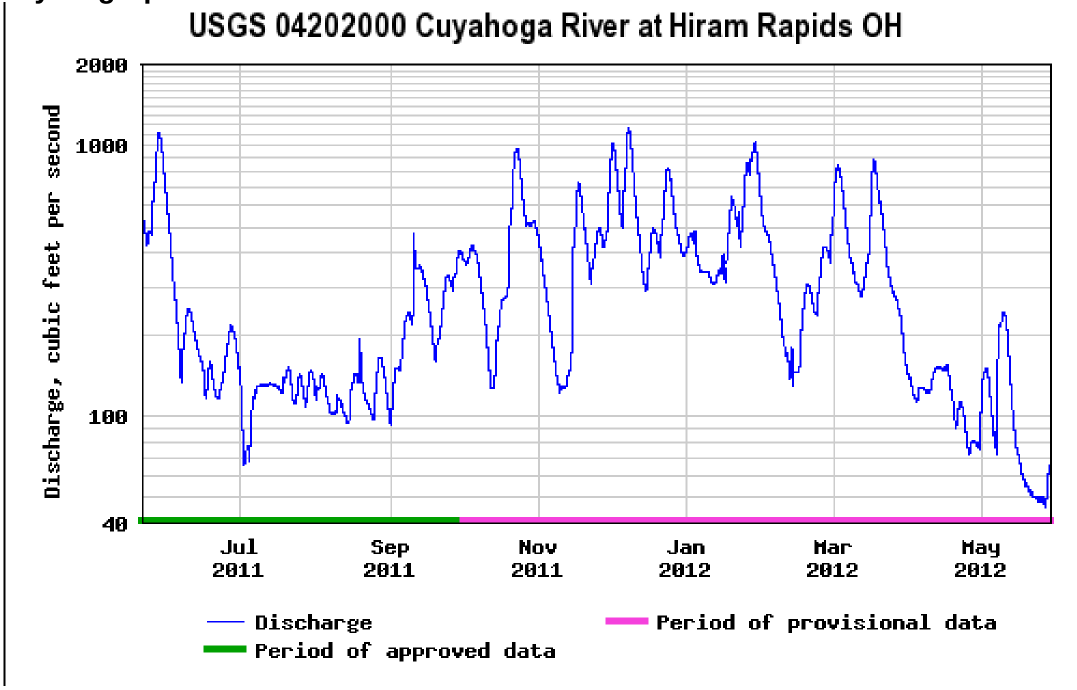
In typical temperate climates similar to northeast Ohio, stream flow fluctuates on a large scale over the year, with lowest flow generally occurring during the summer and early autumn months, with flows increasing through the fall, winter, and early spring, and decreasing in late spring to summer. Stream flow in urbanized landscapes tends to be "flashy," rising and falling rapidly and with extreme peaks during and after storm events, due to the large amounts of runoff coming from impervious surfaces and the limited amount of infiltration and groundwater input. In more undisturbed landscapes, stream flow after storm events rises and falls more gradually and in less extreme amounts.

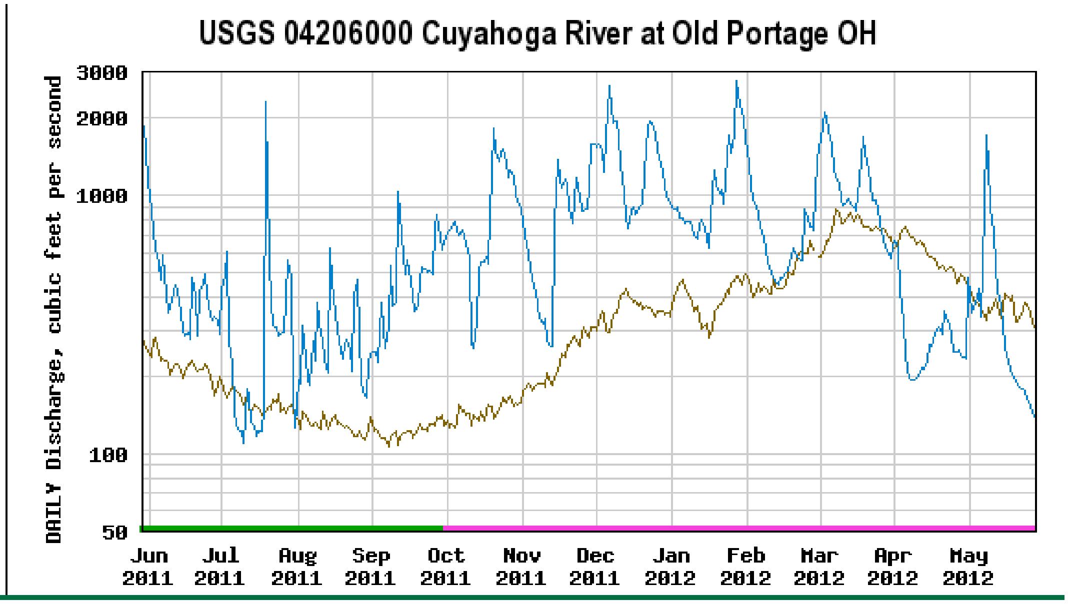
Findings:
Cuyahoga River Stream Gages

Findings: Cuyahoga River Stream Gages

Figure 4a-12a shows the hydrographs over a 1-year period of the three stream gages near the Middle Cuyahoga River. Figure 4a-12b shows the hydrographs from 1985-2012. The stream hydrographs reflect the progression downstream from smaller flows in the upper watershed (ranging from 20 cfs to peaks of 2,000 cfs) to progressively larger and more urbanized watersheds at Old Portage and Independence, with summer low flow of 100 cfs at Old Portage and 200 cfs at Independence, and extreme high flows at Old Portage of 4,000-5,000 cfs and at Independence of 10,000 cfs. The hydrographs show the general increase in flow during fall, winter, and spring months, and the general decrease in summer months. The three stream gages respond to storm events in generally similar ways, but the stream gages in the more urbanized portions of the river downstream show increasingly flashy responses proceeding downstream and further into the urbanized area. The presence of the dam at Lake Rockwell does not appear to alter the general response at the Hiram stream gage versus the other two. This document uses the Portage Path hydrograph for reference, as the Old Portage stream gage includes flow from the Middle Cuyahoga River, and the dams along the Middle Cuyahoga River downstream of the Lake Rockwell dam are not being used to control flow.

Figure 4a-12a Hydrographs 2011-2012





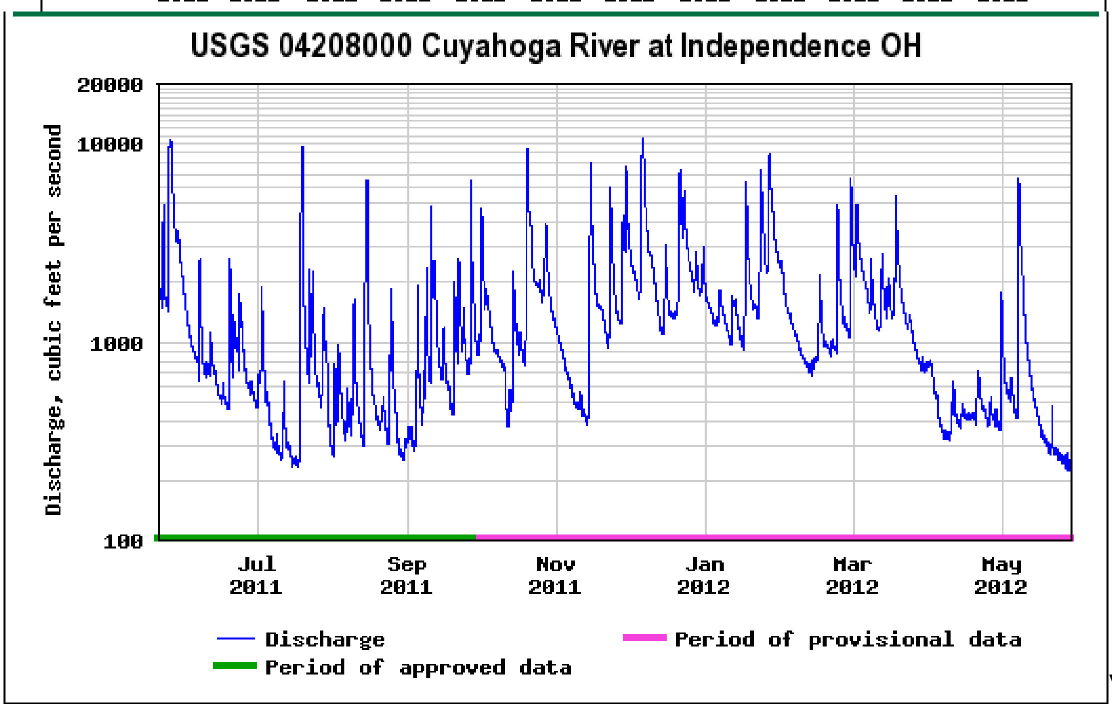
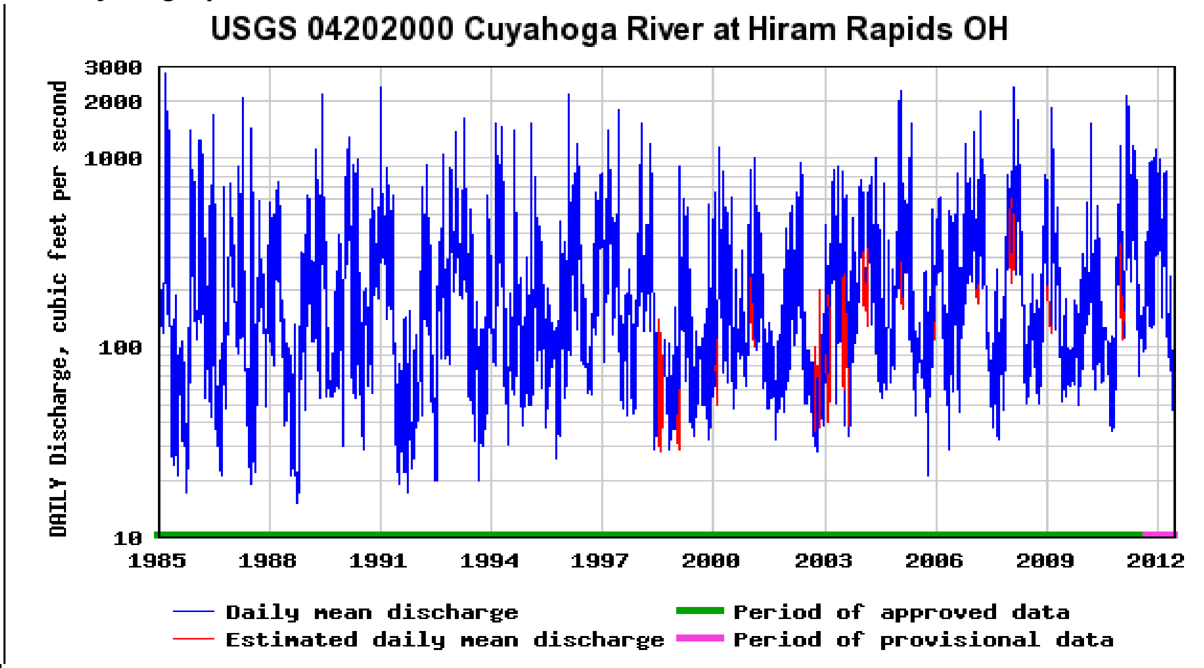
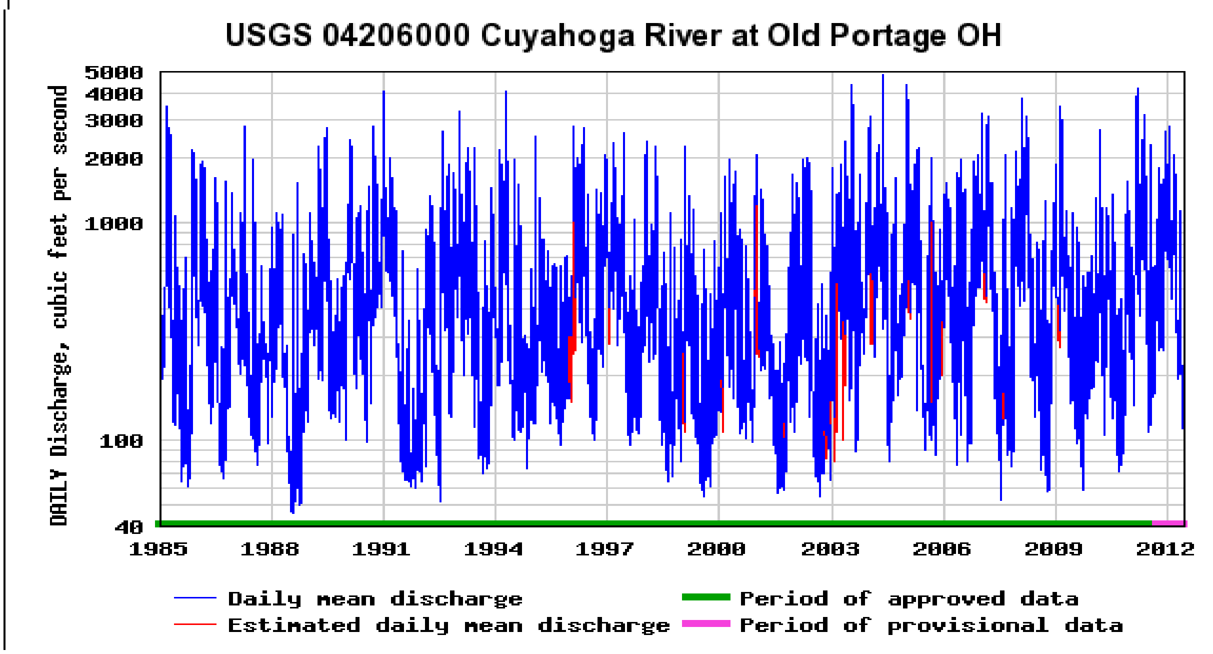


Figure 4a-12b Hydrographs 1985-2012





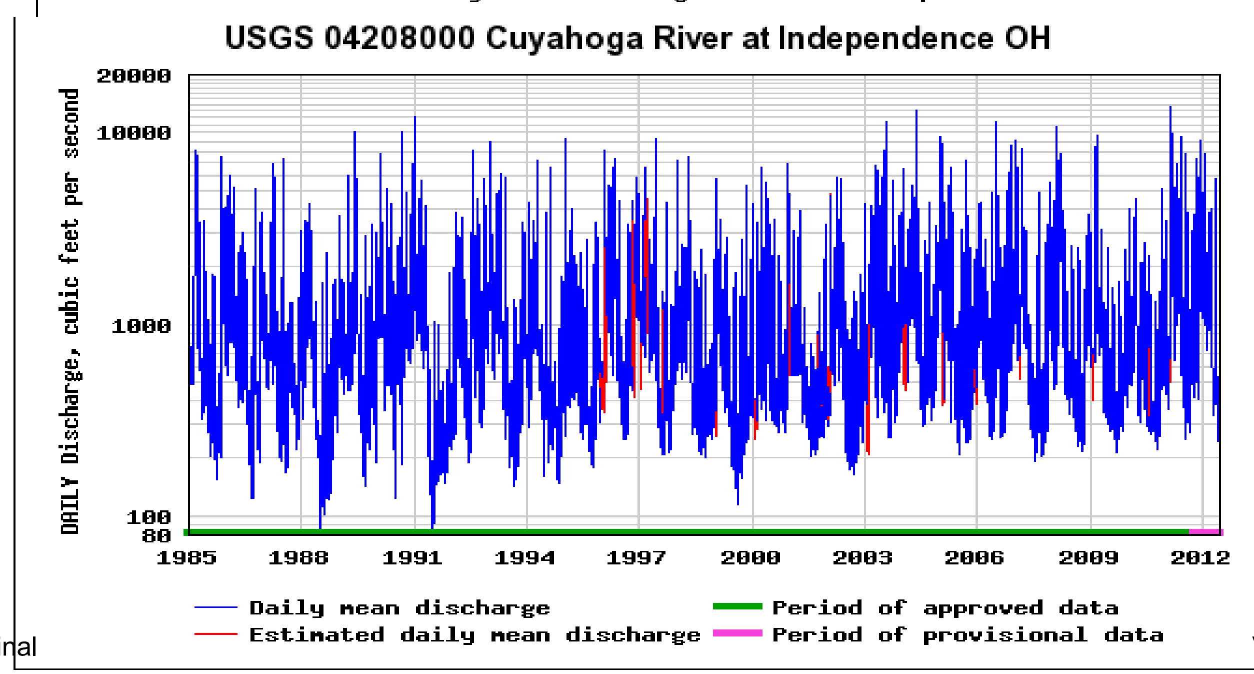


Table 4a-12
Stream Characteristics and Flow

Subwatershed/ stream	Stream Order	Water-shed Size (sq. mi.)	Lth (mi)	Slope ft/mi	Slope Pct	Annual Precip. (in.)	% of Watershed in Forest/ Wetland	Mean Sept. flow (cfs)	Mean Ann. flow (cfs)	2 year (cfs)	10 year (cfs)	100 year (cfs)
Main Stem***	5th	339		2.83		39.8	38.2; 12.6	101	433	4,640	7,260	10,400
Kelsey Cr.	2nd	3.3		37.8	0.72	37.5	18; 2.2	0.67	3.56	235	510	835
Walnut Cr.	2nd	1.92		66.6	1.26	38.7	14.3;2.2	0.41	2.19	165	373	660
MF City Hall	1st	0.82		72	1.36	37.6	15.9; 3.8	0.15	0.86	100	243	449
Fish Creek	3rd	11.5	5.4*	8.3* 10.1	0.19	38.7	26.9; 9.1	2.75	13.5	419	762	1,180
Plum Cr.	2nd above J. Ditch, 3rd below	13.1	5.0*	20.2* 19.3	0.37	36.4	29.8; 11.3	2.61	13.2	484	982	1,420
Johnson Ditch	2nd	4.18		7.07	0.13	36.6	23.2; 11.3	0.79	4.24	178	320	488
Breakneck Creek	3rd to Reed/Hud. 4th below	78.8	26.4*	4.4* 5.15	0.10	35.5	26.8; 11.6	15.1	76	1,640	2,740	4,050
Wahoo	2nd	3.27		14	0.27	36.8	24.2; 4.2	0.65	3.36	186	368	597
Hommon	1st	1.89		22.6	0.43	36.4	25.7; 7.45	0.36	1.88	118	235	382
Brimfield Ditch	2nd	4.52		24.3	0.46	36.5	32.7; 9.3	0.89	4.54	226	439	707
Hudson Ditch	2nd	4.28		23.8	0.45	35.5	28.9;7.5	0.74	4.01	224	441	717
Reed Ditch	3rd	4.7		23.2	0.44	35.6	30.1;16.2	0.83	4.45	219	394	621
Feeder Canal + CLO^	3rd below Cr. Creek	44.2		4.2	0.08	35.4	23.5; 9.6	8.13	41.9	1,050	1,770	2,630
Potter Creek	2nd	5.52	5.2*	13.1* 15.6	0.30	35.5	23.1, 4.3	0.93	5.17	246	463	729
Randolph Ditch	2nd	1.61		37.8	.72	35.4	22.3; 3.8	.25	1.48	124	264	451
Congress Lake Outlet	3rd below Rand. D.	28.2		5.49	0.10	35.5	20.7; 8.2	4.94	26.8	789	1,370	2,080
Cranberry Cr.	2nd	4.17		17.9	0.34	35.5	17.9; 3.6	0.68	3.89	247	479	789
Reidinger Ditch	2nd	0.68		33.3	0.62	35.4	16.5; 3.5	0.1	0.62	63.1	136	232

Sources: Unstarred - USGS StreamStats http://water.usgs.gov/osw/streamstats/ohio.html Ohio DNR, Division of Water, 2001.; with "*" Ohio Gazetteer of Streams, 2001; Water Inventory Report 29. http://dnr.state.oh.us/Portals/7/pubs/pdfs/GAZETTEER_OF_OHIO_STREAMS.pdf;

*** Streamstats model run for upper plus middle Cuyahoga.
^ Streamstats watershed differs slightly from what topography would indicate due to errors in modeling the landscape.
^^ Streamstats could not generate valid watershed, and excluded the northern headwater tributary.

Slope

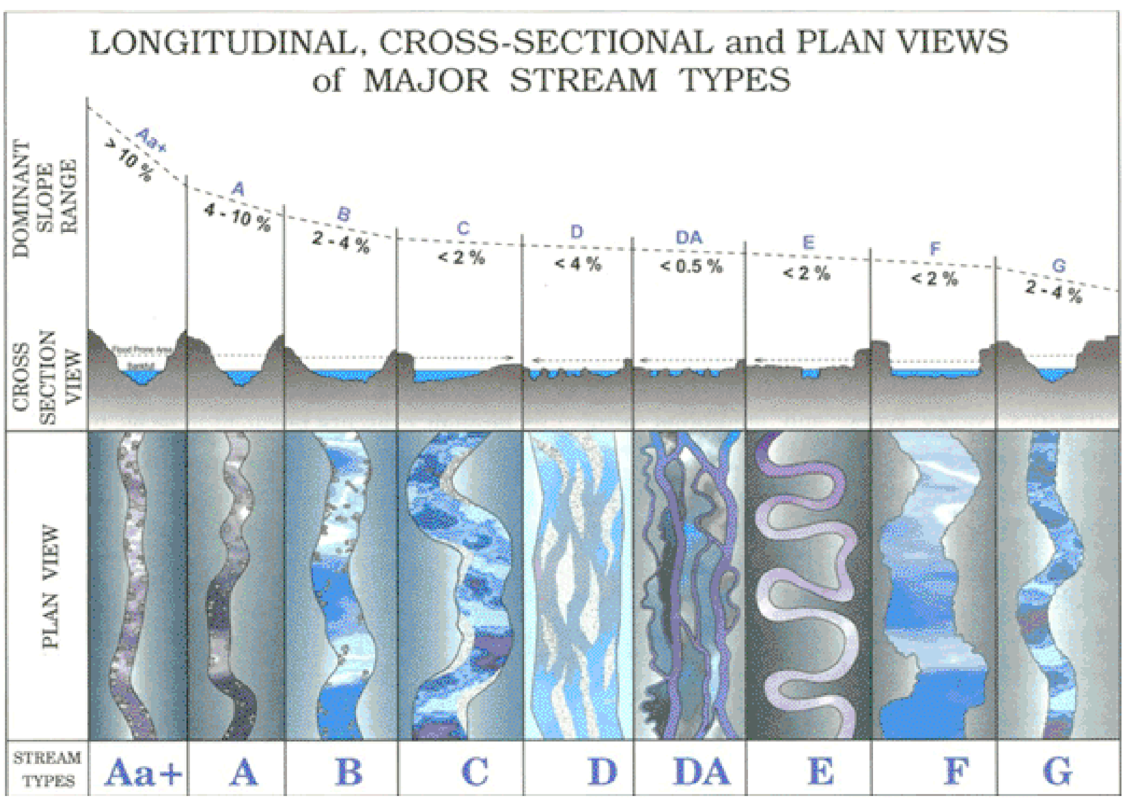
Slope: Background

Background – Stream Slopes Introduction

The slope of a stream affects the amount of energy a stream has, the size of sediment it can transport, and the form. Undisturbed low-gradient streams tend to meander, have broad floodplains, and finer-grained substrate. Higher-gradient streams tend to be narrower, with water traveling in a series of vertical steps, and coarser-grained substrate.

David Rosgen has developed a classification of streams that relates slope to the form that stream systems are likely to take if undisturbed or disturbed. The classification has several tiers of analysis. The Level II analysis looks at stream form, sinuosity, and slope apparent at a mapping scale (e.g., USGS 1:25,000). More detailed levels of analysis require field work to verify width to depth ratios and substrate.

Figure 4a-13 Rosgen Stream Classification



Rosgen, David L. "A classification of natural rivers." Catena 22 (1994): 179. www.wildlandhydrology.com

- Streams with slopes greater than two percent are more likely to be narrower and more entrenched. An Ohio State University fact sheet on stream classification (Ward, D'ambrosio, and Mecklenberg, 2008) notes that streams with slopes of 2-4 percent in Ohio tend to be classified as "B" streams and may be considered "babbling brooks," with channels consisting of a series of rapids and cascades.

Findings:

River and Stream Gradients, Middle Cuyahoga River Watershed

Findings: River and Stream Gradients

Figure 4a-14 and Table 4a-13 present slope information for the Cuyahoga River and watershed streams. The information is presented by county as well as sub-watershed, because a major topographic break and change in underlying geology roughly coincides with the Summit-Portage boundary. Section 4P shows photographs of the Cuyahoga River and streams in the watershed with varying slopes.

- While the overall slopes of the river and tributaries are generally less than 1 percent, portions of streams are much steeper.

- The higher-gradient streams tend to occur along the steep bedrock-controlled Cuyahoga River valley, in the till-covered bedrock uplands of the western portion of the watershed, and in the headwater streams coming off the knolls in the eastern portion of the watershed. In the Main Stem subwatershed, nearly two-thirds of the tributaries are in the steepest categories, whereas in the other subwatersheds, the lowest gradient streams represent most the streams. All the streams with greater than 10 percent slopes are in Summit County, where more than one quarter of the streams have a gradient greater than 2 percent. In contrast, Portage County has a greater proportion of extremely low-gradient streams. More than half the streams in Portage County have gradients of less than 0.3 percent, and in Stark County, none of the streams in the watershed has a gradient greater than 0.6 percent.

- Potter Creek, Congress Lake Outlet, Plum Creek, Breakneck Creek, and Fish Creek are extremely low-gradient, with overall slopes of 0.6 percent or less and many headwater tributaries of less than 1 percent. However, some of the headwater tributaries have slopes of 1, 2, 4, or more percent as they come off the knolls.

- In the Potter Creek subwatershed, most tributaries would be in the slope range for upland drainage categories. The slopes in the Breakneck Creek subwatershed range more widely, between the extremely low slope of Breakneck Creek and the higher gradients of many of the headwater tributaries.

- The slopes of Fish Creek change almost at the county border, reflecting a distinct topographic break between till-covered uplands in Summit County and nearly level buried valley sediments in this portion of Portage County.

- The main stem of the Cuyahoga River has an overall gradient of approximately 0.3 percent, but there are several sections with much steeper slopes (up to 4 percent) and rapids. While the gradient downstream of Water Works Park is approximately 1-2 percent overall, there are areas of steeper gradient - much of the topography of the river channel is masked by the remaining dam pools in Cuyahoga Falls, and low-gradient dam pools are interspersed with steeply plunging falls. In several areas, the resolution of the mapping and stream segment lengths do not allow individual areas of rapids to be identified.

- Streams with slopes greater than 4 percent are likely to develop as cascades or sequences of steps and pools. In the Rosgen classification system, they tend to be considered “A” or “B” streams. The Ohio stream classification paper notes that the higher gradient streams in Ohio are often headwaters coming off hilly uplands.

- Streams with slopes below 2 percent are considered in the Rosgen classification as low gradient streams, likely to meander and have wider floodplains and fringing riparian/wetland systems. Streams below 0.5 percent slope may be braided streams or wetland streams.

The Ohio EPA further distinguishes between lower-gradient streams:

- 0.5 percent and habitat value – Because of the slow velocities, these extremely low-gradient systems are less likely than steeper sloped streams to provide the gravelly substrate that represents the highest quality habitat for invertebrates and fish. In the habitat assessment for typical “warm water” species, a stream with a gradient less than 0.5 percent receives a lower score than one greater than 0.5 percent.

- 0.3-0.6 percent – The proposed beneficial use designations in Ohio’s water quality standards (12/2010) would designate previously channelized water ways with slopes from 0.3-0.6 percent and less than 3.1 square miles of drainage as upland drainage, and these would not be subject to physical, chemical, or biological standards. Alteration permits would receive abbreviated review.

Mapping

Stream slopes were determined comparing the lengths of stream segments in the combined GIS database stream coverage with elevations determined from GIS coverage of digitized USGS 1:24,000 topographic maps. Because of the scale of the mapping, length of stream segments, and, in some cases, discontinuous segments (interrupted by impoundments or even roads), this mapping may not accurately reflect field conditions, but it presents the overall characteristics. Field verification would be required to accurately determine slopes at any site.

Table 4a-13
Summary of River and Tributary Slopes by Subwatershed and County

	Cuyahoga River		Main Stem Tribs.		Fish Creek		Plum Creek	
Slope (Percent)	Length (mi)	Percent	Length (mi)	Percent	Length (mi)	Percent	Length (mi)	Percent
0-0.1	3.1	37%	0.5	2%	3.8	21%	2.4	11%
0.1-0.3	1.2	14%	1.5	7%	2.5	14%	7.8	35%
0.3-0.6	0.3	4%	2	10%	5.2	29%	7.2	32%
0.6-1.0	2.1	25%	4	19%	1.9	11%	1.7	8%
1-2	1.3	16%	5.2	25%	2	11%	2	9%
2-4	0.3	4%	4.2	20%	2	11%	0.9	4%
4-10		0%	2.9	14%	0.4	2%	0.1	0%
>10		0%	0.5	2%		0%	0.3	1%
	8.3		20.8		17.8		22.4	

	Breakneck Creek		Potter Creek		Total Tributaries	
Slope (Percent)	Length (mi)	Percent	Length (mi)	Percent	Length (mi)	Percent
0-0.1	31.0	39%	9.8	23%	47.5	25%
0.1-0.3	18.9	24%	15.3	36%	46	24%
0.3-0.6	8.6	11%	10.1	24%	33.1	18%
0.6-1.0	12.4	15%	5.6	13%	25.6	14%
1-2	8.1	10%	1.7	4%	19	10%
2-4	1.1	1%	0.4	1%	8.6	5%
4-10		0%		0%	3.4	2%
>10		0%		0%	0.8	0%
	80.1		42.9		188	

	Summit County Tributaries		Portage County Tributaries		Stark County Tributaries	
Slope (Percent)	Length (mi)	Percent	Length (mi)	Percent	Length (mi)	Percent
0-0.1	1.9	5%	43.9	31%	1.5	19%
0.1-0.3	5.8	17%	36.8	26%	4.3	56%
0.3-0.6	5.4	16%	26.5	19%	1.9	25%
0.6-1.0	4.9	14%	19.8	14%		
1-2	6.8	20%	12.2	9%		
2-4	6.0	17%	2.3	2%		
4-10	3.5	10%	0.5	0%		
>10	0.5	1%				
	34.8		142.0		7.7	

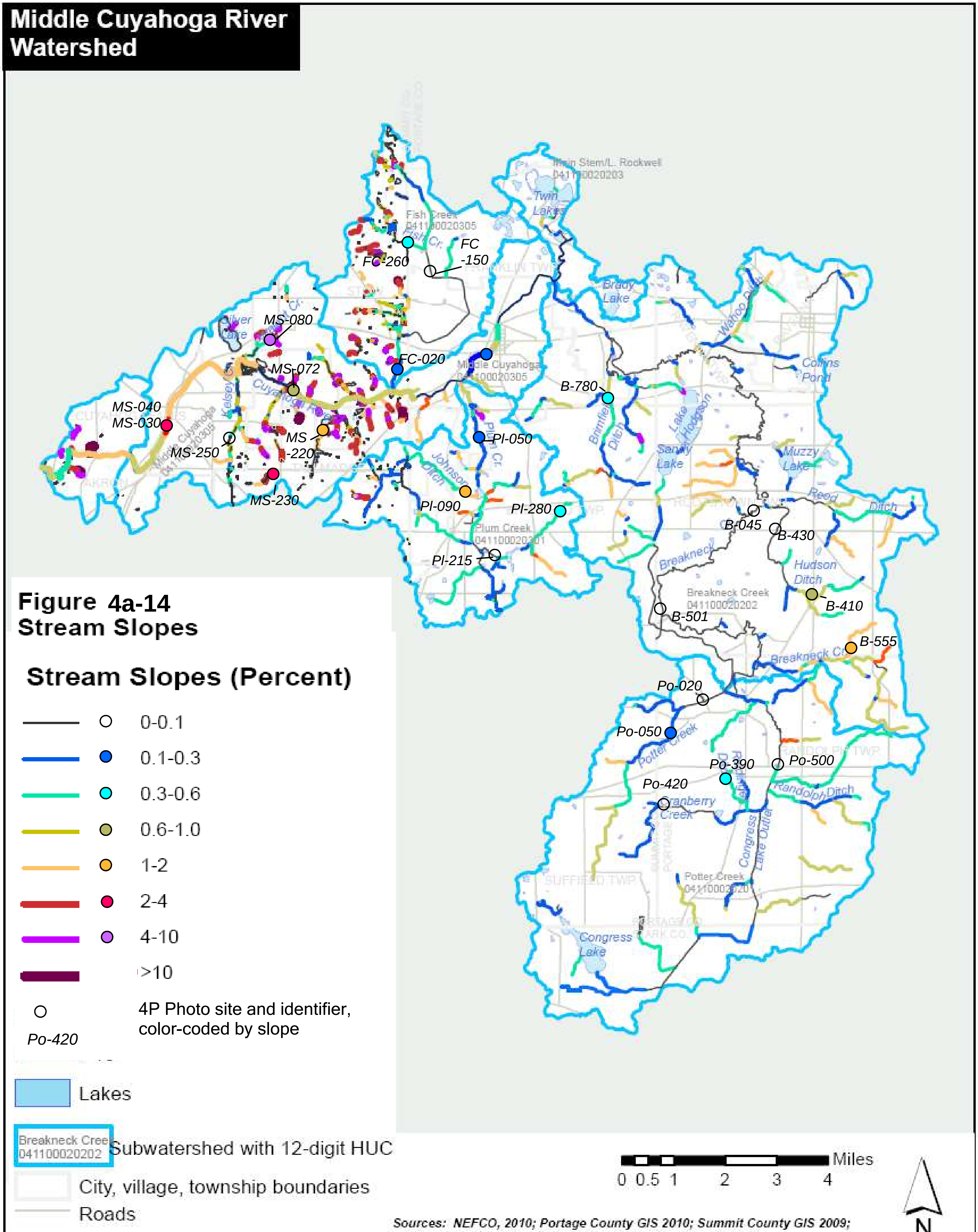


Figure 4a-14 Stream Slopes

Stream Sinuosity

Stream form is related to stream slope and outside factors such as the water-sediment load entering the stream. One of the key indicators in the Rosgen classification is sinuosity, determined by dividing channel length by valley length. Many typically low-gradient streams have sinuosities of 1.2 or greater, and a sinuosity of 1.5 is considered highly sinuous, typical of the lowest-gradient streams (D streams). The steeper streams (A or B streams) tend to have lower sinuosities, as they are often more confined inside their stream channels, and plunge or cascade vertically rather than meandering from side to side.

Mapping

The lengths of stream segments of the combined GIS database were mapped compared with stream valley length determined from a GIS coverage of digitized USGS 1:24,000 topographic maps. It should be noted that the field conditions may differ from these desktop measurements. Many of the line segments used in the mapping were relatively short, which would mask sinuosity. At the scale of mapping used, meanders may not be apparent, or streams may be recovering. Field investigation will be needed to determine characteristics at each site.

Findings:

River and Stream Sinuosities, Middle Cuyahoga River Watershed

Findings: Middle Cuyahoga River Watershed Stream Sinuosity

The predominance of low-gradient streams in the watershed would suggest that many of the streams would have high sinuosities and fringing wetlands and floodplains. However, as the Ohio State University stream classification fact sheet notes, in Ohio, low-gradient channels are common but have often been altered for drainage and meander less than the low slopes would suggest. With a few exceptions, the streams of the Middle Cuyahoga River watershed appear to be following that pattern (See Figure 4a-15):

- Breakneck Creek is highly sinuous with a sinuosity of nearly 1.5. The description of the Cuyahoga River Ecoregions notes it is an extremely low-gradient swamp creek.
- Sinuosity in portions of the main stem, Plum Creek, and Johnson Ditch exceed 1.2, the sinuosity factor that Rosgen associates with typically developing low-gradient streams, which are often in equilibrium with their slope, flow, and sediment load. Some segments of smaller tributaries exceed 1.5.
- Generally, in spite of relatively low gradients in many of the watershed streams, many of them have very low sinuosities, below the 1.2 that Rosgen associates with typically developing lower-gradient streams. Many have sinuosities approaching 1, indicating very little meandering is apparent at the mapping scale. It appears that many streams in the watershed have been channelized, altered.
- A review of aerial photographs suggests that some of the headwater tributaries in the Plum, Breakneck, and Potter Creek subwatersheds may retain much of their sinuosity, but it may not be apparent at the scale of mapping used.

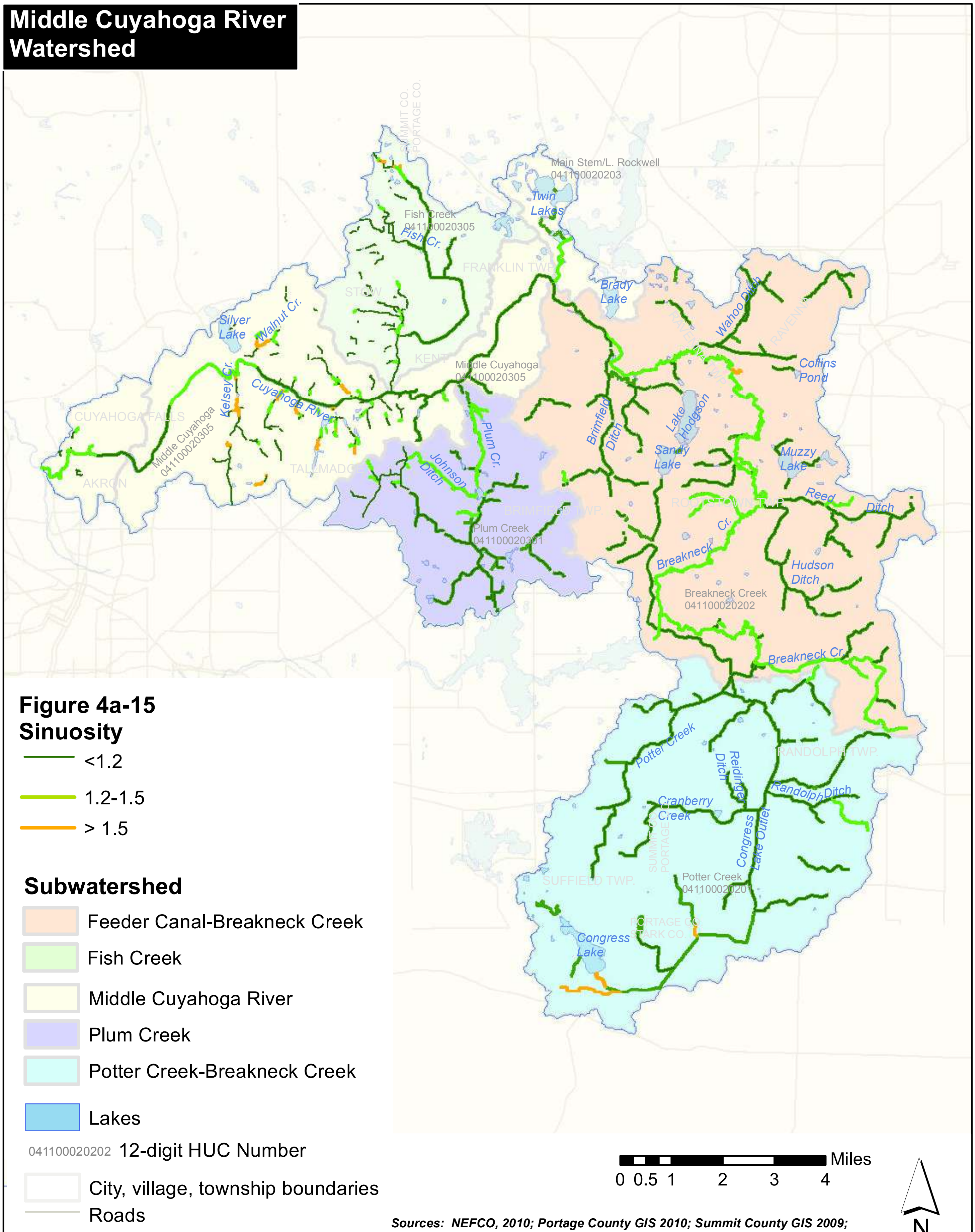


Figure 4a-15 Sinuosity

Floodplain Areas

Floodplains are an important part of a stream system, providing habitat, water quality, hydrological, and safety benefits. Floodplains are the low-lying areas where streams spill out, during high flow, dissipating energy, storing floodwater, depositing sediment, helping to maintain equilibrium stream form, and supporting fringing wetlands, riparian zones, and habitat. They also represent high-risk areas to structures. Activities that encroach on floodplain storage volume or floodplain access increase flood volume, energy, and erosivity downstream.

The Federal Emergency Management Agency maintains maps indicating:
Floodway – areas likely to have damaging velocities of water during certain events and
Floodplains - areas with a certain chance of flooding each year. Areas with 1 percent or 0.2 percent chance of flooding are known as the 100-year or 500-year floodplain and represent severe, rare events. Activity within these zones is regulated by local floodplain managers, often zoning officials, to ensure that structures are not built in the floodway (the area likely to have floodwaters moving at damaging velocities) and that construction within the mapped floodplain is built to local standards, often placing the structure above the base flood elevation.

Flooding occurs much more frequently and is an important part of the river water and sediment budget. In undisturbed streams, “bank-full” events, those where the water is just at the top of the channel and would soon spill out, generally occur with a recurrence interval of once or twice per year. These events are much smaller than the FEMA-mapped events but are probably more significant in the overall processes shaping the channel. One way to determine likely areas of these smaller floods at a watershed scale is by mapping flood-prone soils. Soil mapping occurred largely during the 1970s, so areas mapped as floodprone soils may no longer be associated with flooding streams in the same fashion, if the landscape has changed.

Findings:
Floodplains and Flood-prone soils

Figure 4a-16 presents FEMA-mapped floodplains. In reviewing mapping of floodprone soils, all cases, the floodprone soils occupy a narrow band within the FEMA-mapped floodplains, are not distinctly visible at this scale of mapping, and are not shown.

There are extensive floodplains mapped along many of the tributaries. (See, for example, 4P B-220, B-2; 4P Po-020, Po-1; 4P Pl-040, Pl-1). The main stem for the most part is confined within a relatively narrow bedrock valley, and generally has a much more limited floodplain. (e.g., 4P MS-148, p. 4P MS3). Certain channelized stream sections have very narrow mapped floodplains.

It is important to note that mapping of floodplain does not necessarily mean that the streams have access to the floodplains at that location. Streams may be so incised or so deeply channelized that they can no longer reach the floodplain, addressed later in Section 4d-ii. These would be important areas to restore.

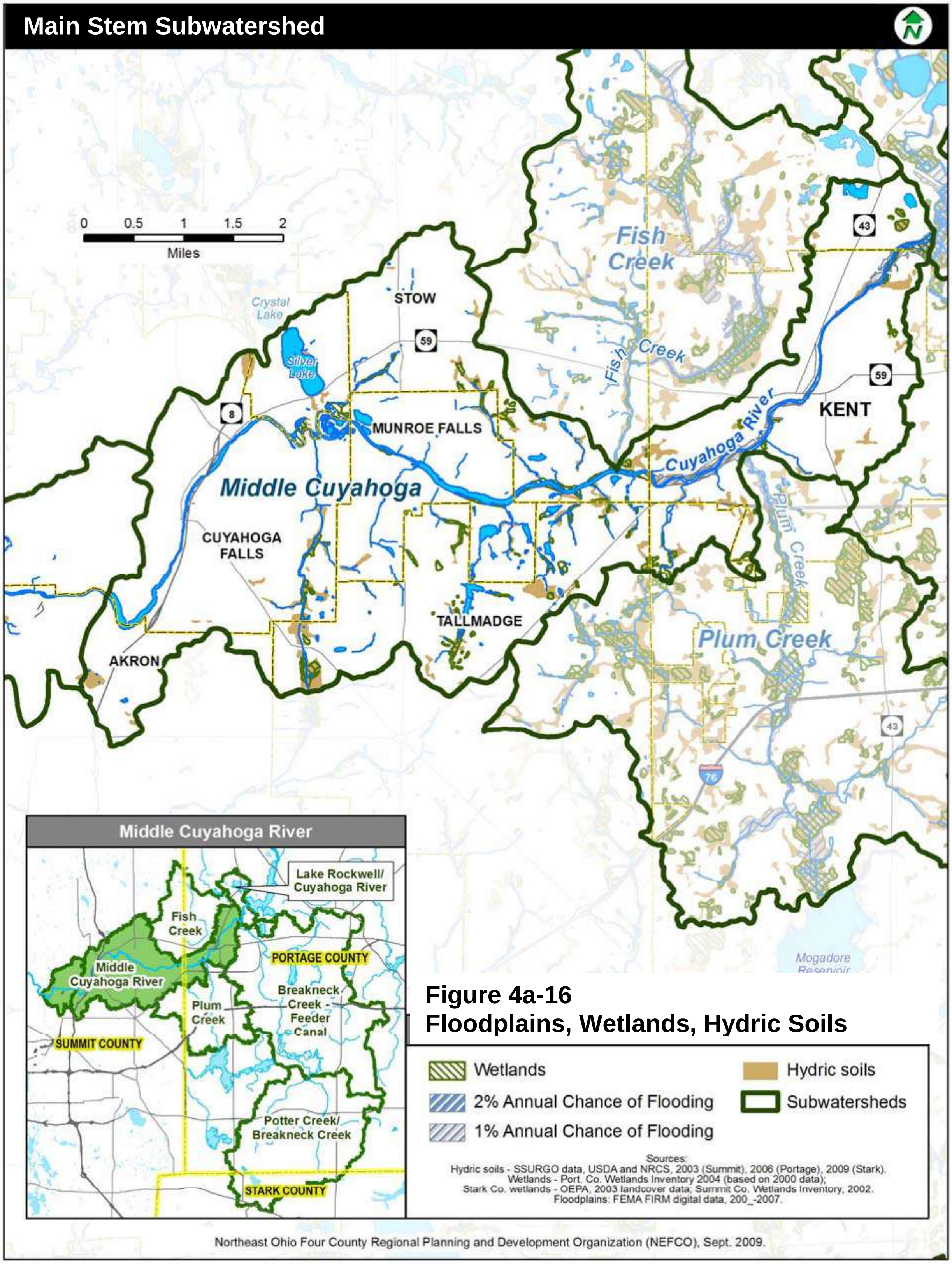


Figure 4a-16
Floodplains, Wetlands, Hydric Soils

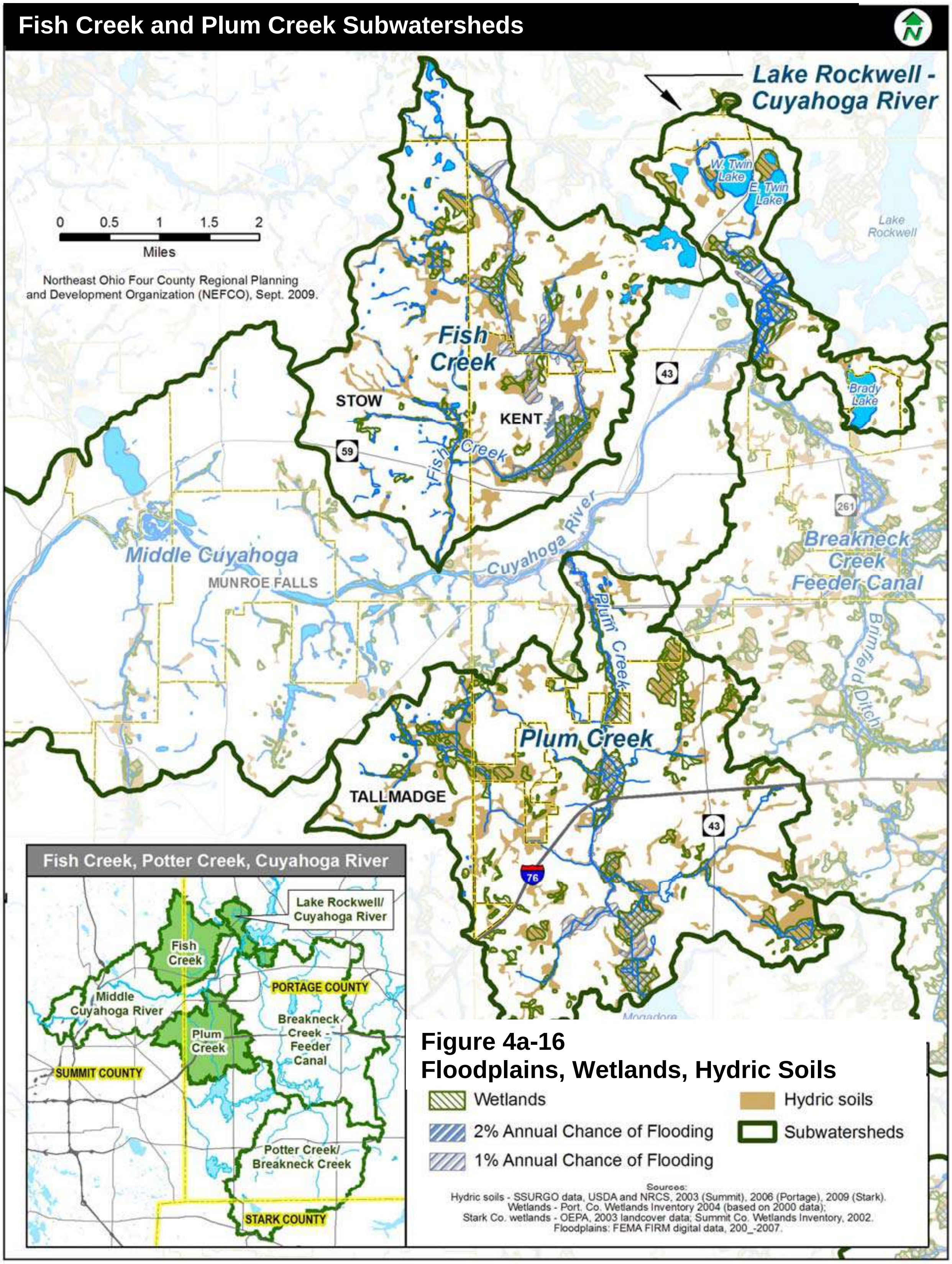


Figure 4a-16
Floodplains, Wetlands, Hydric Soils

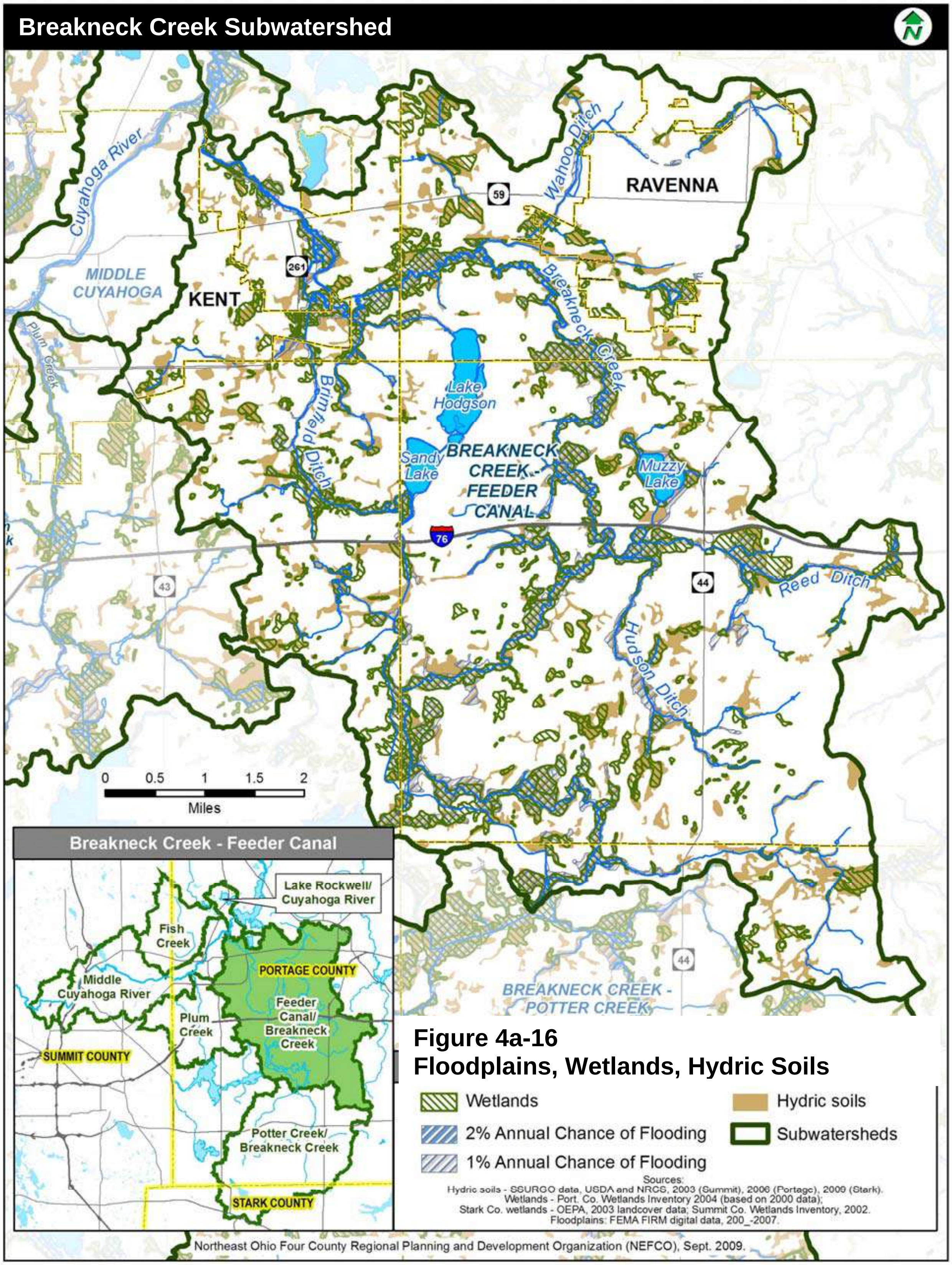
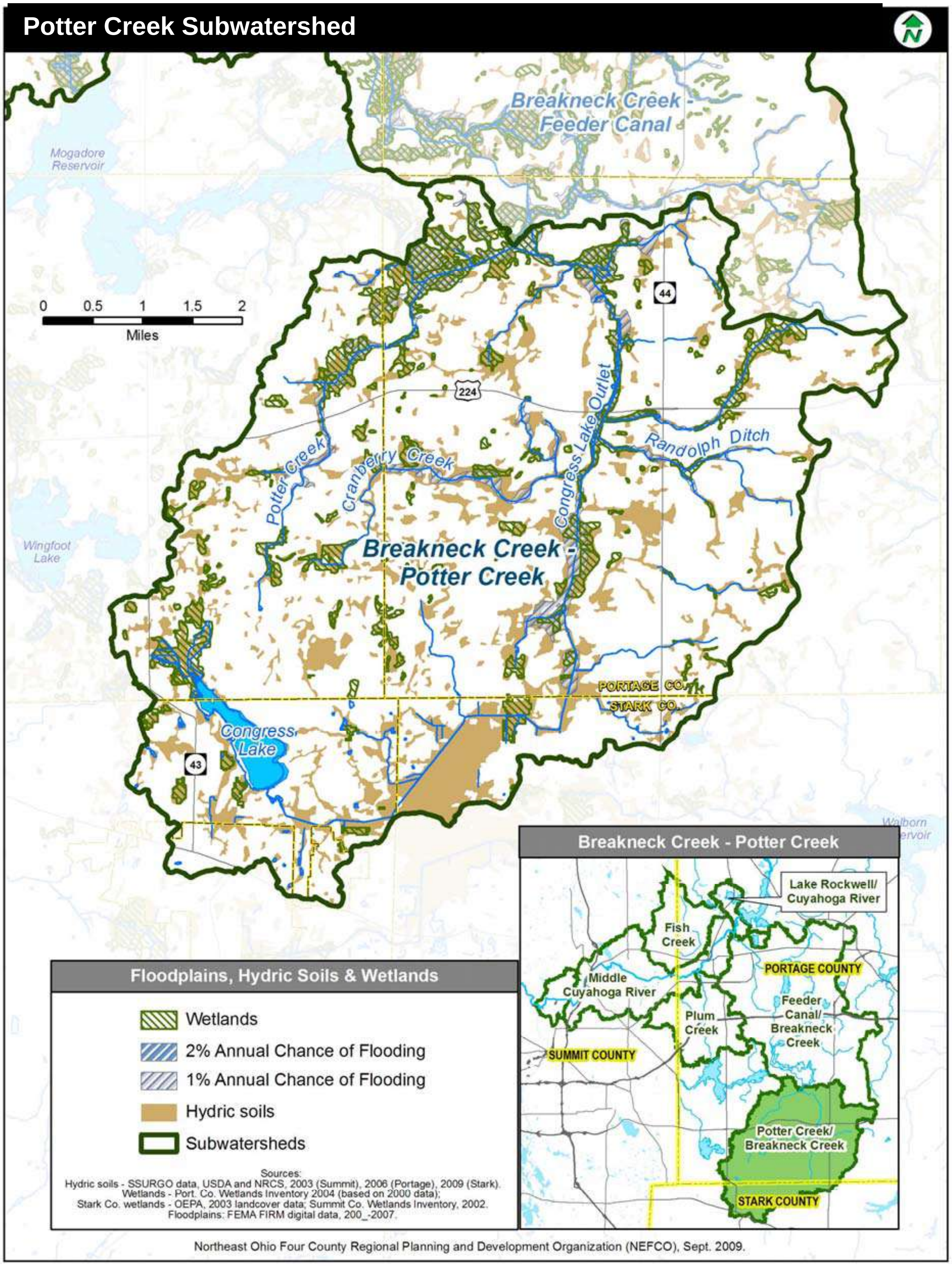


Figure 4a-16
Floodplains, Wetlands, Hydric Soils


Potter Creek Subwatershed
Breakneck Creek - Feeder Canal
Mogadore Reservoir
Wingfoot Lake
0 0.5 1 1.5 2
Miles
44
224
Potter Creek
Cranberry Creek
Congress Lake Outlet
Randolph Ditch
Breakneck Creek - Potter Creek
PORTAGE CO.
STARK CO.
Congress Lake
43
Breakneck Creek - Potter Creek
Lake Rockwell/ Cuyahoga River
Fish Creek
Middle Cuyahoga River
PORTAGE COUNTY
Plum Creek
Feeder Canal/ Breakneck Creek
SUMMIT COUNTY
Potter Creek/ Breakneck Creek
STARK COUNTY
Floodplains, Hydric Soils & Wetlands
Wetlands
2% Annual Chance of Flooding
1% Annual Chance of Flooding
Hydric soils
Subwatersheds
Sources:
Hydric soils - SSURGO data, USDA and NRCS, 2003 (Summit), 2006 (Portage), 2009 (Stark).
Wetlands - Port. Co. Wetlands Inventory 2004 (based on 2000 data);
Stark Co. wetlands - OEPA, 2003 landcover data; Summit Co. Wetlands Inventory, 2002.
Floodplains: FEMA FIRM digital data, 200_-2007.
Northeast Ohio Four County Regional Planning and Development Organization (NEFCO), Sept. 2009.

4.a-iii.b. Surface Water (cont'd)
-ii.2 Streams: Use Designations and Recreational Uses

Background: Use Designations

Background: Use Designations

Ohio's water quality standards are based on beneficial use that water bodies should be able to support. For each beneficial use there are a number of physical, chemical, and biological standards that are monitored to determine attainment.

Aquatic Life Use

Aquatic Life Use is the primary standard monitored by the Ohio EPA. Biological communities change in response to changing conditions. Unlike chemical parameters, biological response is not a measurement of conditions at a single time but, instead, reflect long-term conditions. The three warmwater categories include use of numerical indices reflecting biological community composition and diversity. The categories include:

- Cold Water Habitat (CWH) - these support stream-based trout stocking or coldwater fish and associated vertebrate, invertebrate, and plant species. These systems are rare in the state, and are extremely susceptible to changes in temperature and chemistry.

- Exceptional Warmwater Habitat (EWH) – These support unusual communities (above the 75^{th} percentile of sampled sites)

- Warm Water Habitat (WWH) – this is the most common Aquatic Life Use designation in Ohio, recognizing typical communities of the generally low-gradient streams in Ohio.

- Modified Warmwater Habitat (MWH) – These water courses have been altered to the extent that they are unlikely to support the full breadth of warmwater species again. The numerical biological criteria are lower for this category than for the other warmwater habitats. Modifications can include channel modification, impoundment, or mine-affected.

- Limited Resource Water (LRW) - used strictly to provide drainage. While there are no biological criteria for this water, it must still be free from nuisance chemicals, toxins, or odors.

- *Proposed Aquatic Life Use designation* - Base aquatic life use – this proposed category applies to waters that are conducive to the survival and propagation of aquatic species. It would apply to all undesignated waters

- *Proposed Aquatic Life Use designation* - Primary Headwater Habitat – all waters with drainage areas of less than 1.0 square mile. There are three categories depending on the biological communities they support and the degree of alteration, with Class III being the highest (and subject to similar chemical standards as Cold Water Habitat) and Class I being so altered that most of the functions these provide could be replicated by adequate stormwater best management practices. Classes II and III can be designated as "modified" if they have been channelized or impounded.

- *Proposed designation* - Lake – dugout lake, impoundment, natural lake, and upground reservoir (used for storing drinking water)

Water Supply

Water supply designations include the following:

- Public Water Supplies (PWS) – designated public water supplies, publicly owned lakes and reservoirs, privately owned lakes used for public water supplies; surface waters within 500 yards of public water supply intakes; and emergency water supplies.

- Industrial Water Supplies (IWS) and Agricultural Water Supplies (AWS) have less stringent standards. All waters are designated IWS and AWS unless specifically removed.

Recreation

Standards for Recreation water focus on *e. coli* and certain toxins. Specific effluent treatment standards apply primarily during the recreation period, May 1 through October 31, unless the season is extended due to exceptionally high use during other times of the year. The categories include:

- General water based recreation – those that support or potentially support at least one form of water based recreation. The standards related to this designation apply year-round.

- Bathing waters – primarily used for swimming during the recreation season.

- Primary contact recreation waters are suitable for one or more full body contact recreational use during the recreation season, including water skiing, paddling, wading, swimming. This designation entails the highest standards, in order to allow frequent contact with immersion in the water in a safe manner. Recent changes in water quality standards have created further categories:
    - Class A recreation waters are those supporting frequent primary contact activities, including lakes with public or privately improved access points and waters designated in the Ohio Revised Code (ORC).
    - Class B and C recreation waters support (or could support) occasional or infrequent primary contact activities. Class C waters have watersheds of less than 3.1 square miles.
    - Secondary contact recreation – minimal risk of exposure to pathogens due to factors such as infrequency of use or remote locations.

Other Proposed Designations: Drainage Use

There are no chemical, bacterial, or biological criteria for streams designated drainage uses.

- Upland Drainage – historically channelized, with watersheds of less than 3.1 square miles and slopes of 0.3-0.6 percent, depending on watershed size.

- Water conveyance – constructed or modified channels made to carry drainage during wet periods. These drain 3.1 square miles or more, are historically channelized, and are otherwise designated WWH, MWH, or LRW.

Findings: Use Designations, Middle Cuyahoga River Watershed

Findings: Middle Cuyahoga River Watershed Designated Uses

As shown on Table 4a-14 and Figure 4a-17, the Cuyahoga River and seven of the tributaries have been designated for aquatic life use. The Cuyahoga River has been designated Category A, Primary Recreation, supporting an increasing amount of recreational paddling. In addition, Lake Hodgson supports public recreational use.

Stream	**Water Quality Designation**	**Comments/Other**
Cuyahoga River	WWH, Category A Primary Recreation	Canoe livery has been established at Tannery Park in Kent
Fish Cr.	WWH/ MWH-C	Channelized to provide drainage upstream of RM 1.4
Plum Cr.	WWH	
Breakneck Cr.	WWH	Includes Congress Lake Outlet
Potter Cr.	WWH	
Congress Lake Outlet	MWH-C	Dug canal connecting Congress Lake with Lake Hodgson
Feeder Canal	MWH-C	Dug canal connecting Congress Lake with Lake Hodgson, flow restricted by control structure, receives flow only occasionally in summer
Lake Hodgson	Public water supply	Recreational use, allows boating and fishing, boat rental
Wahoo Ditch	LRW	Drainage purposes only

Lake Hodgson is the public water supply for the City of Ravenna. Ohio EPA has identified source water management areas for public water supplies. The area identified as source water protection areas include the emergency management zone, an area within 1,000 feet of the intake, and the corridor management zone, a zone 1,000 feet wide along the lake and Feeder Canal, and 500 feet wide along major tributaries. The Potter Creek subwatershed and a small portion of Breakneck Creek subwatershed along the Feeder Canal are in the Corridor Management Zone, most of which is not owned by the City of Ravenna. Because Lake Hodgson is a surface water supply, it is susceptible to surface contamination sources, including: agricultural and residential runoff; failing septic systems; spills; oil and gas wells/pipes; transportation facilities; and the Lake Hodgson marina (which allows no gas-powered motors), and the Randolph Waste Water Treatment Plant. Recommended management measures included lake monitoring; spill response and containment; careful monitoring of conditions during which withdrawals were made from the Congress Lake Outlet; careful management of recreational activities on the lake; protection from nutrients, suspended solids, pesticides; education and outreach; coordination with other agencies; and zoning ordinances to address land use and chemical storage. The City of Ravenna monitors water quality parameters in the lake.

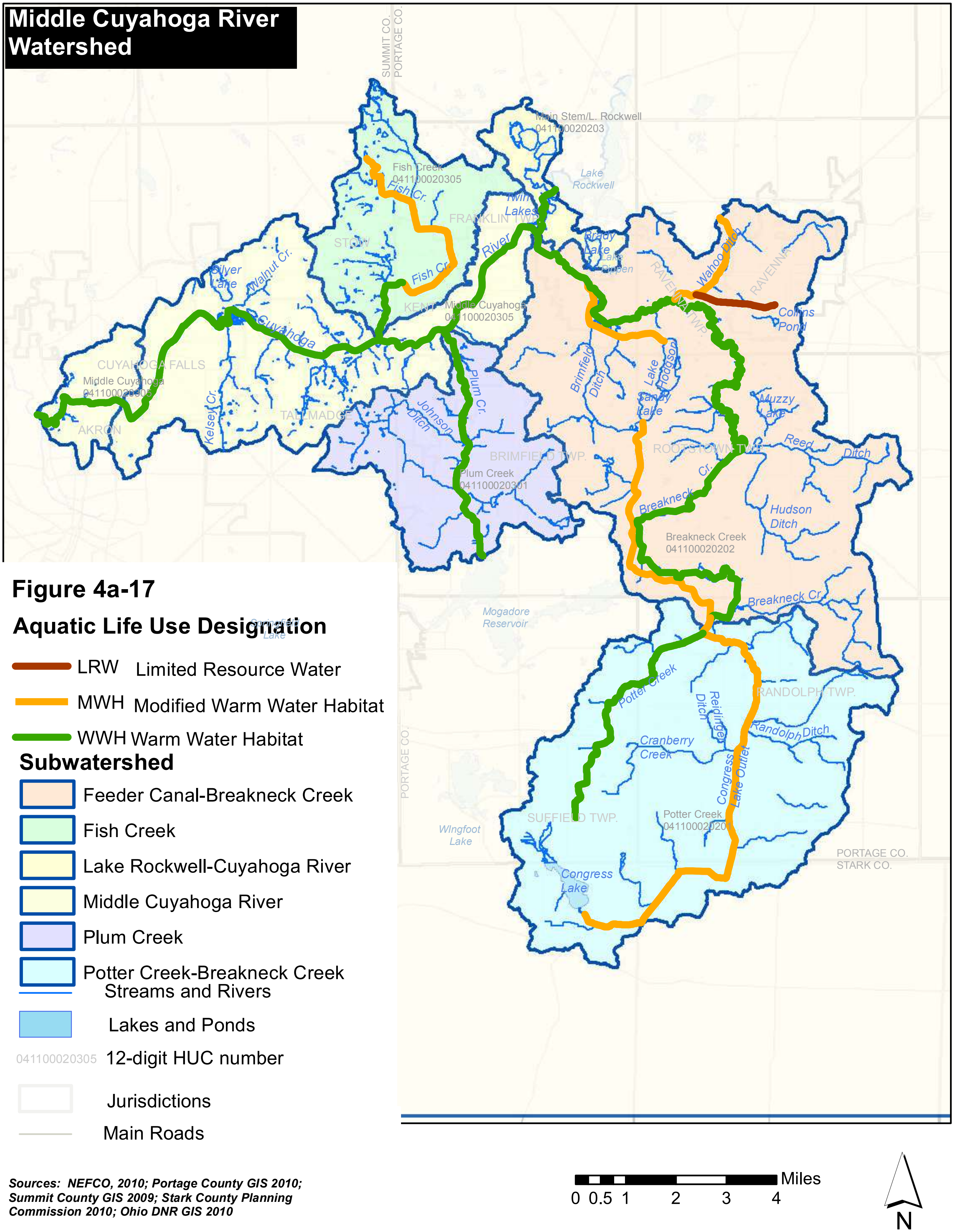


Figure 4a-17

Aquatic Life Use Designation

Sources: NEFCO, 2010; Portage County GIS 2010; Summit County GIS 2009; Stark County Planning Commission 2010; Ohio DNR GIS 2010

Recreational Uses

Recreational use has been important along the water bodies and waterways of the watershed and is becoming increasingly so.

- The main stem of the Middle Cuyahoga River is becoming increasingly important for paddling. Near the lower end of the watershed, the rapids at the Sheraton dam provide challenges to expert-level paddlers. A canoe livery was established in the summer of 2010 by the City of Kent and Kent State University in Tannery Park downstream of the Kent dam. The liver offers trips to Brust Park or Water Works Park, where there are canoe pull-outs or boat launches. The venture was so successful in its first year that it is doubling its fleet, as of summer, 2011. The City of Kent has been exploring the possibility of an additional put-in for expert paddlers above the rapids of the Brady's Leap area.

- Municipal or MetroParks bike-hike or hiking trails parallel the main stem from Kent through Cuyahoga Falls, offering passive recreation (hiking) opportunities and fishing access. Some of the paths pass alongside gorges, cliffs, and rapids, offering access to dramatic scenery.

- Portage Park District has begun acquiring parcels along Breakneck Creek, which are currently being used for conservation and occasional passive recreation.

- Cuyahoga Falls, Kent, and Munroe Falls regularly have festivals at parks along the river. These are becoming increasingly important community gathering places.

- Various municipal parks are located along tributaries, including Plum Creek Park, several parks in Cuyahoga Falls, Adell Durbin Park in Stow, and parks in Kent along Fish Creek. Many of these offer access to the tributaries.

- The City of Ravenna allows boating on Lake Hodgson with non-gasoline powered boats, and rents boats.

As of the writing of this plan, a number of communities and organizations have begun the effort to establish a Cuyahoga River water trail, which will establish regularly maintained put-in and pull-out locations and will include a brochure highlighting routes, pull-outs, and important features. Much of the Middle Cuyahoga would occupy the section designated as the "Heritage" section, highlighting the historic dams, communities, and features along its banks. The lower section of the main stem in the watershed would be classified the "expert" section, taking advantage of the Class IV and V rapids in the Gorge section. A short stretch of expert rapids is already exposed, and should the dams in Cuyahoga Falls be removed, it is anticipated that more expert level rapids will be exposed. There are a number of challenges to meet in developing a water trail, but stakeholders see this as an important opportunity to highlight the resource and provide a regional economic development opportunity.

4a-iiic Groundwater Resources
-i Aquifers; i.1 Flow; Flow Regime; 1.3 Pollution potential

Groundwater Resources: Background

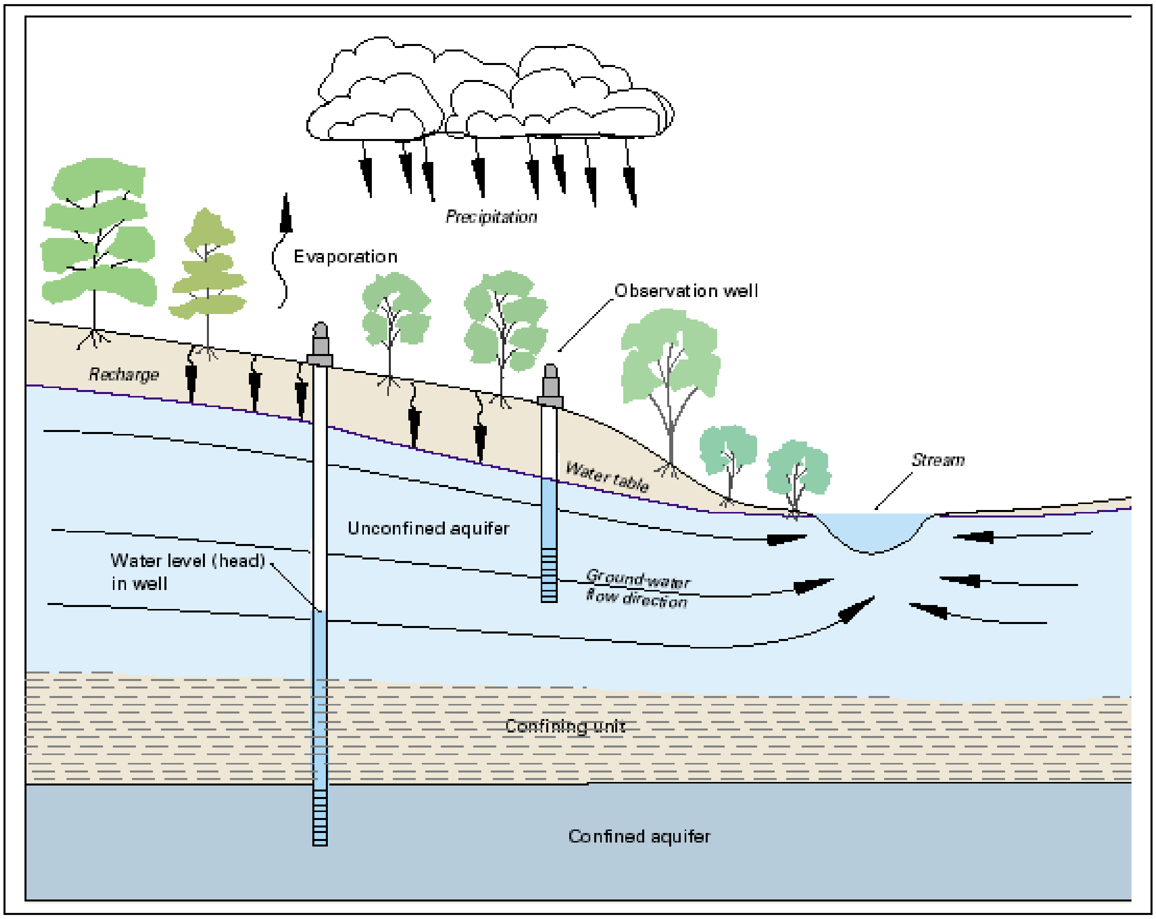
Background - Groundwater

Introduction

The water resources and hydrology of an area extend below the ground surface, where water flows through connected spaces between or rocks, as shown on the following illustration.

Note: This section considers the flow of groundwater, sources of groundwater, public water supplies, and susceptibility to pollution together (in a different order of the Appendix 8 outline), because they all address flow of groundwater. Section 4a-iiic-i.2, Source Water Assessment Plans, is presented after this discussion related to groundwater flow.

Figure 4a-18
Groundwater Hydrology Diagram



Source: Hydraulic Head and Factors Causing Changes in Ground Water Levels U.S. Geological Survey Circular 1217 by Charles J. Taylor and William M. Alley 1217 Box A http://pubs.usgs.gov/circ/circ1217/html/boxa.html

Groundwater…

- Is recharged through infiltration.

- Flows through connected spaces between sediment or rocks, flowing most easily where relatively large pore spaces are connected, such as in sand and gravel or sandstone, (high transmissivity). Groundwater flow through till is limited, as the finer silt particles fill the spaces between the sand and gravel.

- May flow through surface sediment or rocks (unconfined) or in permeable layers, such as sandstone, that are between impermeable ones such as shale (confined);

- Flows from areas of high potential to low potential within areas of similar transmissivity, which in surface sediments often reflects the topography. This is mapped as the potentiometric surface, the level to which water would rise in an open well.

- Groundwater often emerges at the surface in wetlands and streams, providing a base level of flow during dry weather. Where permeable layers emerge below impermeable layers in cliffs, the groundwater emerges as seeps.

- Areas of high groundwater tables are often wetlands and may be poorly suited for septic systems and structures.

Groundwater provides an important source of drinking water in public and private wells. Areas that are best suited for wells are usually in sediment or bedrock with high transmissivity, which makes them especially susceptible to contamination from materials carried in the groundwater. Contamination can occur from spills on the surface that enter the groundwater or from travel of contaminants below the surface.

Mapping and Data

Ohio DNR has mapped a number of groundwater characteristics for use in developing wells, monitoring and understanding flow patterns, and managing contaminated groundwater:

- Potentiometric surface, allowing determination of flow direction (generally perpendicular to potentiometric contours and to the lower elevations);
- Groundwater aquifers, units storing enough water to potentially support wells;
- Transmissivity and hydraulic conductivity (how easily water moves through the subsurface);
- Pollution susceptibility, reflecting transmissivity and other hydraulic factors, as well as whether the aquifer is near the surface and thus, more susceptible to surface influences (this data is known as DRASTIC maps, with the acronym standing for a number of factors influencing susceptibility to pollution); and
- Well locations and withdrawal amounts.

Three USGS groundwater monitoring wells are located within the Middle Cuyahoga River Watershed: Kent near Route 59, Cuyahoga Falls at the Cuyahoga Falls water supply, and Quail Hollow State Park in Stark County. Monitoring data from these were compared to each other and stream hydrographs to determine how the groundwater in each area changes seasonally and with precipitation.

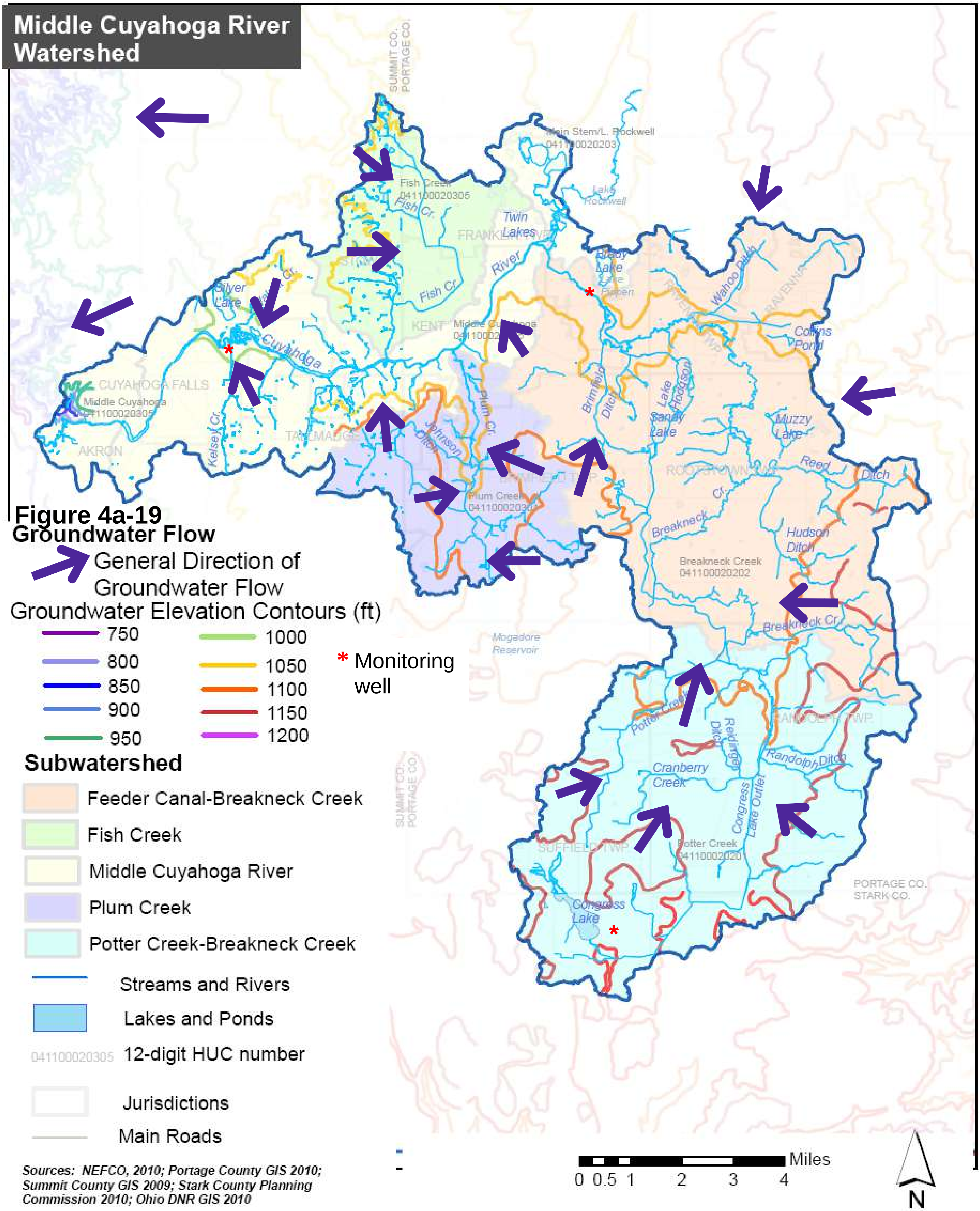
Ohio EPA has determined zones likely to contribute groundwater to public wells within one and five years, to allow public water suppliers to protect the sources of their well water. Water suppliers may adopt source water protection programs, which identify potential sources of contaminants and disruptions to public water supplies and incorporate measures to reduce risks to the water supplies.

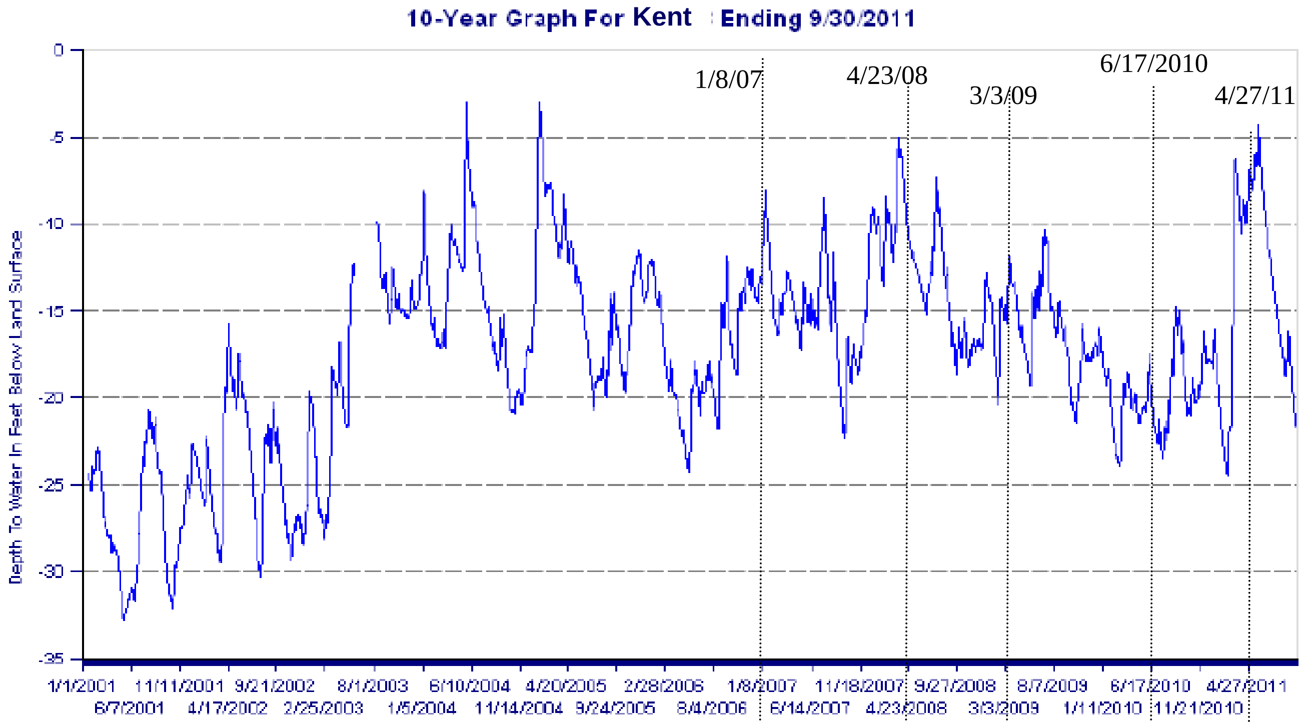
Findings:
Groundwater Resources, Middle Cuyahoga River Watershed

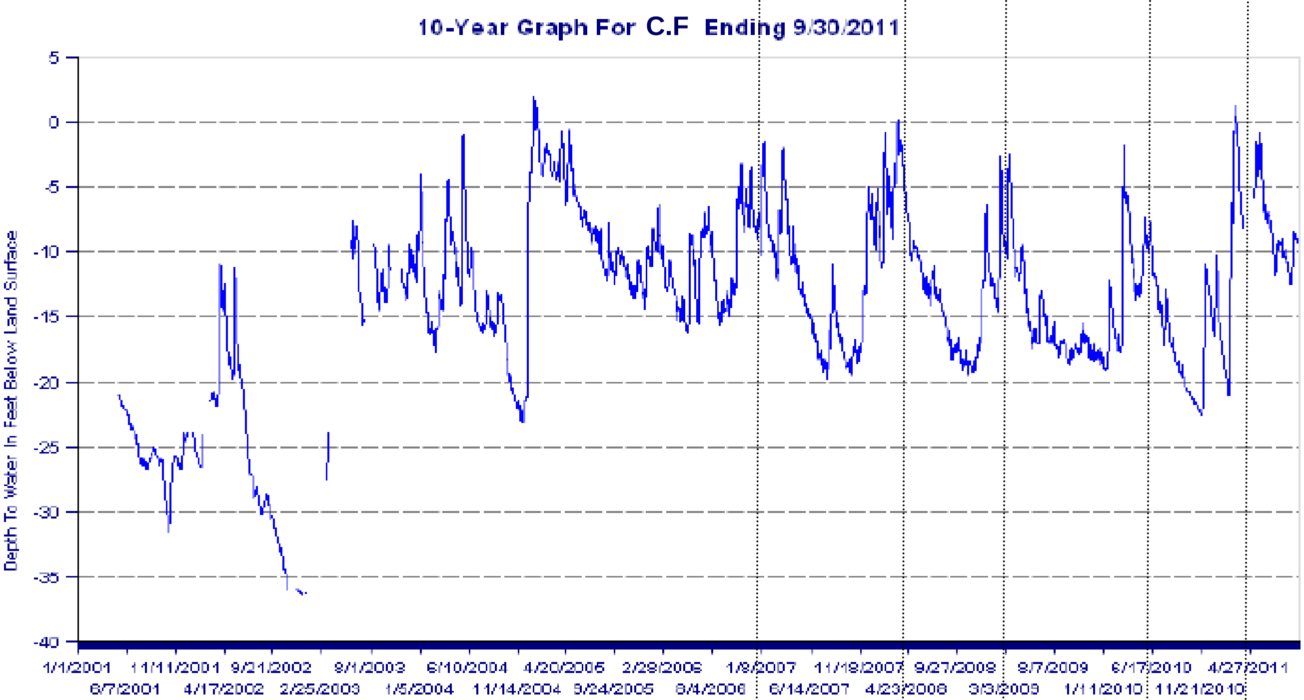
Figure 4a-19 shows the general direction of the groundwater flow, which is generally toward the river and tributaries. This figure also shows the location of the monitoring wells.

Figures 4a-20.1 through 4a-20.4 compare groundwater levels at three locations in the watershed and in relation to flow in the Cuyahoga River. Groundwater levels typically fluctuate during the year, with the highest levels in late fall to spring and the lowest levels in summer. The Quail Hollow State Park monitoring well, which is influenced by wetlands rather than streams, clearly exhibits this seasonal fluctuation. The other two monitoring wells show more rapid fluctuations in the groundwater elevations, which correspond to changes in flow in the Cuyahoga River, especially during wet periods, and indicate that these two wells are influenced by precipitation. The changes at the Cuyahoga Falls monitoring well, which is adjacent to and recharged by the river, more closely reflect the changes in the river flow during wet periods than Kent, where fluctuations appear to be modified, perhaps by the extensive wetlands nearby.

Figure 4a-21 presents the major aquifers, public water supplies, and areas of highest pollution potential. There are three major groundwater public water supplies: Cuyahoga Falls, Kent, and Portage County. They are all within the sand and gravel aquifer of the buried river valleys. Numerous smaller wells are also found in the sand and gravel aquifer. Lake Hodgson is a surface water public water supply, but Lake Hodgson and the Feeder Canal likely receive water from groundwater flow. The Kent and Portage County public water supplies are in areas of higher or moderate pollution potential – where groundwater moves easily through sediment, there is a greater likelihood that pollutants will also move easily, and these aquifers do not have isolating lenses of low-permeability material above them to provide protection from surface pollutants.


Middle Cuyahoga River Watershed
Figure 4a-19
Groundwater Flow
General Direction of Groundwater Flow
Groundwater Elevation Contours (ft)
750
800
850
900
950
1000
1050
1100
1150
1200
* Monitoring well
Subwatershed
Feeder Canal-Breakneck Creek
Fish Creek
Middle Cuyahoga River
Plum Creek
Potter Creek-Breakneck Creek
Streams and Rivers
Lakes and Ponds
041100020305 12-digit HUC number
Jurisdictions
Main Roads
Sources: NEFCO, 2010; Portage County GIS 2010; Summit County GIS 2009; Stark County Planning Commission 2010; Ohio DNR GIS 2010
Miles
0 0.5 1 2 3 4
N
SUMMIT CO.
PORTAGE CO.
STARK CO.
Fish Creek 041100020305
Main Stem/L. Rockwell 041100020203
Lake Rockwell
Twin Lakes
Fish Cr.
River
Brady Lake
Silver Lake
Cuyahoga
CUYAHOGA FALLS
Middle Cuyahoga 041100020305
AKRON
TALLMADGE
KENT
Kelsey Cr.
Johnson Ditch
Plum Cr.
Plum Creek 041100020301
Brimfield Ditch
Lake Hodgson
Sandy Lake
Wahoo Ditch
Collins Pond
Muzzy Lake
Reed Ditch
ROOTSTOWN TWP
Breakneck Cr.
Hudson Ditch
Breakneck Creek 041100020202
Breakneck Cr.
Mogadore Reservoir
Potter Creek
Redinger Ditch
Randolph Ditch
RANDOLPH TWP
Cranberry Creek
Congress Lake Outlet
Potter Creek 041100020201
SUFFIELD TWP
Congress Lake





Quail Hollow State Park, Stark Co.

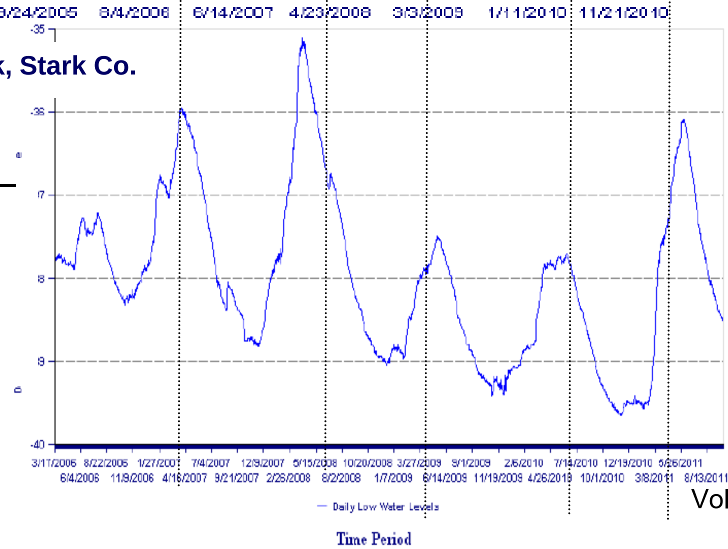


Figure 4a-20.1 Groundwater Flow Regime—Long-term Monitoring Well Hydrographs
Kent, Cuyahoga Falls, Quail Hollow State Pk

Source: Ohio Department of Natural Resources Ohio Monitoring Well Network. http://www.dnr.state.oh.us/water/waterobs/obs_well_map.asp, 2012.

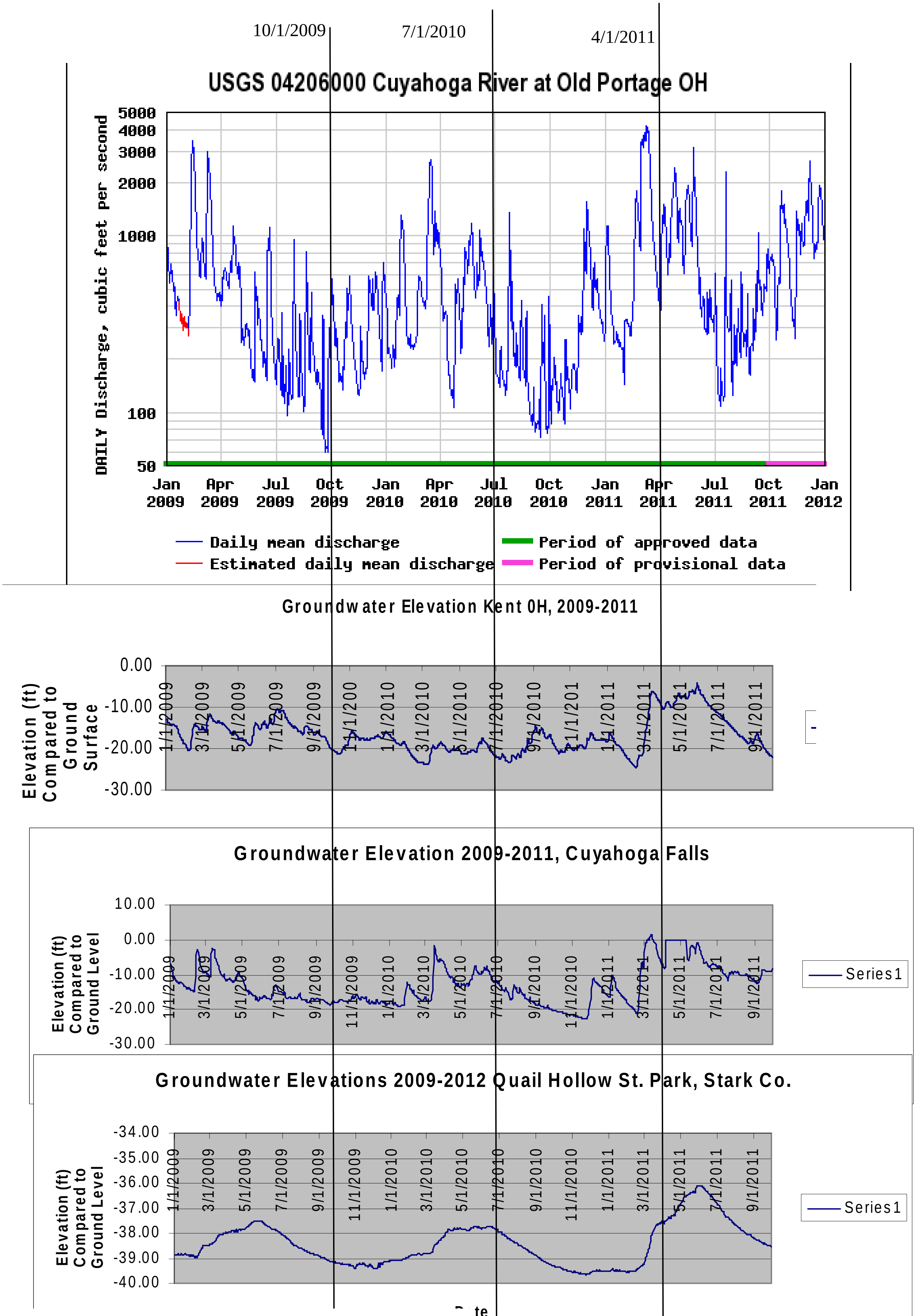


Figure 4a-20.2 Groundwater Elevations Compared to Cuyahoga River Flows

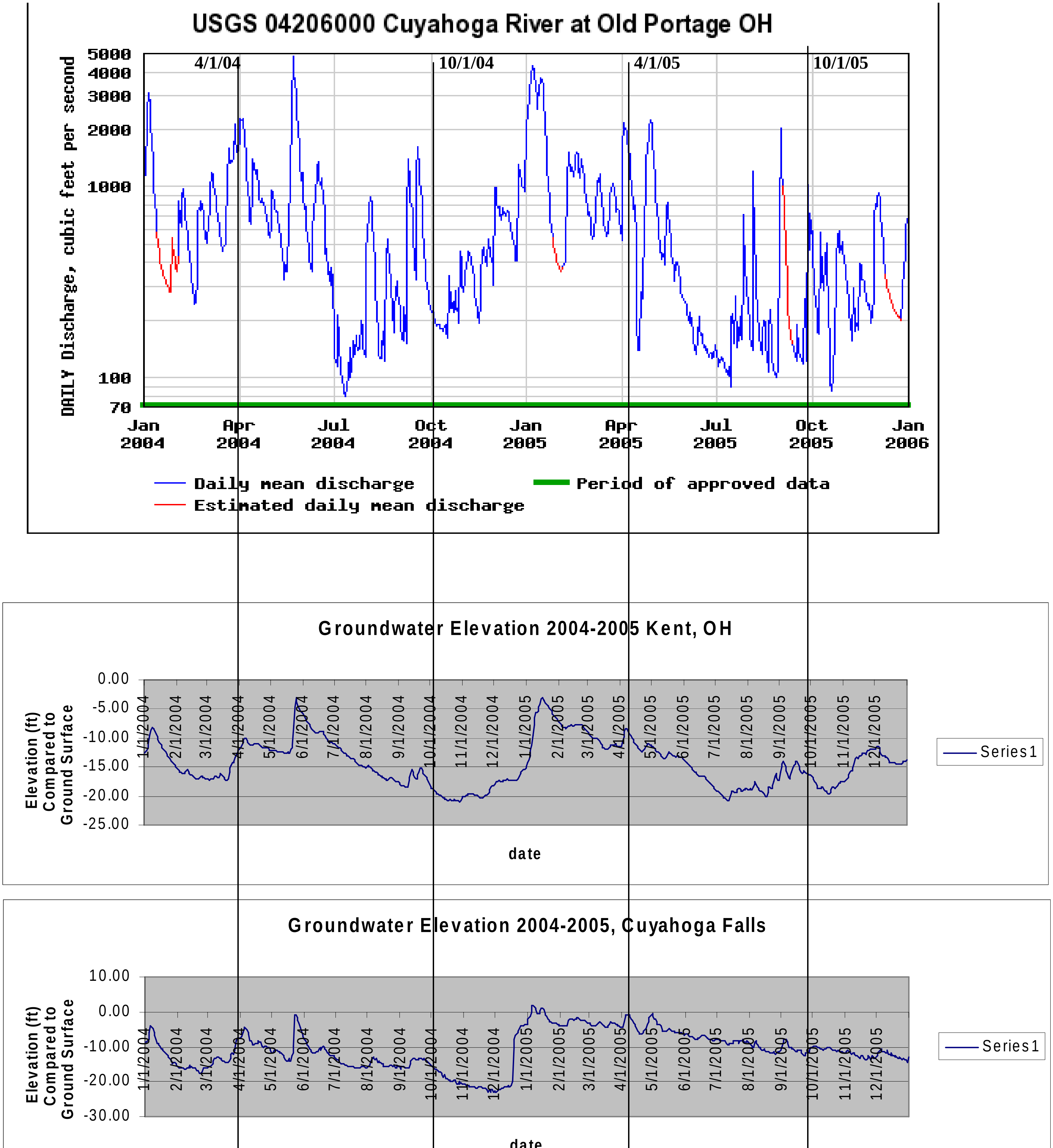


Figure 4a-20.3 Groundwater Elevations Compared to Cuyahoga River Flows, Wet period

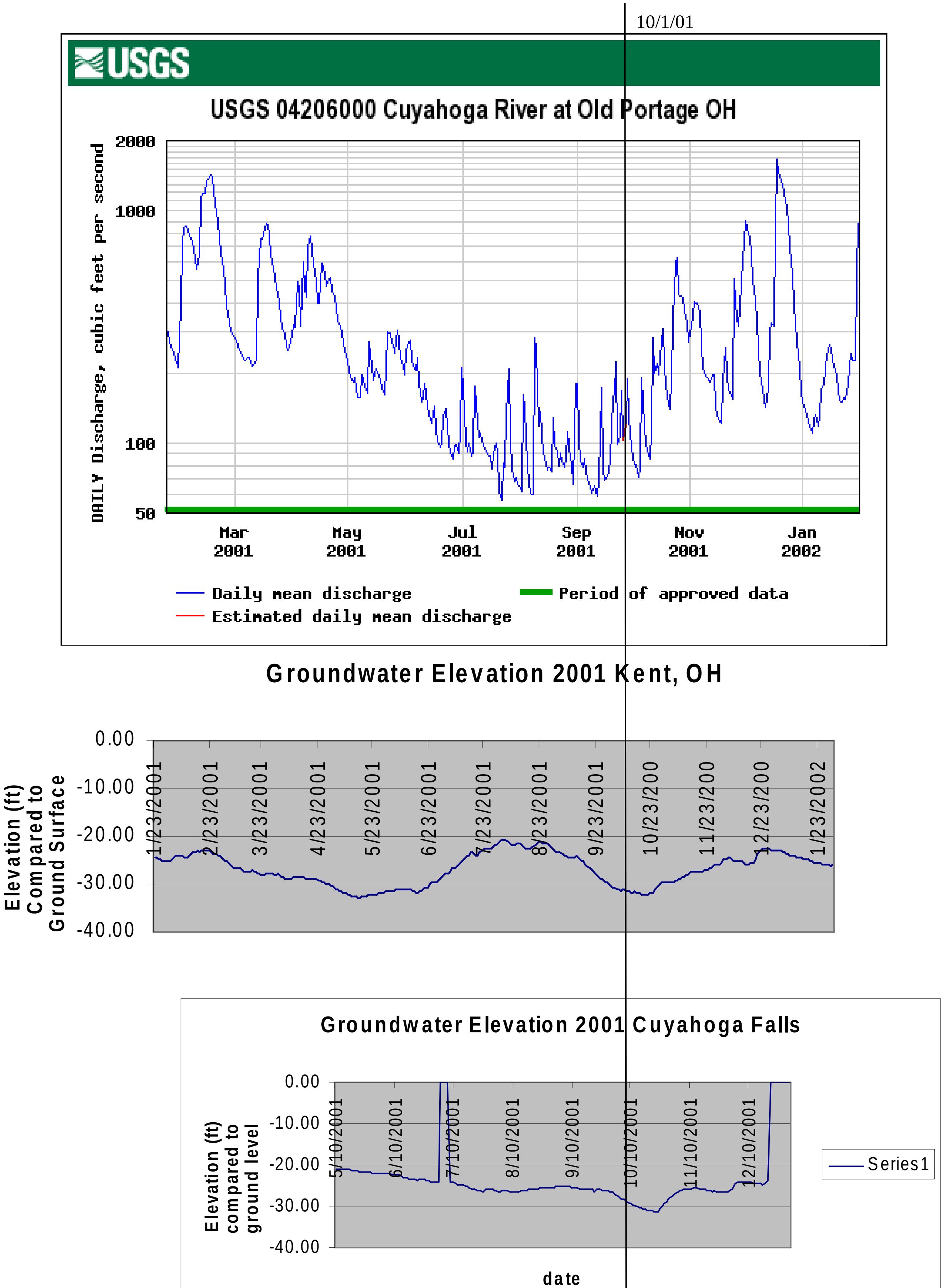


Figure 4a-20.4 Groundwater Elevations Compared to Cuyahoga River Flows, Dry period

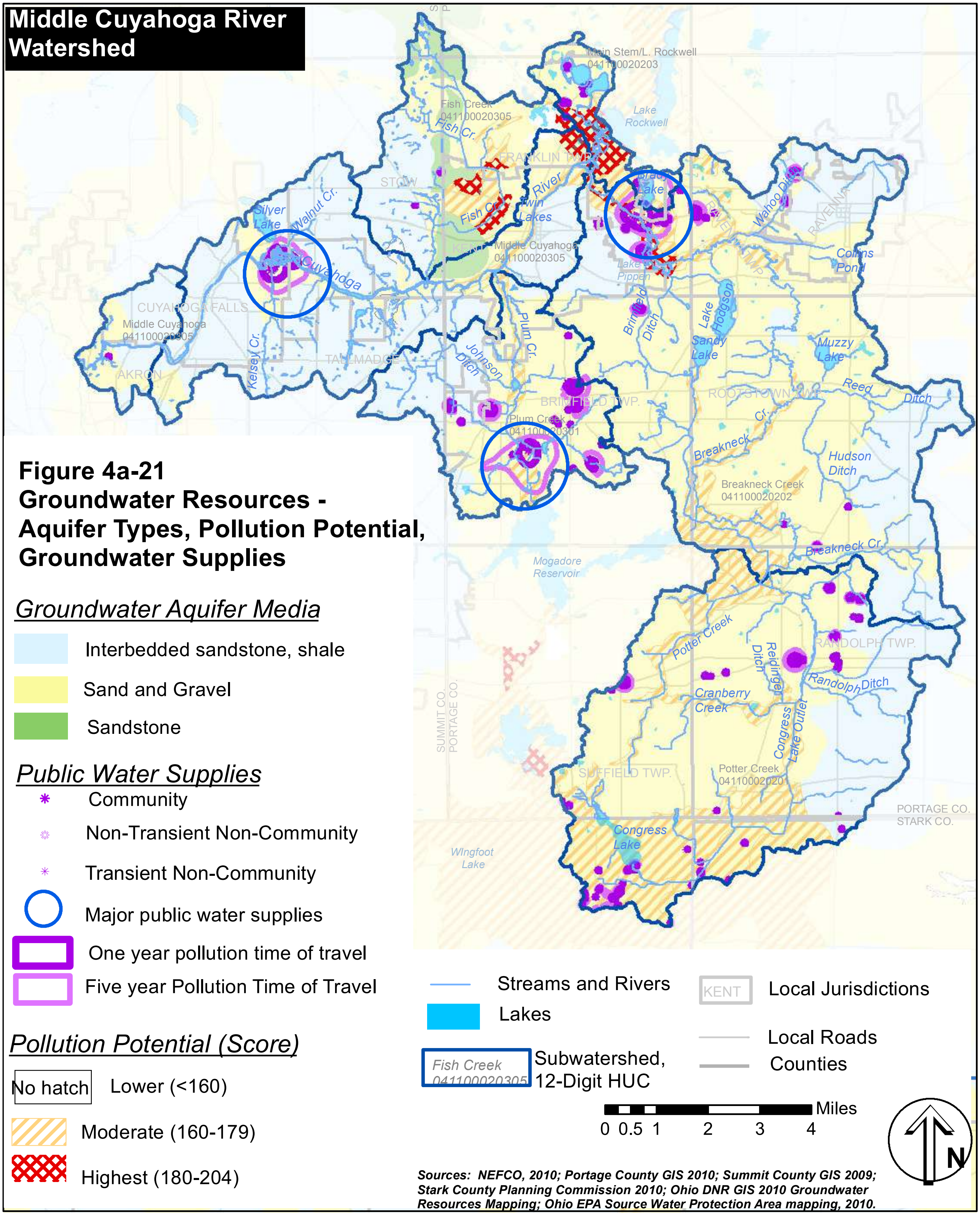


Figure 4a-21
Groundwater Resources - Aquifer Types, Pollution Potential, Groundwater Supplies

4a-3c Groundwater Resources (cont'd)
-i.2 Source Water Assessment Plans

The Ohio EPA has developed Source Water Assessments for all public water supplies, which describe the water supply characteristics, and identify susceptibility to contamination, zones likely to influence the water supply, potential sources of contamination within one- and five-year time of travel zones. Public water suppliers may develop Source Water Protection Plans, which list potential water quality threats, measures to minimize threats, alternate water supplies in case of emergency, and outreach goals.

Table 4a-15 presents the key findings for the three major groundwater public water supplies in the watershed, i.e., Cuyahoga Falls, City of Kent, and Portage County.

- The City of Kent and Portage County do not own (i.e., have control over) the 1- and 5-year time of travel zones associated with their groundwater supplies.

- Potential sources of contamination to the three water supplies include: Transportation; oil and gas wells; surface water contamination at Cuyahoga Falls and Kent; industrial/commercial/automobile-related facilities; agricultural uses (Ravenna); golf course (Portage County); and toxins from old landfills (Kent).

- Recommendations generally include: encouraging land uses that do not pose risks; acquisition of land near the water supply; outreach to educate landowners about risks of spills; notifying emergency services of potential for spills; spill containment; and in the case of Ravenna's water supply, agricultural best practices. With a golf course in Portage County's water supply protection area, it may be appropriate to provide specific outreach efforts to the golf course to encourage reduced use of chemicals and other best practices.

- The City of Kent's Source Water Protection Plan identified as potential concerns several uncapped or active landfills and emphasized the need for outreach and land use controls.

- The City of Cuyahoga Falls is in the process of finalizing their source water protection plan. Unlike Portage County and Kent, Cuyahoga Falls owns a substantial portion of their source water protection area, which is largely contained within Water Works Park.

- In addition to these major public water supplies, there are numerous smaller supplies providing water to individual developments. Reviews of the source water assessments indicate that in several cases, potential contamination sources have been identified, but not necessarily verified. The Ohio American Water Co., serving the Beechcrest allotment at Route 43 in Brimfield, produces approximately 108,000 gallons per day and has shown evidence of human impact, with toluene appearing in the samples.

Table 4a-15 Summary of Source Water Plans/Reports for Major Public Water Supplies (Surface and Groundwater)

Water Supply	Year of Assessment/ Plan	Type of water supply	Gallons/ people served	Soil	Potential contaminant sources	Groundwater Quality
Portage Co. Brimfield	2002	3 wells - 2 in buried valley sediment; - 1 in bedrock	632,000 510	Muck to silty loams, low permeability	Asphalt plants; above-ground storage tanks; natural gas lines; oil/gas wells; golf course; transportation;	No evidence of chemical contamination
Kent	1993	3 wells 1 (Breakneck Creek wellfield) recharged by Breakneck Creek and surface reservoir Buried valley sediment (Sand, gravel, till) flanked by sandstone	3.3-3.7 mgd		Oil & gas wells Underground storage tanks Commercial/industrial Automobile garage Breakneck Creek contamination, Ravenna WWTP Abandoned landfill ("Old Kent Dump" – on opposite side of groundwater divide), salvage yard Powder Mill site: landfill	The Kent Wellfield Susceptibility Assessment indicated no evidence in finished water of contamination.
Ravenna	2002	Surface water – kettle lake in buried valley complex	1.75 mgd 15,000	Poorly-drained Canfield to well-drained Chili	Oil and gas wells; Transportation Underground storage tanks Marina, no gas boats Gas station/automobile dealership Cemeteries; golf course Residential developments Agricultural uses; Randolph WWTP Randolph salt storage Note: Lake Hodgson rarely draws water from as far away as Congress Lake	No violations of finished water Some pesticides detected at low levels
Cuyahoga Falls	2002	Floodplain, sand/gravel	6-9.7 mgd 49,000	Silty loams	Underground storage tanks Injection well; transportation; pond Dumps/landfills; emergency response site; park (chemicals); sewer line, water treatment plant	No evidence of chemical contamination in finished water

4a-iv.1 - Land Cover, Urban Areas, and Impervious Surfaces

Land Cover: Background

Background

One of the most important elements of the watershed plan is balancing resource protection and management with the need of the residents, businesses, and communities in the watershed to use the land. Wetlands, woods, and other areas of native vegetation contribute to the health of water resources and watersheds. Development and agriculture are a necessary part of human settlement, but they alter hydrology and contribute non-point source pollution. Land cover information is used in:

- Assessing intactness of or impacts to stream channels, riparian areas (streamside habitats) and wetlands,
- Assessing impervious cover in a watershed (watersheds with greater than 10 percent impervious surface tend to show impacts, unless there are well-functioning riparian areas to mitigate impacts); and
- Modeling the amount and composition of runoff from disturbed land and impervious surfaces (surfaces such as pavement or roofs that do not allow rain water to be absorbed into the ground).

In identifying how land is being used, resource managers use land cover and land use mapping, alone or in combination. Each data set has advantages and disadvantages.

- Land cover mapping generally uses aerial photographs or satellite imagery to identify physical features on the landscape. Such mapping often cannot distinguish between uses that appear similar from the air or space. For instance, it can be difficult to distinguish between small commercial buildings or houses, offices or apartment buildings. In some cases, neighborhoods with mature trees may be mapped as woods, based on the visual characteristics of the tree cover. Land cover interpretation maps the physical footprint of structures, pavement, and types of vegetation on the ground.
- Land use mapping indicates how the land is being used. Uses that are grouped by function may have different land cover and effects on the watershed. For instance, with land use data, undeveloped land is often described as “vacant,” which does not allow distinctions to be made between wetlands, woods, or old fields. Land use mapping can represent the physical footprint, as viewed from aerial photographs or satellite imagery, or the parcel use designation.

Several sources of land cover or land use mapping are available, including Ohio EPA, National Oceanographic and Atmospheric Administration Coastal Change Analysis Program (CCAP), Akron Metropolitan Area Transportation Study (AMATS), and County parcel land use data, all from the period of 2005-2006. A review of the available mapping indicated that even with pixels of 30 m (approximately 100 feet) on each side, the CCAP satellite-based mapping provided a high degree of accuracy in mapping neighborhoods, useful analysis of impervious surfaces (the surfaces that prevent rainwater from filtering into the ground), and a wide enough variety of land cover types to allow further analyses.

The CCAP mapping identifies developed land in terms of percent imperviousness:

- High intensity is 80-100% impervious, corresponding to areas with large areas of parking lot or roof, e.g., densely developed urban centers, large commercial, industrial, multi-family, or institutional uses.

- Medium intensity is 50-80% impervious. This often corresponds to some larger roads, many smaller commercial uses, and many residential uses.

- Low intensity is 20-50% impervious, generally low-density residential uses, smaller roads

- Developed open space is 0-20 percent impervious, often large expanses of turf.

For ease of analysis, average values of impervious cover were applied to determine the percent of impervious cover in each subwatershed (i.e., high intensity – 90%, medium intensity – 65%, low intensity – 35%, and open space – 10%).

Findings:
Land Cover, Middle Cuyahoga River Watershed

Findings: Middle Cuyahoga River Watershed Land Cover Mapping

Figure 4a-22 and Table 4a-16 summarize the 2006 CCAP land cover mapping, allowing the following observations:

- Across the watershed, the most prevalent land cover types are low intensity developed areas, pasture/hay, and deciduous forest. Approximately one-third of the watershed is in developed uses. Most of the developed land occurring in the northern portion of the watershed. This area includes older neighborhoods and downtown areas in Cuyahoga Falls, Munroe Falls, Stow, Kent, and Ravenna. As noted previously, the Fish Creek and Plum Creek subwatersheds have undergone considerable development recently.

- The watershed as a whole is approximately 13 percent impervious. Imperviousness ranges from just under 3 percent in the rural, agricultural Potter Creek subwatershed to 25 percent in the developed subwatershed along the mainstem. The urbanized areas within the subwatersheds would have a much higher degree of imperviousness.

- The Main Stem and Fish Creek subwatersheds are predominantly low intensity developed uses with associated developed open space, and deciduous forest. These two subwatersheds have the highest percent imperviousness, 28 and 20 percent, respectively.

- Reflecting its developing nature, the Plum Creek subwatershed has a similar amounts of agricultural, low intensity, and developed open space uses, but considerably less woods.

- Breakneck Creek is a mix of agricultural land and woods, with a smaller proportion of developed land. The watershed as a whole is approximately 10 percent impervious, but the northern portion in intensely urbanized, with much higher imperviousness, and the southern portion is much less developed.

- Potter Creek is primarily agricultural, with nearly 25 percent in woods or wetlands.

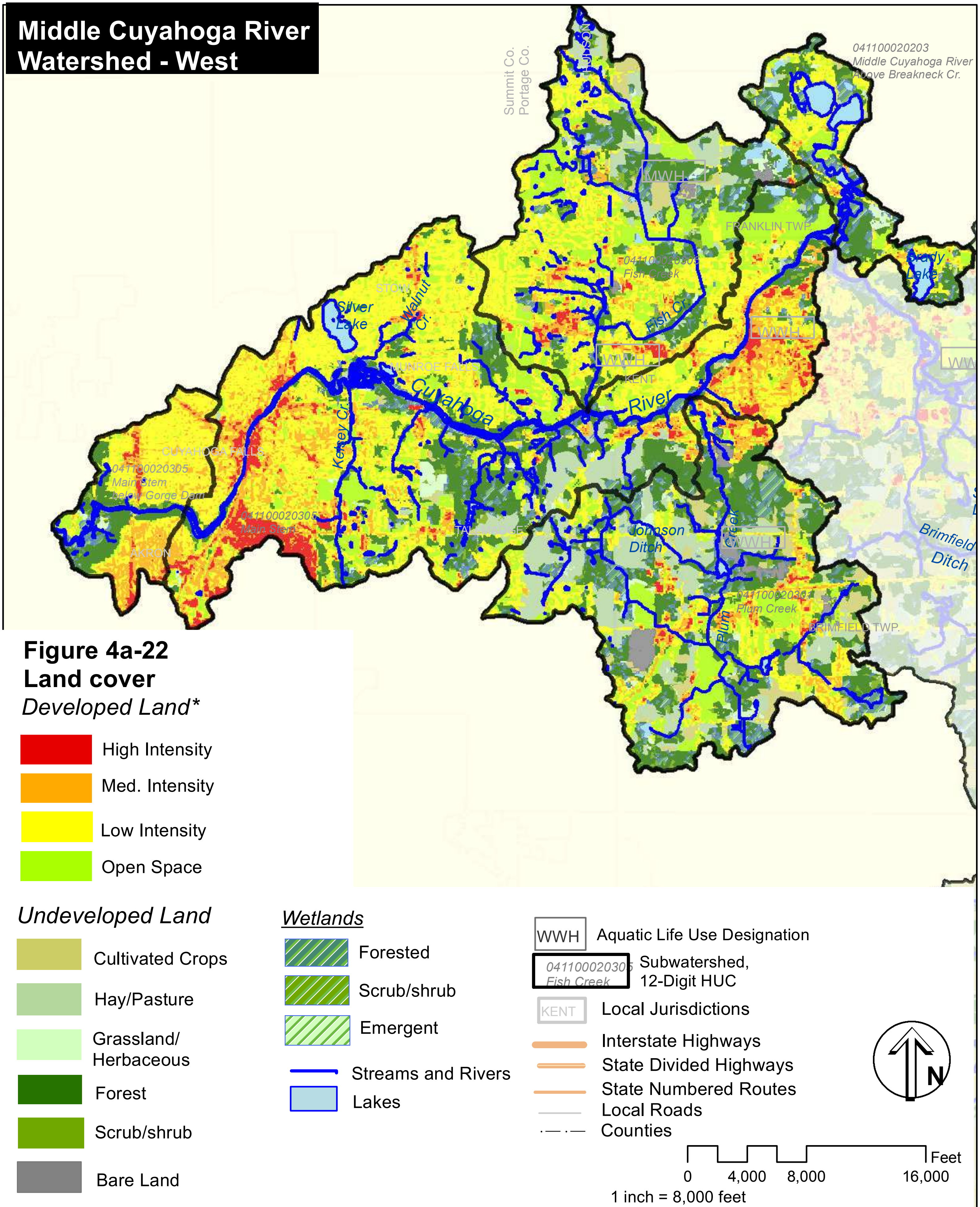
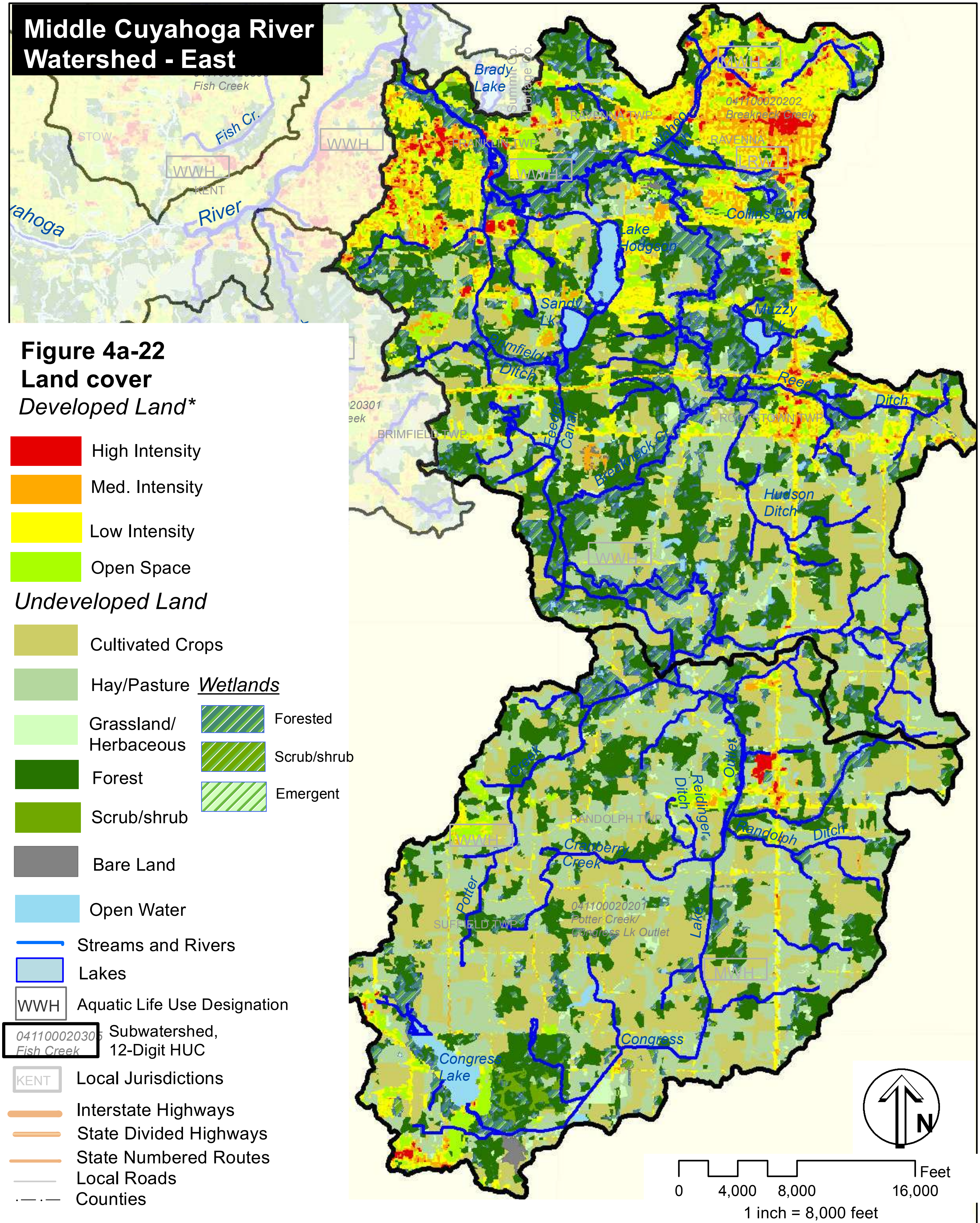


Figure 4a-22
Land cover

**Developed land intensity based on imperviousness (e.g. buildings, parking lots, roofs): High - 80-100% (e.g., commercial/industrial, large parking lots); Medium - 51-79% ; Low - 21-50% Open Space - <20% impervious.*

Sources: NEFCO 2010, Summit, Portage, and Stark Co. GIS mapping 2009-2010; NOAA Coastal Change Analysis Program Land Cover Mapping 2006.



*Developed land intensity based on imperviousness (e.g. buildings, parking lots, roofs): High - 80-100% (e.g., commercial/industrial, large parking lots); Medium - 51-79% ; Low - 21-50% Open Space - <20% impervious.

Sources: NEFCO 2010, Summit, Portage, and Stark Co. GIS mapping 2009-2010; NOAA Coastal Change Analysis Program Land Cover Mapping 2006.

Table 4a-16

Land Cover and Imperviousness by Subwatershed

Land Cover	Main Stem Middle Cuyahoga		Fish Creek		Plum Creek		Breakneck Creek		Potter Creek		Total Watershed	
Developed by imperviousness	**Acres**	**%**	**acres**	**%**	**acres**	**%**	**acres**	**%**	**acres**	**%**	**acres**	**%**
High intensity (90% impervious)	873	4.2%	113	1.2%	121	1.3%	406	1.3%	82	0.4%	1,595	1.9%
Medium intensity (65% imperv.)	2,396	12.0%	366	4.0%	479	5.4%	1,760	5.7%	204	0.9%	5,206	6.2%
Low intensity (35% impervious)	6,214	36.2%	1,987	42.1%	1,186	15.9%	4,042	13.5%	986	4.4%	14,415	17.2%
Open space (10% impervious)	2,571	14.1%	1,629	22.9%	1,098	11.6%	1,767	5.5%	538	2.4%	7,602	9.1%
Cultivated Land	82	0.6%	244	2.5%	533	6.3%	3,962	14.2%	6,710	30.3%	11,531	13.8%
Pasture/Hay	573	4.5%	480	5.0%	1,410	18.1%	4,354	18.0%	6,729	31.9%	13,546	16.2%
Grassland	216	1.1%	72	0.8%	153	1.7%	494	1.6%	394	1.7%	1,330	1.6%
Deciduous Forest	3,013	17.9%	1,246	13.9%	2,033	24.5%	7,490	25.6%	3,741	17.0%	17,524	21.0%
Evergreen Forest	37	0.2%	7	0.1%	29	0.3%	122	0.4%	235	1.0%	430	0.5%
Mixed Forest	15	0.1%	5	0.0%	3	0.0%	23	0.1%	24	0.1%	69	0.1%
Scrub/Shrub	154	0.8%	108	1.2%	177	1.8%	195	0.7%	169	0.7%	804	1.0%
Forested Wetland	1,016	5.1%	367	4.4%	777	8.6%	3,404	11.0%	1,543	7.0%	7,106	8.5%
Scrub/Shrub Wetland		0.0%		0.0%		0.0%	108	0.3%	109	0.5%	217	0.3%
Emergent Wetland	69	0.3%	16	0.2%		0.0%	36	0.1%	13	0.1%	135	0.2%
Bare Land	2	0.1%	64	0.7%	239	2.4%	31	0.1%	58	0.3%	394	0.5%
Water	581	2.8%	96	1.0%	54	0.6%	608	1.9%	322	1.4%	1,661	2.0%
total area (acres)	17,813		6,801		8,292		28,801		21,857		83,565	
Total area (sq. miles)	28		11		13		45		34		131	
Impervious	4,776	25.7%	1,198	20.7%	945	11.3%	3,101	10.1%	605	2.7%	10,625	12.7%

4a-iv.1 Land Use/Land Cover
-a Urban

The urban areas are apparent on Figure 4a-22 as the concentrations of high, medium, and low-density development. The northern one-third of the watershed is the most heavily developed. This portion of the watershed contains the more densely settled communities of eastern Cuyahoga Falls, Munroe Falls, Stow, portions of Tallmadge, Kent, and the city of Ravenna. Some of these, like Cuyahoga Falls, Munroe Falls, Kent, and Ravenna, are historic centers of development. Others, like portions of Tallmadge, Stow, and parts of Munroe Falls, developed primarily in the latter 1900s. Outside the heavily developed area in the north, Brimfield, Rootstown, Randolph, and Hartville have varying degrees of development at their centers. Whereas Stow experienced substantial development between 1990 and 2010, more intense development began in Brimfield since 2000.

4a-iv.1 Land Use/Land Cover
-a.i Impervious surfaces

In four of the five subwatersheds, imperviousness ranges from 10 to 26 percent for the subwatersheds, with urban areas at much higher levels. Increased imperviousness generates additional runoff and loading to the stream channels, raising the risk of vertical instability, stream degradation, unstable banks, increased flooding problems, and degradation of habitat and water quality. The increased imperviousness also generates additional contaminants that enter the water courses as non-point source pollution in runoff. When watersheds reach an imperviousness level of 10 percent, degradation can be observed in stream systems. When the level of imperviousness reaches 20 percent, degradation is likely, although intact buffer systems can help reduce the impacts.

4a-iv.1 Land Use
- a.ii Home Sewage Treatment Systems (HSTS)

The presence of sewer service is of interest in watershed management because

1) Failing, inadequately designed, or discharging home sewage treatment systems are a source of nutrients and pathogens to surface and groundwater; and

2) The availability of sewer service, especially in areas with soil limitations for home sewage treatment systems, tends to attract and focus development.

Figure 4a-23 shows the areas in the watershed that are served by sewers. Most of the Summit County portion of the watershed has sewer service. In Portage County, Kent, Ravenna, Brimfield, and a portion of Randolph Township have or are anticipated to get sewer service. Even though townships do not often provide sewer service, Brimfield has access to systems from adjoining communities through Joint Economic Development Districts. Not all properties within the sewered areas are connected to the sewer system. However, it is expected that over time, as home sewage treatment systems fail, more properties will be connected to sewer service where it is available.

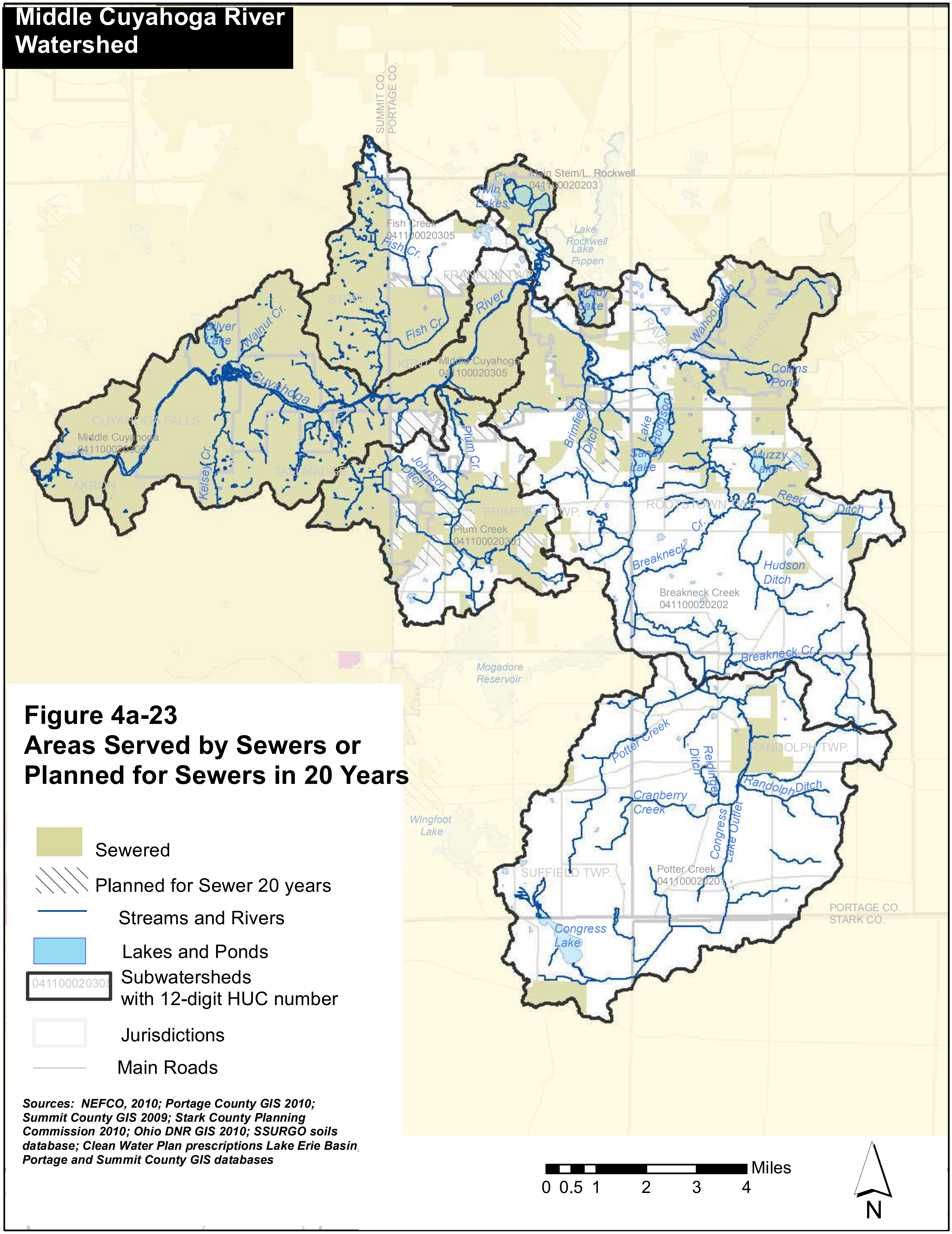


Figure 4a-23
Areas Served by Sewers or Planned for Sewers in 20 Years

Sources: NEFCO, 2010; Portage County GIS 2010; Summit County GIS 2009; Stark County Planning Commission 2010; Ohio DNR GIS 2010; SSURGO soils database; Clean Water Plan prescriptions Lake Erie Basin, Portage and Summit County GIS databases

As shown in Figure 4a-23, the availability of sewer service versus HSTS is as follows in the watershed.

- The main stem subwatershed is largely served by sewer systems.
- About three-fourths of the Fish Creek and Plum Creek subwatersheds is or is anticipated to be served by sewers.
- Sewer service in the Breakneck Creek subwatershed is available near Kent, in Brimfield, in the vicinity of Ravenna, and near Lake Hodgson and Muzzy Lake.
- In the Potter Creek subwatershed, sewer service is provided only at Hartville and the center of Randolph, where failing septic systems necessitated installation of a small wastewater treatment plant.

4a-iv 1 Land Use/Land Cover
-b Forest

As shown in Table 4a-16, forest or forested wetland ranges from 17 percent to 37 percent. Surprisingly, the smallest percentage of forest is not the urbanized Main Stem subwatershed, but the Fish Creek subwatershed. Portions of the Main Stem subwatershed in Summit County remain undeveloped, and MetroParks, Serving Summit County holds a large parcels of wooded land in the Munroe Falls, Gorge, and Cascade Valley MetroParks.

Portage County developed a watershed study for the county in 2004, which included mapping of forested land and wetlands, and analysis of relative importance of protecting various resources. The Portage County Watershed Study identified the wooded wetlands along Breakneck Creek as high importance for watershed functions.

4a-iv Land Use
-1c Agricultural Uses

Agricultural uses and practices greatly influence the water quality of the streams and lakes in the watershed. Agricultural fields are often sources of nutrients and sediment in runoff, and the amount of each that enters streams depends on factors such as the crops grown, tillage practices, cover used, buffers, and whether livestock have direct access to streams.

NRCS staff in Portage County, where most of the watershed agricultural land is, noted that they did not have an inventory of all practices conducted by farmers but were able to provide the following comments and estimates based on observations:

- The primary crop types are a corn-bean-wheat rotation, and use as hayland in rotation with corn. Tillage practices used are approximately 10 percent conventional, 50 percent conservation, and 40 percent no-till. (Conventional tillage involves breaking up and inverting soil prior to planting. Conservation tillage practices leave crop residue on the ground. No-till practices are a form of conservation tillage, planting directly into the residue.)
- Most farm fields in the watershed are 10-25 acres.

- Chemical application includes spring herbicides, fertilization at planting. Some producers apply herbicides in the summer and some side dress with nitrogen for corn.

- Producers in Portage County are not using irrigation practices.

- Farmers are using best management practices, such as grassed buffer strips, to varying degrees.

- Most (90 percent) farmers with livestock allow unrestricted access to streams. Livestock operations are found in all subwatersheds to varying degrees. Even the more urbanized subwatersheds have one or two farms with livestock.

The use of drainage tiles has also been observed in some of the fields.

A comparison of watershed agricultural data with Agricultural Census Data for 2007, (Table 4a-17) indicates that Portage and Stark Counties had larger average/median farm sizes than Summit County, with average sizes of approximately 100 acres and median farm sizes of approximately 35 acres. In all three counties, over half of the farms were under 50 acres. (Note: according to Portage Soil and Water Conservation District staff, it is difficult to assess how many acres are included in farms at any time, because lease arrangements change, and fields may be taken out crops for a period of time.) Stark County is much more heavily agricultural than Portage and Summit. Because the Potter Creek subwatershed includes only a small portion of Stark County, inventoried animals from Stark County were not included in estimates.

One farm in Summit County has been noted while photographing streams. The portion of Stark County in the watershed is dominated by Congress Lake and its associated development, the Quail Hollow State Park, and muck farms being used to grow tomatoes.

4a-iv.2 Protected Lands - Parks, Large Parcels

Protected Lands: Background

Background

Lands that are protected from development can help protect resources by providing a vegetated buffer and intact habitat. Corridors of protected lands (e.g., along streams) are especially valuable, as they provide space for migration along natural wildlife corridors. Corridors can also be used for hike-bike trails.

It should be noted that simply because a parcel is preserved as a park does not necessarily mean that the stream is protected, as the landscape within parks can be (and often is) altered dramatically for ease of maintenance, recreational uses, and to provide the unobstructed views to which park visitors are often accustomed.

However, even where riparian landscapes have been altered, streams in public parks or other conservation lands present very good opportunities for demonstration projects or improvement. They often have substantial visibility, and they allow restoration of large areas, which will not be used for private development. Even large privately owned parcels, or those held by homeowners' associations, may provide good opportunities for restoration or preservation, if the

Table 4a-17 Agriculture in Subwatersheds Compared with Census of Agriculture by County

	Portage County	Summit County	Stark County	Main Stem ag (percent of Summit+ Portage Counties)	Fish Creek ag (percent of Portage + Summit)	Plum Creek ag (Percent of Portage + Summit)	Breakneck Cr. ag (Percent of Portage Co.)	Potter Cr. ag (Percent of Portage Co.)
Acres in farms/ agricultural uses	82,759	15,166	138,061	0.7%	0.7%	2.0%	10.0%	16.2%
Average size farm (ac)	96	45	106					
Median size farm (ac)	38	15	35					
				Estimated Livestock/Poultry based on % of County Ag. Land in Subwatershed				
Cattle and calves	7,971	1,199	26,824	61	68	182	801	1294
Beef	2,215	*	3,707				223	360
Dairy	1,834	*	9,732				184	298
Hogs and Pigs	524	*	5,871	4	4	10	53	85
Sheep and lambs	643	98	1,582	5	5	15	65	104
Chickens								
Layers	2,189	3,262	4,081	36	40	108	220	355
Broilers sold	360	421	22,089,471	5	6	15	36	58

*Inventory not reported due to small number of farms in county and confidentiality requirements.

landowner is willing. Easements held by a third party can help ensure that the restored or protected areas remain undisturbed. Developing and implementing long-term management practices for large parcels in single ownership is easier and probably more effective that many small parcels, as management measures or easements can be consistently developed and applied. Existing parks and conservation lands can serve as the nuclei of larger, connected habitat areas or corridors.

A number of sources were consulted to map parks and large parcels:

- AMATS land use data
- County planning/GIS Departments
- Ohio DNR GIS database
- Land use mapping was queried for public, institutional, and recreation/conservation lands

In addition, some of the watershed communities have instituted riparian setbacks in their development codes, requiring that development or disturbance be set back from streams, wetlands, or floodplains. Setbacks can be an effective tool to protect long stretches of streambank from encroachment.

Findings:
Parks and Conservation

Findings: Middle Cuyahoga River Parks, Conservation, and Large Parcels

As shown on Figure 4a-24, substantial amounts of land along streams are held as parks, conservation lands, or belong to owners of large parcels. These provide:

- A good start to protecting significant stream corridors and providing passive recreational opportunities along streams and rivers through establishment of connected greenways;
- Opportunities to restore portions of stream bank that have been altered;
- Recreational, aesthetic, and transportation (e.g., bike-hike trails) resources for local communities and counties.

Large portions of the margin of the river are protected as parks and bike-hike trails.

- Conservation lands in the watershed include Triangle Bog and Kent Bog nature preserves and the Jesse Smith conservation land in Kent.

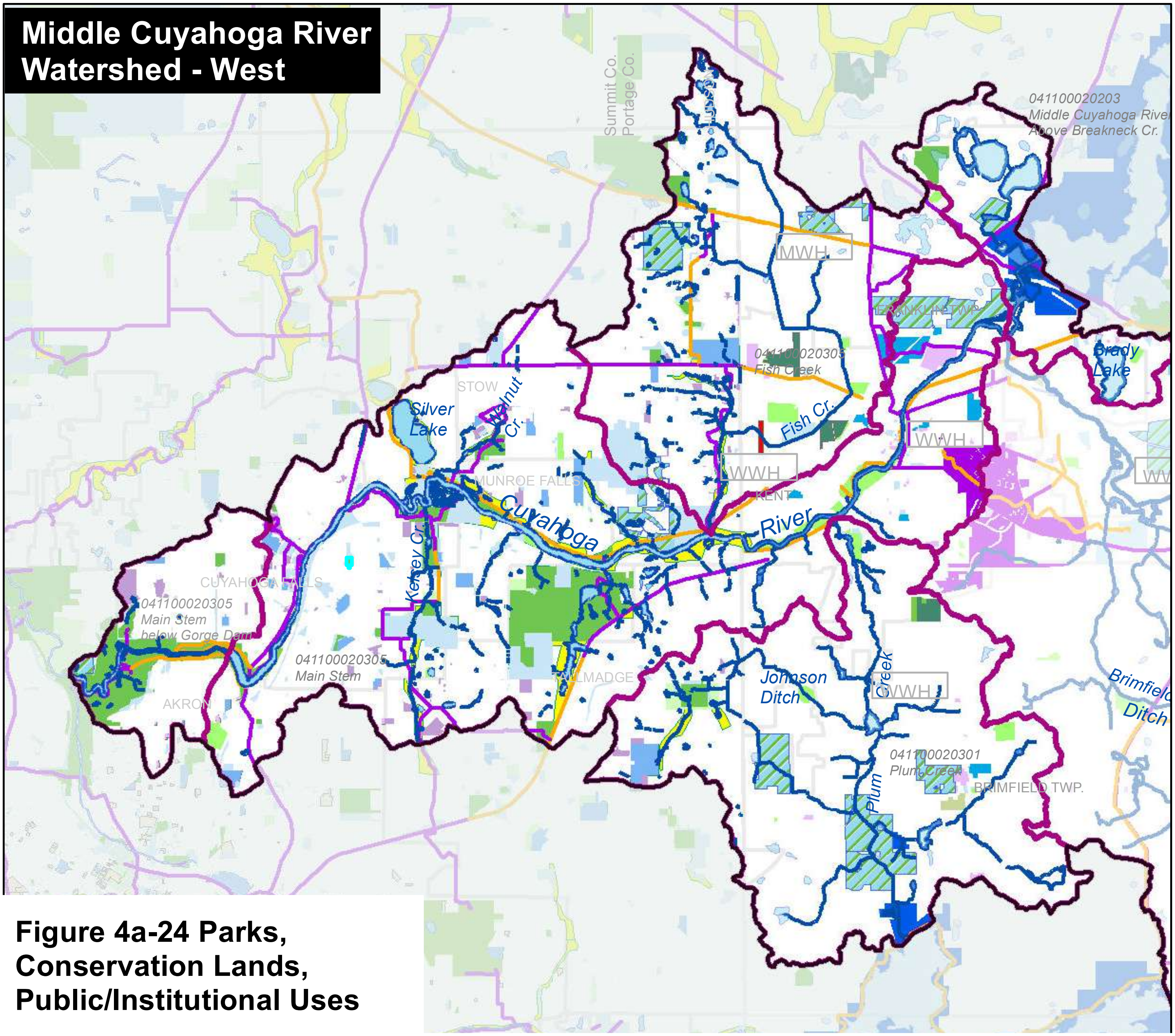


Figure 4a-24 Parks, Conservation Lands, Public/Institutional Uses

- Municipal/Township Parks, Ballfields
- Park district/state park
- Deed Restrictions, Easements, Limited Dev.
- Nature preserve
- Agricultural
- Riparian, Reservoir Protected lakeshore, WRRSP
- Public land
- Greenway
- Wetland reserve program
- Elementary/Secondary School
- University
- Other institutional uses
- Golf Course
- Hiking or bike-hike trail: Existing, Proposed
- Streams and Rivers
- Lakes
- WWH Aquatic Life Use Designation
- 041100020303 Fish Creek Subwatershed, 12-Digit HUC
- KENT Local Jurisdictions
- Interstate Highways
- State Divided Highways
- State Numbered Routes
- Local Roads
- Counties

N

0 4,000 8,000 16,000 Feet
1 inch = 8,000 feet

Sources: NEFCO 2010, Summit, Portage, and Stark Co. GIS 2009-2010; Ohio DNR GIS base map; 2011.

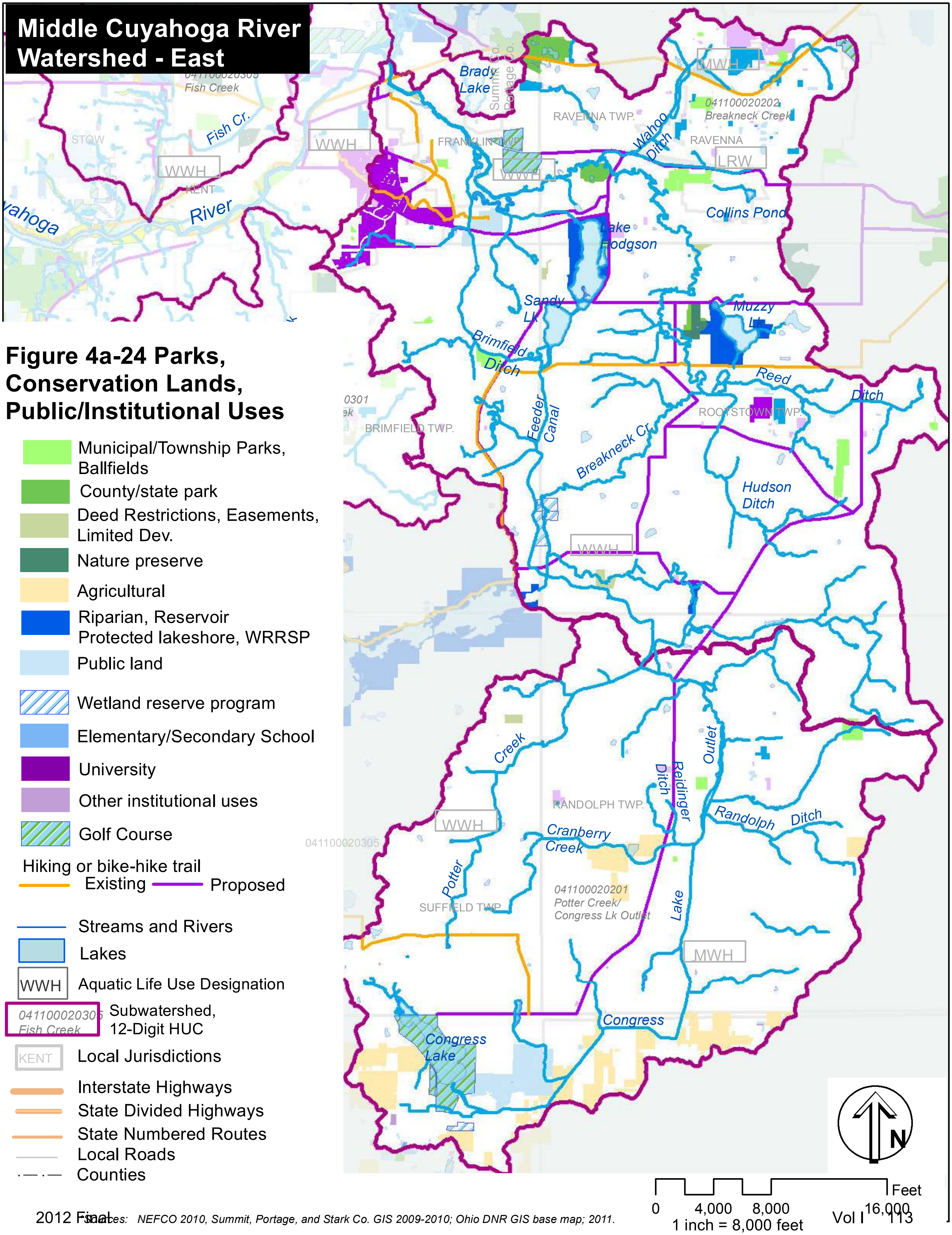


Figure 4a-24 Parks, Conservation Lands, Public/Institutional Uses

Sources: NEFCO 2010, Summit, Portage, and Stark Co. GIS 2009-2010; Ohio DNR GIS base map; 2011.

- MetroParks, Serving Summit County has three parks in the watershed, Munroe Falls Park, Cascade Valley (at the confluence with the Little Cuyahoga River), and the Gorge MetroPark. Quail Hollow State Park protects wetlands in Stark County. Substantial areas of all these parks are left undisturbed.

- Portage Park District owns parcels at Towners Woods and Breakneck Creek Preserve and anticipates encouraging passive recreation only.

- The City of Kent maintains a string of City parks and a lengthy hiking (or bike-hike) trail along the river.

- In Munroe Falls, the immediate vicinity of the river on the north side is unlikely to be developed due to steep slopes, the lack of infrastructure, riparian setbacks, and ownership by Ohio Edison and CSX railroad.

- The City of Cuyahoga Falls has several parks, including Water Works Park, along the river.

- All the major tributaries have at least one park along them and often have more than one.

- In addition, there are numerous parcels owned by homeowners' associations, institutions, and public owners. Many of these have been altered but present opportunities for restoration, enhancement, preservation, and stewardship.

Communities with riparian setbacks include Tallmadge, Munroe Falls, Kent, Ravenna, and Brimfield.

Table 4a-18 summarizes parks and conservation land held in total or as easements. These amounts are approximate and represent data sources from several years. They do not necessarily include publicly owned land that can also be used for conservation. County park districts, conservancies, and several communities are actively acquiring land for conservation.

County and state parks represent large holdings in the three counties, but as noted above, local communities hold a considerable amount of land in parks and conservation/recreation areas. Conservancies like The Nature Conservancy and Western Reserve Land Conservancy have not been as active in this portion of northeast Ohio as some other areas, but they still have several holdings as easements or purchases. Some of the unique habitat areas may be good opportunities for land conservancy involvement in the future.

Table 4a-18
Parks and Conservation Land

	Acres				
Subwatershed	**Local Park**	**County/ State Park**	**Riparian/Wildlife/ Natural Area/ Reservoir**	**Easement**	**Comments**
Main Stem	411	1202	820		Local includes several city-owned parks along Cuyahoga River. County parks include Portage County Camp Spelman, which is partially in the Fish Creek subwatershed, and the MetroParks, Serving Summit County Cascade, Gorge, and Munroe Falls MetroParks metroparks The latter was recently expanded. Conservation includes City of Akron public water supply holdings. Conservancy holdings: TNC 33 acres Crystal Lake nature preserve; Western Reserve Land Conservancy 9 ac. easement, 44 acres north of Kent.
Fish Creek	412	61	99		Camp Spelman and Silver Creek Park (Stow) are partially in the watershed. Kent is acquiring a conservation loop around a portion of Fish Creek.
Plum Creek	195	22	231	24	Includes Cooperrider bog, Plum Creek Park (site of recent stream restoration), Tallmadge Jaycee park/wetland area, and Portage County wellfields
Breakneck Cr	295	350	671	185	Local includes Lake Hodgson access. Conservation includes Kent wellfields, Lake Hodgson, Muzzy Lake, Triangle Bog
Potter Cr.	49	703	267 farm conserv.	38	Quail Hollow State Park. Conservancy holdings 16 ac. Easement.

Sources: 2008 Parks Database, Portage County; 2010 and 2012 Summit, Stark, and Portage County tax databases; Summit County Parks database

4a-iv.3 Land Use, Status and Trends

Factors controlling the density of future development include zoning, degree of development within communities, access to the highway system, conservation lands, and access to sewer systems. Park and conservation lands have been discussed in Section iva-iv.2.

From 2000-2007, development in the watershed was occurring rapidly near the already developed centers of Stow, Tallmadge, Munroe Falls, and Kent. The areas in the immediate vicinity of these cities are approaching build-out, with limited large parcels available in the cities for new development. Newly developing areas focused near I-76, primarily in Brimfield, especially after establishing a Joint Economic Development District with Tallmadge for utilities, and also in Rootstown. These areas were growing rapidly due in part to accessibility of the interstate highway and sewer service. Figure 4a-25 shows numerous developments in progress in the Plum and Breakneck Creek subwatersheds when the photograph was taken in 2006.

Beginning in 2007-2008, a major economic downturn occurred, that was initially characterized by a slump in the housing market. At the time, many housing developments had received approvals but had not been fully constructed. As of summer, 2011, the housing market has not yet rebounded. There is a substantial backlog of foreclosed properties, as well, suggesting that the housing market may still not recover for some time to come.

However, assuming the housing market eventually recovers, the areas where development was occurring rapidly during the growth period are likely to see development pressures once again. Some of the approved subdivisions may be able to proceed, and the factors that made this area popular for development will remain in place– accessibility of sewer service, interstate highways, and employment centers.

Figure 4a-23, which shows areas served by sewer, helps to indicate the areas that are likely to experience development once development begins again in earnest.

- The Plum Creek watershed and portions of the Breakneck Creek watershed are likely to experience development pressure, because of ready access to sewers and highways.

- The sewers south of Kent and Ravenna go along the state numbered highways, Routes 43 and 44, which are already centers of development and are likely to continue as such.

The zoning tends to support continuation of current land use patterns.

- In Brimfield and Tallmadge, the area around Mogadore Road and Howe Ave. have been developing as industrial uses, and the area is zoned for continued industrial development.

- Portage and Stark county townships are largely zoned for low density residential use.

- Brimfield's comprehensive plan calls for the most intensive development in the vicinity of I-76 and north, which will continue to affect Plum Creek and Breakneck Creek subwatersheds. Likewise, Rootstown's zoning calls for development near Route 44 and I-76, continuing the current land use patterns.

Since large portions of the Plum Creek and Breakneck Creek subwatersheds in the growing areas are undeveloped, there is potential for substantial impacts from development and also the ability to manage the as-yet unrealized growth.

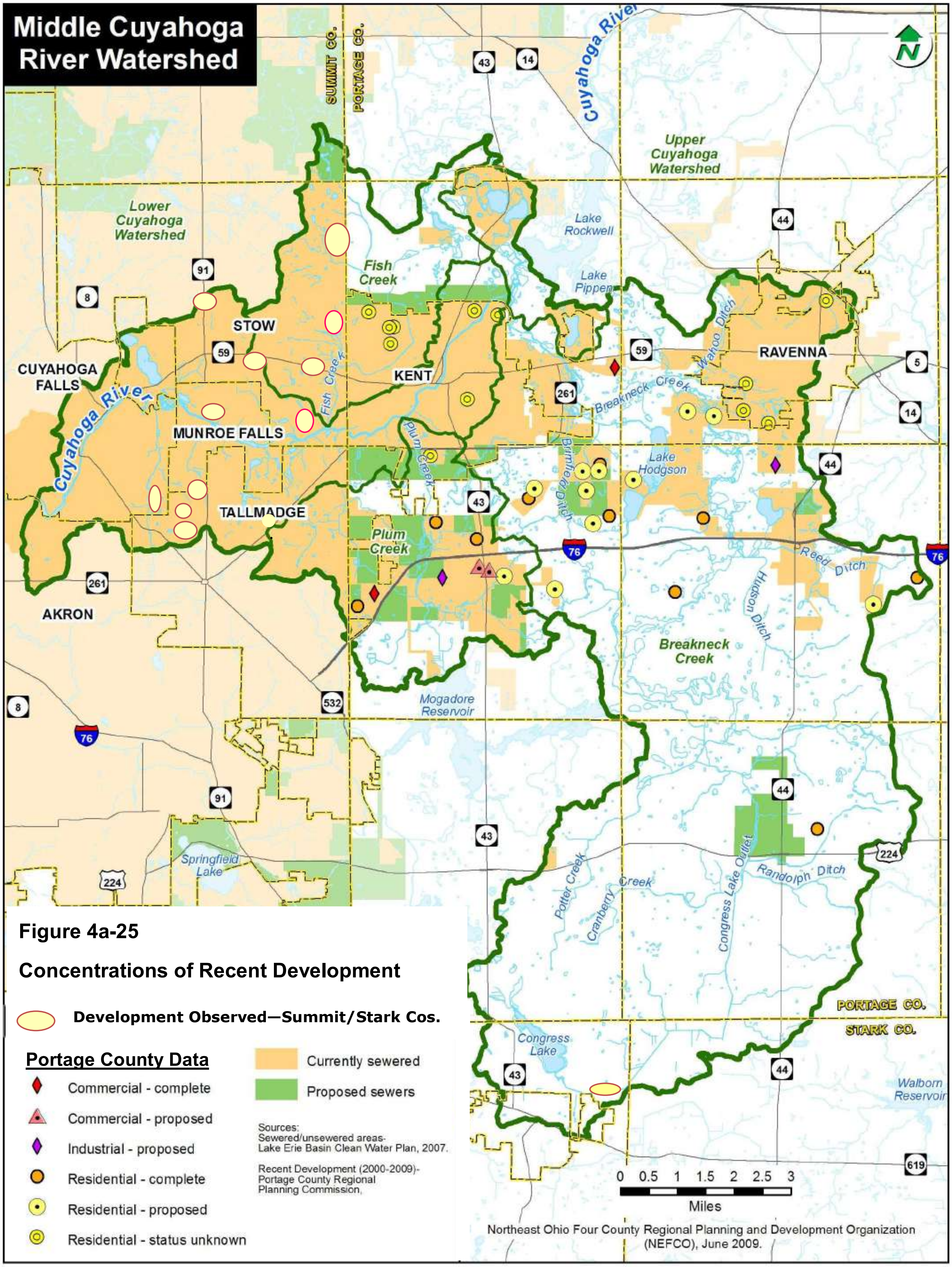


Figure 4a-25

Concentrations of Recent Development

4b. Cultural Resources

The Cuyahoga River and its surrounding landscape played a major role in the development of the region. The general layout of many communities in the region resulted from the benefits provided by the river, and many of these communities have historic centers. Because of the intensive use of the river and its tributaries, the historical uses were also very important in the alteration of the river and stream network. Finally, the location of historic and prehistoric resources is important in considering restoration and preservation opportunities and regional attractions. Riverside parks and hiking corridors can serve multiple purposes – linear transportation (bicycle/hiking) routes; recreation; conservation of important riparian vegetation; and providing access to and opportunities to appreciate the region's history and cultural resources. Historic riverfront cities offer the combined attractions of historic buildings and streetscapes and river access. These often present ideal locations for parks and festival locations, and provide economic opportunities.

This is not intended to be a complete inventory of all known historic and prehistoric sites. The intent of this section is to provide a historical context and highlight certain locally and regionally important features.

Many of the major roads in the watershed have been around for nearly 200 years, and isolated historic structures are still found along them. Many of the cities and villages also began over 150 years ago, and the centers of these communities often contain well-preserved historic buildings of various eras and styles, contributing to a sense of aesthetics and place.

The sandstone ledges over which the river flows created falls that became ideal sites for water-powered mills. These became centers of industrial development in the current cities of Kent, Munroe Falls, Cuyahoga Falls, and Akron. The dam in Kent is one of the remaining arch-weir dams from the early 1800s and was preserved during the restoration of the Cuyahoga River flow in Kent. Several historical mills still standing in Kent and visible from the river were developed because of the water-power available. The remaining dams in Cuyahoga Falls also reflect this history.

The Cuyahoga River was an important transportation route because of its location near the continental divide between the Lake Erie and Ohio River basins. Cleveland and Akron developed at the mouth of the river at Lake Erie, and Akron at the summit of the drainage divide, respectively. Portage and Summit Counties were both named for their locations on the watershed divide. Because the Cuyahoga River passes within 3 miles of the Tuscarawas River watershed, the Native Americans who were in the region before settlement developed a path to portage between the two basins, downstream of the confluence with the Little Cuyahoga River. The Portage is noted in various markers, statues, and road names a short distance downstream of the confluence with the Little Cuyahoga River.

During the 1820s, canals were dug connecting Lake Erie to the Ohio River, with the first segment being Akron to Cleveland. Subsequently, the Pennsylvania and Ohio canal was dug between the Cuyahoga River at Cascade Locks and the Beaver River in Pennsylvania, and the Feeder Canal was dug to provide water from Congress Lake, Sandy Lake, and Lake Hodgson (then Muddy Lake) to the P&O Canal. See Figure 4b-1. Throughout the region, the presence of the reliable, relatively fast transportation routes of the canals connected Ohio to other regions in the country and created a booming economy. Towns often developed at the locks. The developing rail system began out-competing the canals by the 1850s. By 1868, the P&O Canal