YELLOW CREEK
WATERSHED ACTION PLAN

Eastgate Regional
Council of Governments
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Serving Northeast Ohio since 1973

The Eastgate Regional Council of Governments is a multipurpose Regional Council of Governments for Ashtabula, Mahoning and Trumbull Counties, as established by Section 167.01 of the Ohio Revised Code. Eastgate is the agency designated or recognized to perform the following functions:

- Serve as the Metropolitan Planning Organization (MPO) in Mahoning and Trumbull Counties, with responsibility for the comprehensive, coordinated and continuous planning for highways, public transit and other transportation modes as defined in Moving Ahead for Progress in the 21st Century (MAP-21) legislation.
- Perform continuous water quality planning functions in cooperation with Ohio and U.S. EPA.
- Provide planning to meet air quality requirements under MAP-21 and the Clean Air Act Amendments of 1990.
- Administration of the Economic Development District Program.
- Administration of the Local Development District of the Appalachian Regional Commission.
- Administration of the State Capital Improvement Program for the District 6 Public Works Integrating Committee.
- Administer the area clearinghouse function, which includes providing local government with the opportunity to review a wide variety of local or state applications for federal funds.
- Administration of the regional Rideshare Program for Ashtabula, Mahoning and Trumbull Counties.
- Conduct demographic, economic and land use research.
- At General Policy Board direction, provide planning assistance to local governments that comprise the Eastgate planning area.
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LIST OF ACRONYMS

305(b)	Ohio EPA Water Quality Report
ACS	American Community Survey
AMD	Acid Mine Drainage
ARRA	American Recovery and Reinvestment Act
AWARE	Alliance for Watershed Action and Resource Education
CASTLO	Campbell Struthers Lowellville Community Improvement Corporation
CTIC	Conservation Technology Information Center
CWA	Clean Water Act
DNAP	Division of Natural Areas and Preserves
DO	Dissolved Oxygen
DSW	(Ohio EPA) Division of Surface Water
EAU	Ecological Assessment Unit
ER	(Ohio EPA) Emergency Response
FEMA	Federal Emergency Management Agency
FPA	Facility Planning Area
GIS	Geographic Information System
GPB	(Eastgate) General Policy Board
GPM	Gallons Per Minute
GWPP	Ground Water Pollution Potential
HSTS	Home Sewage Treatment System
HUC	Hydrologic Unit Code
IBI	Index of Biotic Integrity
ICI	Invertebrate Community Index
iLRC	interactive Local Report Card
IR	Integrated Report
MA	Management Agency
MIwb	Modified Index of well being
MOU	Memorandum of Understanding
MS4	Municipal Separate Storm Sewer Systems
NEDO	(Ohio EPA) Northeast District Office
NPDES	National Pollution Discharge Elimination System
NPS	Nonpoint Source Pollution
NRCS	Natural Resource Conservation Service
NTNC	Non-Transient Non-Community
NWI	National Wetland Inventory
OAC	Ohio Administrative Code
ODNR	Ohio Department of Natural Resources
OEPA	Ohio Environmental Protection Agency
ORAM	Ohio Rapid Assessment Method
ORC	Ohio Revised Code
OWI	Ohio Wetland Inventory
POTW	Publically Owned Treatment Works
PPM	Parts Per Million
QHEI	Qualitative Habitat Evaluation Index
RM	River Mile
SR	State Route
STEPL	Spreadsheet Tool for Estimating Pollutant Load
SWAP	Source Water Assessment Plan
SWAT	Storm Water Abatement Advisory Team
SWCD	Soil and Water Conservation District
SWMD	Solid Waste Management District
SWMP	Stormwater Management Plan
SWPP	Source Water Protection Plan
TNC	Transient Non-Community
USGS	United States Geological Society
WAU	Watershed Assessment Unit
WAP	Watershed Action Plan
WQMA	Water Quality Management Plan
WRLC	Western Reserve Land Conservancy
YSU	Youngstown State University

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Mahoning County District Board of Health
Mahoning County Engineers
Mahoning County Farm Bureau
Mahoning Soil and Water Conservation District
Mill Creek MetroParks
Natural Resource Conservation Service

I. INTRODUCTION

This document establishes the Watershed Action Plan (WAP) for the Yellow Creek Watershed, a sub watershed of the Mahoning River, is located in northeastern Columbiana County and eastern Mahoning County, as illustrated in ***Figure 1***. The goal of the WAP is to describe the watershed's characteristics and water quality, while addressing water quality impairments and habitat alterations within the watershed. The WAP will serve as a technical and educational document for both the watershed's governing agencies and citizens and will establish recommended goals for education and outreach opportunities, preservation/protection, restoration, and overall water quality improvement measures via increased data collection and model ordnances.

A. Defining the Yellow Creek Watershed

i. Yellow Creek Watershed: Overview

The Yellow Creek Watershed begins in northeast Columbiana County and expands north into eastern Mahoning County (***Figure 2***). The center of the watershed is located at 40°58'12.00"N, 80°36'36.00"W. The watershed is approximately 39.53 square miles and is broken down into two, 12-digit Hydrologic Unit Codes (HUC):

- Headwaters Yellow Creek
  - 12-digit HUC: 050301030805
  - Location: 40°55'48.00"N, 80°37'12.00"W.

- Burgess Run-Yellow Creek
  - 12-digit HUC: 050301030806
  - Location: 41° 0'36.00"N, 80°35'60.00"W

As a part of the greater Mahoning River Watershed, Yellow Creek incorporates several townships and municipalities (***Figure 3***):

- Columbiana County
  - Unity Township
  - Fairfield Township
  - City of Columbiana

- Mahoning County
  - Springfield Township
  - Beaver Township
  - Poland Township
  - Boardman Township
  - Village of New Middletown
  - Village of Poland
  - City of Struthers

Figure 1: Mahoning River Watershed

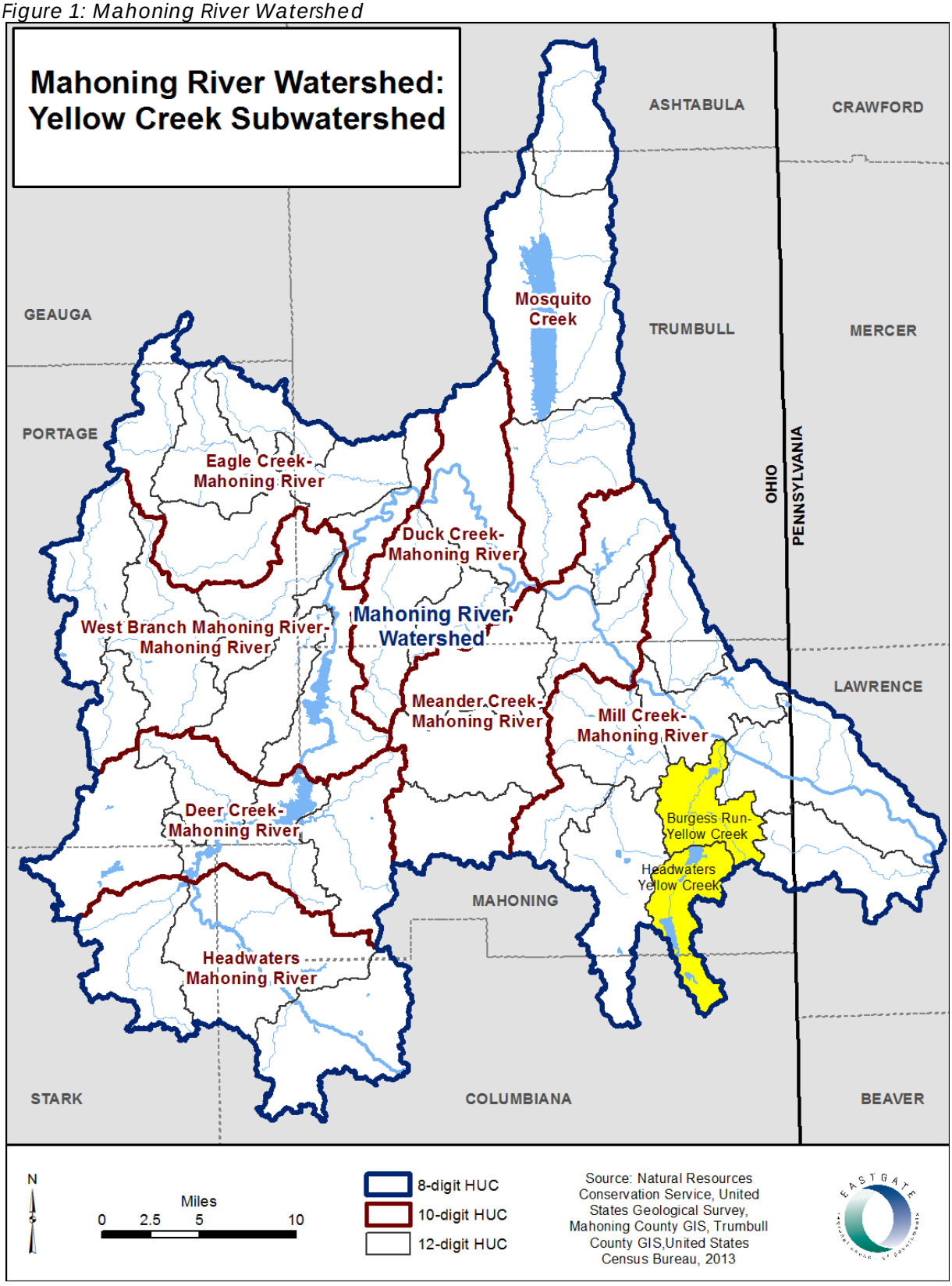


Figure 2: Location of the Yellow Creek Watershed

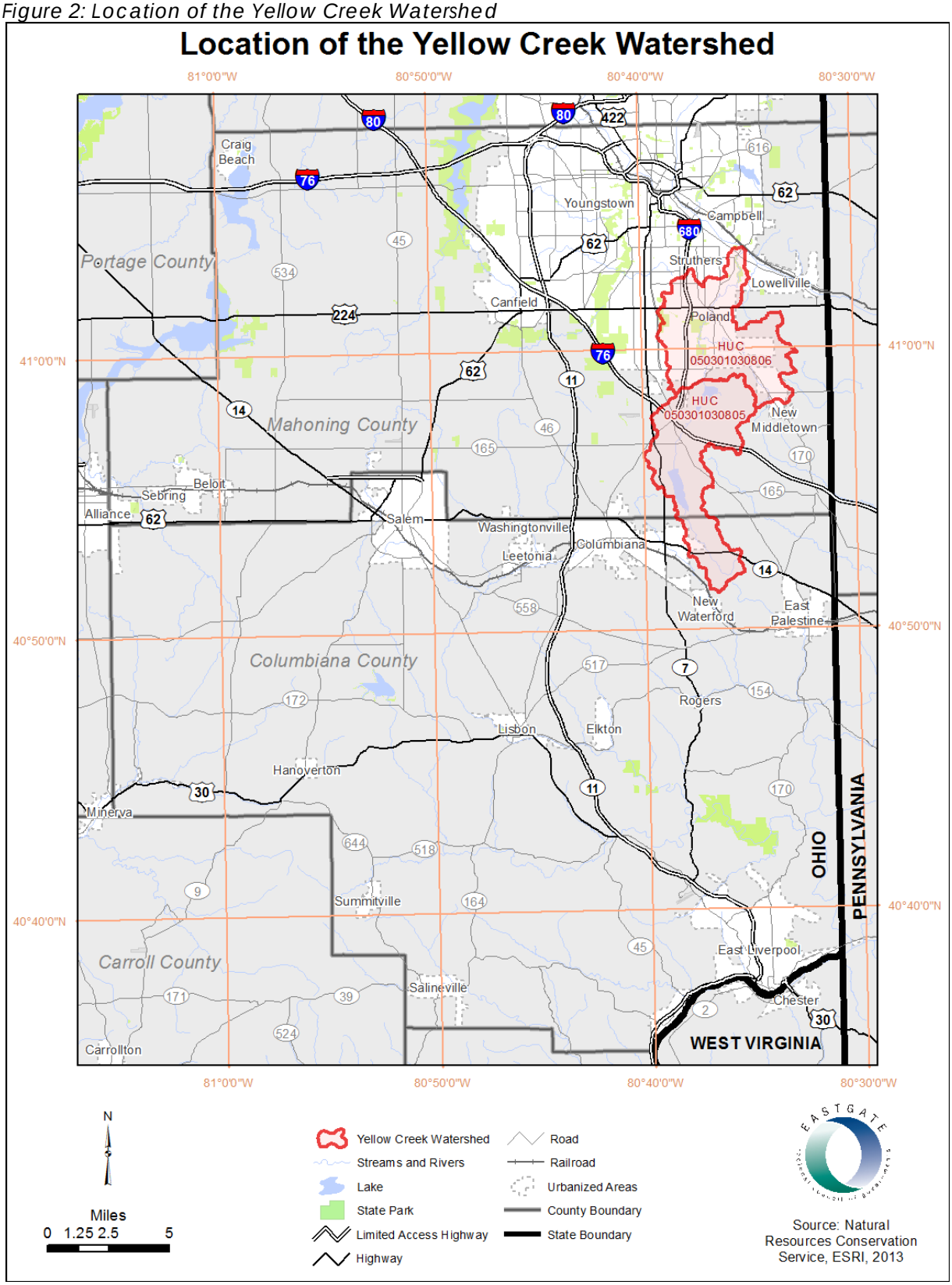
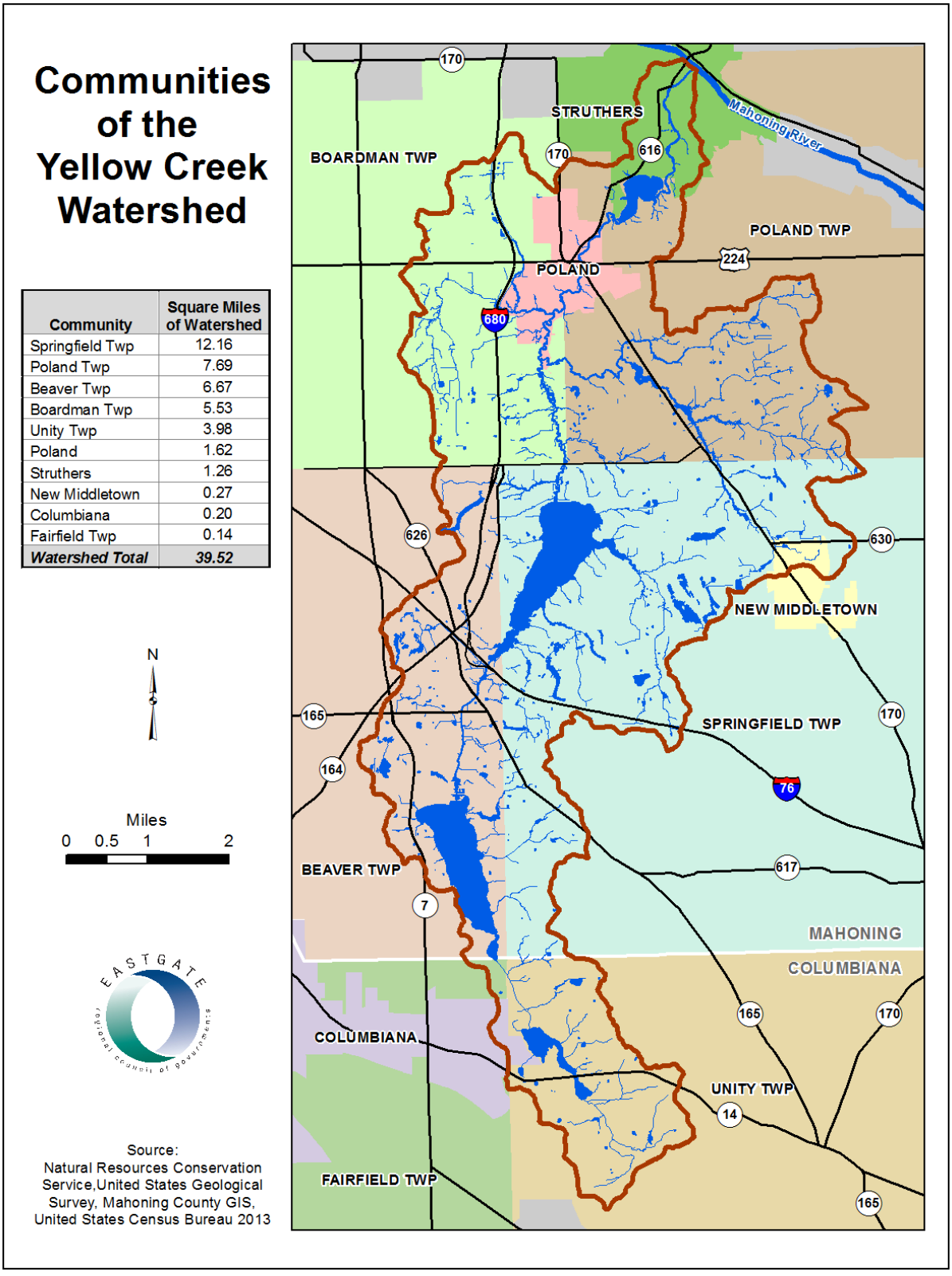


Figure 3: Communities of the Watershed



ii. Special Districts

Special districts within the Yellow Creek Watershed include four parks, nine school districts, four sanitary sewer districts, two soil and water agencies, one regional government agency, and more.

Parks

There are four parks located within the watershed managed by four separate entities. The watershed communities with park lands include the City of Struthers, Village of Poland and Boardman Township. All four parks are located within the urban, Burgess Run-Yellow Creek portion of the watershed (HUC 050301030806) and include, from north to south:

- Yellow Creek Park- 76 acre gorge; located within the City of Struthers and managed by Mill Creek MetroParks;
- Mauthe Park- 10 acres; located in the City of Struthers and managed by the city;
- Poland Municipal Forest (Poland Woods)- 244.5 acres; located in the Village of Poland and managed by the village; and
- Boardman Township Park (Boardman Park)- 227 acres; located in Boardman Township and managed by the township; http://www.boardmanpark.com.

Two of the four parks, Yellow Creek Park and Poland Woods, surround the mainstem of Yellow Creek; Boardman Park surrounds a tributary, McKays Run, to Yellow Creek. Both parks provide a good level of riparian protection.

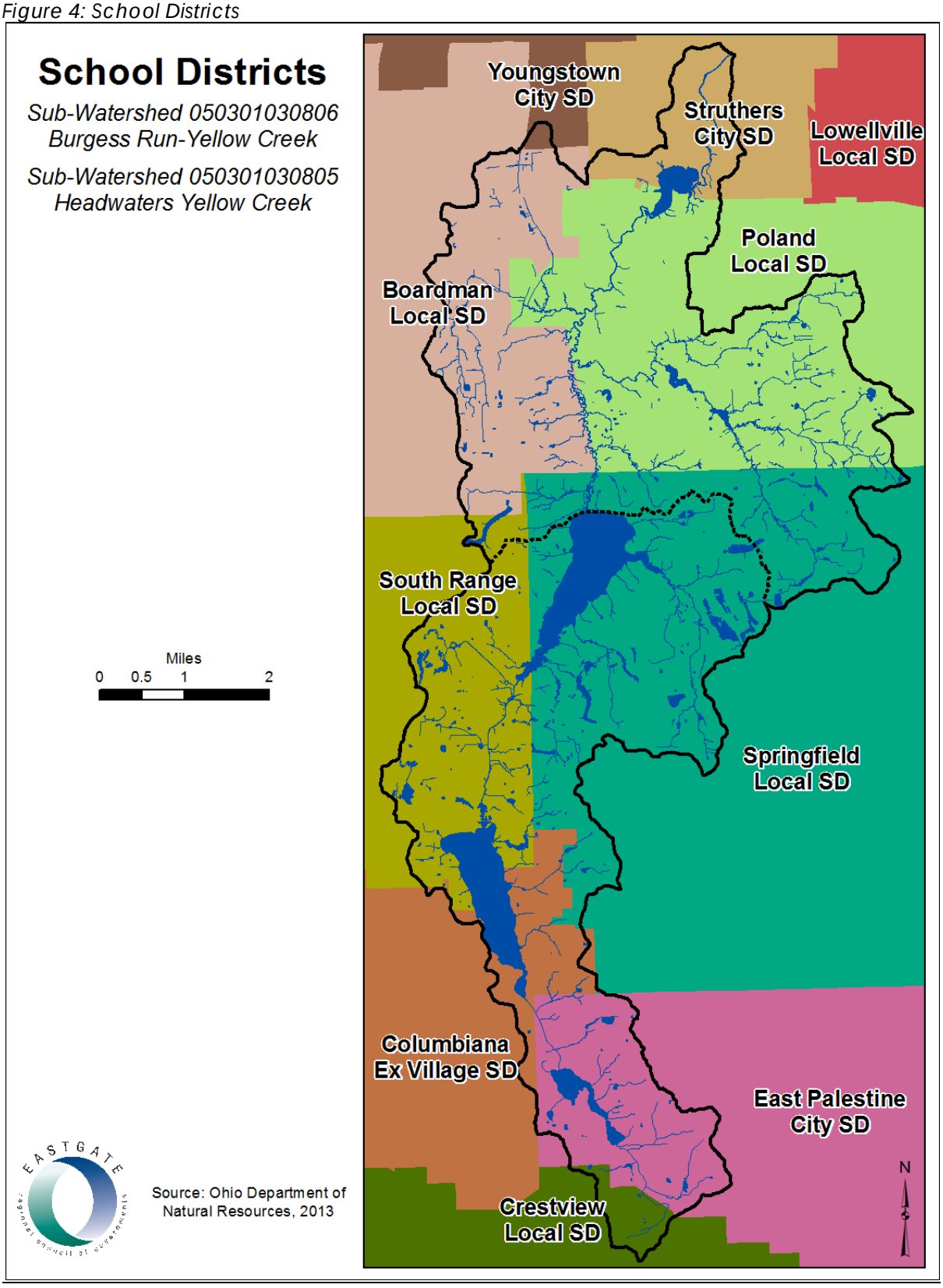
Schools

Children within the Yellow Creek Watershed are serviced by one of nine school districts. Enrollment data for the districts was obtained for the 2010-2011 school years (Ohio Department of Education, 2012) and is summarized in *Table 1* and illustrated in *Figure* 4.

Table 1: School Districts

School District	Total Enrollment 2010-2011	Elementary Schools	Middle Schools	High Schools
Struthers City	2,013	2	1	1
Youngstown City	6,088	7	3	6
Boardman Local	4,662	4	2	1
Poland Local	2,293	4	1	1
South Range Local	1,283	1	1	1
Springfield Local	1,116	1	1	1
East Palestine City	1,265	1	1	1
Columbiana Exempted Village	1,004	1	1	1
Crestview Local	1,246	1	1	1
Total	**20,970**	**22**	**12**	**14**

Figure 4: School Districts



Sanitary Sewer

Sanitary sewer is prevalent within the Burgess Run-Yellow Creek subwatershed and is sparsely available within the Headwaters-Yellow Creek subwatershed. Three, 201 Facility Planning Areas (201 FPAs) exist within the Yellow Creek Watershed: Boardman FPA, Struthers FPA, and New Middletown FPA. An FPA is a delineated boundary that indicates areas already sewered, areas planned to receive sewer and areas that are serviced by onsite non-discharging home sewage treatment systems or can be serviced by a wastewater treatment plant. Each FPA is associated with a common wastewater treatment plant which in turn receives wastewater generated within sewered areas of the boundary. The Management Agency (MA) for each FPA is responsible for the sanitary sewer planning within their respective FPA and the Mahoning County District Board of Health is responsible for wastewater planning for the unsewered areas. For more information on home sewage treatment systems (HSTS), refer to pg. 70.

Health Districts

Two health districts exist within the watershed- Mahoning County District Board of Health and Columbiana County Health Department. Both health districts provide environmental services (i.e. home sewage treatment system inspections, ground water well testing) to residents within their respective counties. On July 1, 2009 the City of Struthers joined the other 23 townships and municipalities in Mahoning County serviced by the Board of Health. The Mahoning County District Board of Health has a Solid Waste Program that enforces the Ohio EPA's and Board of Health's regulations governing solid waste disposal and construction and demolition debris disposal, infectious waste, composting, and scrap tire management and illegal dumping activities. For more programmatic information please visit each department's respective website:

- Mahoning County District Board of Health- http://www.mahoninghealth.org
- Columbiana County Health Department- http://www.columbiana-health.org

Solid Waste Management District (SWMD)- The Mahoning County Green Team

The Mahoning County Green Team (The Green Team) services Mahoning County with solid waste and litter reduction programs in order to protect the health, safety, and welfare of all Mahoning County residents. According to their website, the Green Team "is under the authority of the Board of Mahoning County Commissioners who actively supports the goals of the program. The District is one of 52 in Ohio created as a result of the passage of H.B. 592 in 1988. Each district was established with the mission of reducing reliance on landfills and incinerators through the establishment of reuse and recycling programs. This is accomplished by developing an integrated solid waste management system that is implemented in an environmentally sound, technically feasible, cost effective and publicly acceptable manner. The District has a Solid Waste Plan that serves as the guide for all waste reduction programs and fiscal matters". The Green Team provides yard waste composting seminars, appliance, electronics and tire recycling drives, household hazardous waste collection drives, and educational programs. For more program information please visit their website at http://www.mahoningcountyoh.gov/DepartmentsAgencies/Departments/GreenTeam.

Water and/or Storm Water District

The ABC Water and Stormwater District was formed in January 2010 under ORC Chapter 6119. The District was formed between Austintown, Boardman, and Canfield townships and contains a board on which one member from each township sits. Understanding water and stormwater do not follow political boundaries, the District allows each township the ability to work individually and/or collectively on common water and stormwater issues.

Soil and Water Conservation

Two Soil and Water Conservation Districts (SWCD), Columbiana SWCD and Mahoning SWCD provide a partnership in managing the soil, water, and land managing resources within the watershed. Both SWCDs operate their own regulatory and educational programs to meet the needs of their respective counties. For more programmatic information please visit each SWCD's respective website:

- Columbiana County- http://columbiana.oh.nacdnet.org
- Mahoning County- https://www.facebook.com/mswcd

Regional Council of Governments

The Mahoning County portion of the watershed is located within the Eastgate Regional Council of Governments (Eastgate) planning region. Eastgate is the Metropolitan Planning Organization focused on Transportation, Economic Development, and Water Quality Management for Ashtabula, Mahoning, and Trumbull Counties. Eastgate's mission is to "provide a regional forum to discuss issues of mutual interest and concern, and to develop recommendations and plans to address those issues." Eastgate is a voluntary association of local governments, including counties, cities, and townships in Ashtabula, Trumbull, and Mahoning Counties in northeast Ohio. Eastgate is one of six regional planning agencies in the State of Ohio designated as a water quality management agency (WQMA). This designation was given by the Governor of the State of Ohio in order to fulfill duties set forth within Section 208 of the Clean Water Act. As the WQMA, Eastgate updates and keeps current the 208 Water Quality Management Plan (208 Plan). To learn more about Eastgate and its programs please visit their website at www.eastgatecog.org.

iii. Special Designations

According to a review of the Ohio Administrative Code (OAC) 3745-1-25, Antidegredation Table 25-1, no parts of Yellow Creek or its tributaries have been given a special designation.

iv. Phase II Stormwater Communities

The Clean Water Act (CWA) of 1972 was established to enforce regulations under the Federal Water Pollution Control Act of 1948. The CWA was written with the intent to "restore and maintain the chemical, physical, and biological integrity of our nation's waters (Section 101(a))" by achieving two goals (Section 101(a)(1)):

- eliminate the discharge of pollutants into surface waters; and
- achieve a level of water quality that allots the protection and propagation of fish, shellfish, and wildlife and for recreation in and on the water.

The CWA contains a national policy measure that states the "discharge of toxic pollutants in toxic amounts" is prohibited (Section 101(a)(3)). In 1987, the CWA was amended by Congress to establish regulations and issue permits for addressing non-agricultural stormwater discharges. The amendment created a phased implementation strategy for the National Pollution Discharge Elimination System (NPDES) Permit. In 1990, Phase I of the plan was activated, followed by Phase II in 2002. Under Phase II, six minimum control measures must be addressed as requirements of the program. The six measures include:

- Public Education and Outreach;
- Public Involvement and Public Participation/Involvement;
- Illicit Discharge Detection and Elimination;
- Construction Site Runoff Control;
- Post- Construction Runoff Control; and
- Pollution Prevention/Good Housekeeping.

The following entities have entered into a Memorandum of Understanding (MOU) with the Mahoning County Engineers Office to implement stormwater management plans:

- Mahoning County;
- Austintown Township;
- Beaver Township;
- Boardman Township;
- Canfield Township;
- Coitsville Township;
- Poland Township;
- Springfield Township; and
- Mill Creek MetroParks.

The City of Struthers, Village of Poland, and Village of New Middletown are under their own Phase II permits and have individual plans. The City of Columbiana and Fairfield and Unity Townships in Columbiana County are not Phase II Stormwater Communities.

B. Demographics

U.S. Census Bureau 2010 data was used to evaluate demographic factors. Census block boundaries do not align with watershed boundaries. Therefore, data is estimated based on the percentage of each census block within the watershed.

Table 2: Population

Population	Total	Percent
Population	35,313	100%
Males	16,879	47.8%
Females	18,434	52.2%
Age	35,313	100%
Younger than 5	1,587	4.5%
5 to 17	5,630	15.9%
18 to 21	1,501	4.3%
22 to 29	2,532	7.1%
30 to 39	3,498	9.9%
40 to 49	4,832	13.7%
50 to 64	8,641	24.5%
65 or older	7,092	20.1%

i. Population and Age

According to the U.S. Census Bureau's 2010 data, there are approximately 27,917 residents (Bureau, American Fact Finder: Community Facts, 2013) within the Yellow Creek Watershed (*Table* 2). A majority of the residents are 50 years or older. There are more females (18,434) than males (16,879) living within the watershed. A map of population distribution is provided in *Figure* 5.

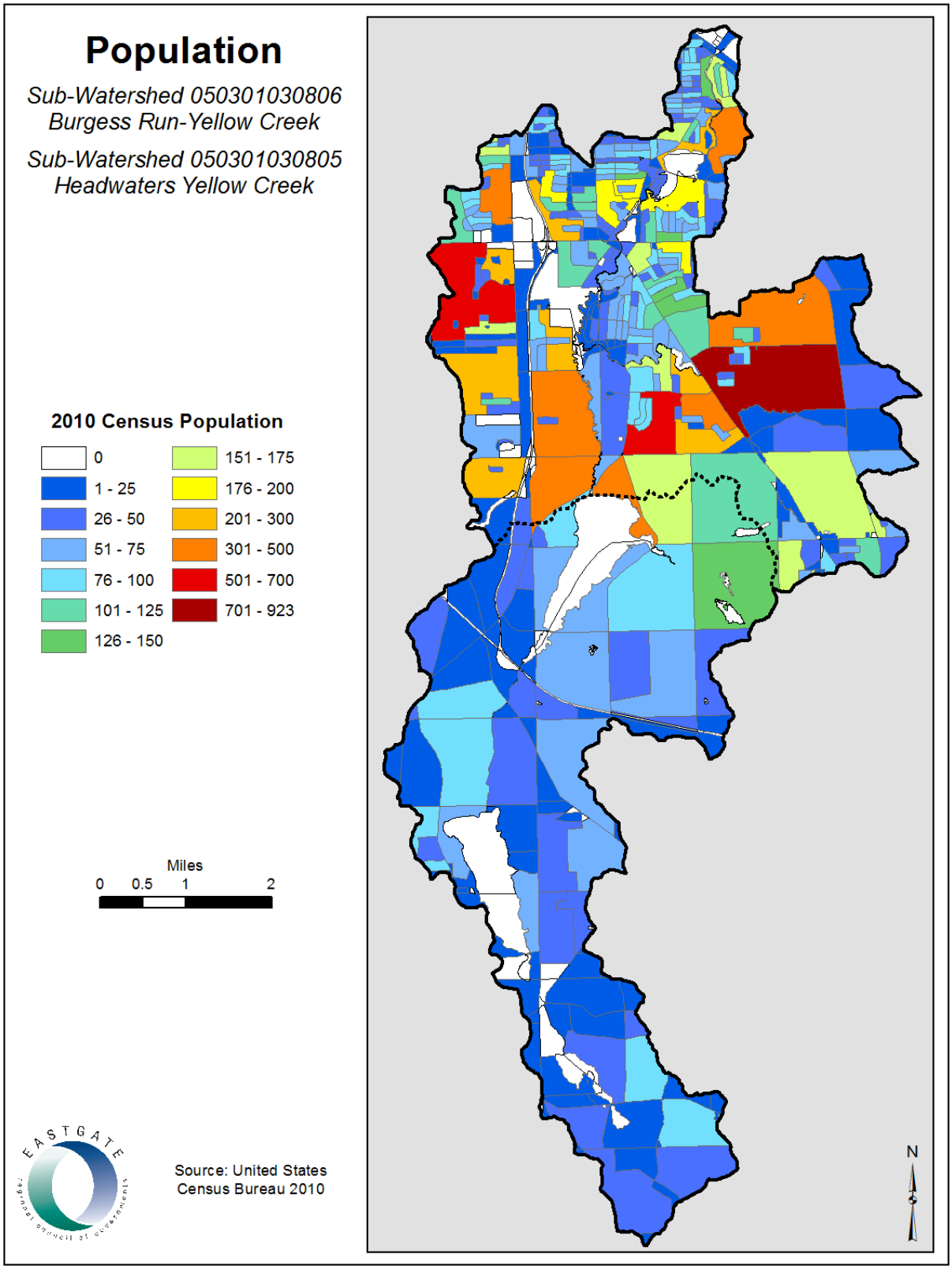
ii. Education Levels

Education levels were recorded by the U.S. Census Bureau for individuals age 18 and older. *Table 3* illustrates 34.3% of residents age 18 and older have a college degree, while 35.2% have a high school diploma or equivalency (Bureau, American Fact Finder: Community Facts, 2013). A small portion of residents are without a diploma or education.

Table 3: Educational Attainment

Educational Attainment	Male	Female	Total	Percent
Total Population > 18 years old	8,700	9,941	18,641	100%
College Degree	3,087	3,318	6,405	34.3%
Graduate School Degree	900	912	1,812	9.7%
Bachelor's Degree	1,769	1,604	3,373	18.1%
Associate Degree	418	653	1,071	5.7%
Some College; no degree	1,786	2,195	3,981	21.3%
High School Graduate (includes equivalency)	2,904	3,656	6,560	35.2%
Some schooling no diploma	749	922	1,671	8.9%
9th -12th grade no diploma	636	747	1,383	7.4%
Less than 9th grade	113	175	288	1.5%

Figure 5: Population Distribution



iii. Housing

According to the U.S. Census Bureau's 2010 data, most houses in the Yellow Creek Watershed were constructed during the 1950's, 60's and 70's when the region was at an economic peak (*Table 4*) (Bureau, American Fact Finder: Community Facts, 2013). Fewer houses have been constructed in the years since. For information on home construction trends in Mahoning and Columbiana County, refer to *Table 41*.

Table 4: Housing

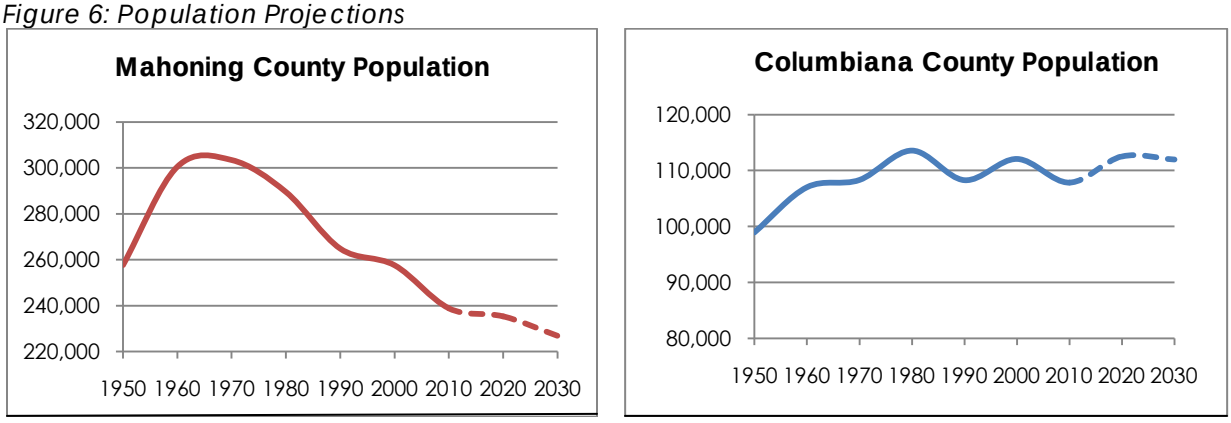
Housing (Year Built)	Total	Percent
2005 and later	282	2.8%
2000-2004	735	7.2%
1990-1999	1,336	13.1%
1980-1989	1,022	10.1%
1970-1979	1,402	13.8%
1960-1969	1,467	14.4%
1950-1959	1,970	19.4%
1940-1949	626	6.2%
1939 and earlier	1,321	13.0%
Total Units	**10,161**	**100%**

iv. Population Trends

Population has been declining in Mahoning County since the late 1970's when the Youngstown steel mills closed, eliminating the region's primary industry and causing a loss of 40,000 jobs. The Ohio Department of Development (2011) *expects the population of Mahoning County to continue to decline. The population of Columbiana County may increase by a few thousand people by the year 2030 (*Figure *6).*

Not only has the region seen a decline in population, it has also seen a change in population distribution. Similar to all areas of the country, people are moving out of the urban center and into surrounding suburbs, contributing to urban sprawl and a deteriorated city center.

Figure 6: Population Projections



v. Education Trends

A decline in population can be observed in school enrollment statistics (*Table 5*) from the Ohio Department of Education (2010). Many school districts have shown a decrease in enrollment since 2000 whether they are rural (Springfield Local), suburban (Boardman Local), or urban (Youngstown City). Youngstown City Schools have shown the most dramatic decrease in student enrollment since 2000. However, some school districts did have moderate increases in enrollment. It cannot be determined whether the decrease in enrollment represents intra-regional movement (out of the watershed, but remaining in the region), or whether it reflects inter-regional movement (out of this region and into another).

Table 5: Change in Student Enrollment

School District	Change in Number of Students Enrolled									
	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2000-2010
Boardman Local	-23	155	-47	-11	-69	14	-41	-143	25	-140
Columbiana Ex Village	-8	5	13	-10	3	8	12	26	-32	17
Crestview Local	-15	17	29	6	12	4	-11	16	33	91
East Palestine City	-50	-53	0	-18	-25	-34	-32	-24	6	-230
Poland Local	7	14	66	-116	-75	2	-27	85	-65	-109
South Range Local	14	-17	53	-7	36	-6	-35	-4	-11	23
Springfield Local	-17	-1	33	-22	24	-18	-15	-17	-20	-53
Struthers City	-23	32	-24	26	21	-2	66	44	-77	63
Youngstown City	-658	-248	-364	-476	-750	-400	-478	-396	-278	-4,048

Ohio Department of Education (2010)data shows that regardless of student mobility, graduation rates have remained high or improved over time for most school districts in the Yellow Creek Watershed (*Table 6)*. Youngstown City schools continue to struggle, but have also generally improved over time, despite a significant decline in enrollment.

Table 6: Graduation Rates

School District	Graduation Rate								
	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09
Boardman Local	93.1%	>95%	>95%	95.0%	>95%	>95%	>95%	>95%	>95%
Columbiana Ex Village	94.7%	84.2%	90.2%	89.1%	94.7%	>95%	>95%	>95%	93.6%
Crestview Local	>95%	93.3%	>95%	>95%	>95%	94.7%	>95%	>95%	94.3%
East Palestine City	90.9%	91.0%	94.0%	90.4%	94.3%	92.1%	93.6%	93.9%	>95%
Poland Local	>95%	>95%	>95%	>95%	>95%	>95%	>95%	>95%	>95%
South Range Local	93.9%	>95%	94.9%	>95%	>95%	>95%	>95%	>95%	>95%
Springfield Local	>95%	>95%	95.0%	>95%	>95%	>95%	>95%	>95%	>95%
Struthers City	75.4%	83.6%	91.8%	92.3%	93.3%	93.2%	91.9%	>95%	92.4%
Youngstown City	53.1%	47.6%	54.1%	56.9%	66.3%	71.0%	70.7%	72.8%	58.0%

Educational trends can also be observed in higher education enrollment. Youngstown State University is located in downtown Youngstown and attracts students from both Mahoning and Columbiana Counties. According to Youngstown State University's (2012) enrollment data, fall term enrollment by Mahoning and Columbiana County students has declined by an average of 690 students since reaching a peak in 2010 (*Table 7*). More recent data from Youngstown State University (2012) shows overall enrollment rates remain at around 13,800 students and the number of degrees conferred is approximately 2,000 each year (*Figure 7*, *Table 8*).

Table 7: YSU Enrollment by County

YSU Preliminary 14th Day Enrollment- Fall Terms, By Key Counties										
	2008		2009		2010		2011		2012	
Overall Totals	**#**	**%**	**#**	**%**	**#**	**%**	**#**	**%**	**#**	**%**
Columbiana, OH	833	6.07	884	6.02	842	5.54	750	5.16	717	5.19
Mahoning, OH	6,776	49.92	7,480	50.95	7,790	51.27	7,722	53.11	6,982	50.55
Trumbull, OH	3,240	23.63	3,446	23.47	3,555	23.40	3,335	22.94	3,117	22.57
Other OH Counties	1,429	10.42	1,380	9.40	1,355	8.92	1,255	8.63	1,268	9.18
Lawrence, PA	329	2.40	309	2.10	305	2.01	390	2.68	377	2.73
Mercer, PA	277	2.02	280	1.91	269	1.77	399	2.74	364	2.64
Other PA Counties	270	1.97	307	2.09	266	1.75	314	2.16	344	2.49
All Other States	558	4.07	596	4.06	812	5.34	376	2.59	644	4.66
Total	**13,712**	**100**	**14,682**	**100**	**15,194**	**100**	**14,541**	**100**	**13,813**	**100**

Figure 7: YSU Enrollment

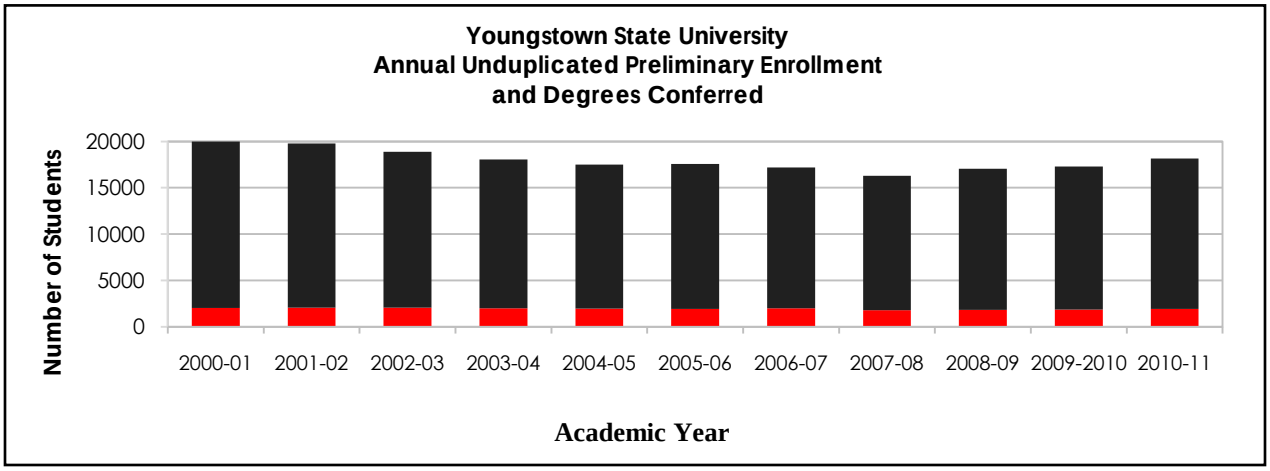


Table 8: YSU Enrollment by Year

	ACADEMIC YEAR (summer through spring)										
	2000-2001	**2001-2002**	**2002-2003**	**2003-2004**	**2004-2005**	**2005-2006**	**2006-2007**	**2007-2008**	**2008-2009**	**2009-2010**	**2010-2011**
Annual Unduplicated Preliminary Enrollment	18,296	17,716	16,827	16,026	15,517	15,602	15,177	14,488	15,212	15,439	16,220
Degrees Conferred	2,042	2,073	2,068	2,015	1,991	1,952	2,010	1,822	1,844	1,865	1,933
Degrees Conferred as a % of Unduplicated Preliminary Enrollment	11.2%	11.7%	12.3%	12.6%	12.8%	12.5%	13.2%	12.6%	12.1%	12.1%	11.9%

vi. Income Levels, Locations of Growth

There is a wide range of household income levels in the watershed (*Table 9*). This can be attributed to the variety of community types existing in the watershed: urban cities (Struthers), small villages (Poland Village), rural agricultural areas (Unity Township, Springfield Township), and commercial centers (Boardman Township). Most workers are considered private wage and salary workers (*Table 10*).

Table 9: Household Income

Household Income	Number of Households	Percent
Less than $10,000	428	5%
$10,000-$14,999	493	5%
$15,000- $24,999	1,145	12%
$25,000-$34,999	1,054	11%
$35,000-$49,999	1,369	15%
$50,000-$74,999	1,960	21%
$75,000-$99,999	1,247	13%
$100,000-$149,999	1,063	11%
$150,000-$199,999	343	4%
Greater than $200,000	338	4%
Total	**9,440**	**100%**

Table 10: Class of Workers

Class of Workers in Yellow Creek	Number	Percent
Workers 16 and over	22,074	100%
Private wage and salary workers	17,784	80.6%
Government workers	2,960	13.4%
Self-employed in own and not incorporated business workers	1,302	5.9%
Unpaid family members	26	0.1%

In the future, the watershed may attract higher income levels. The area surrounding Evans Lake has experienced significant development over the last 5 years. The new homes and proximity to The Lake Club, formerly Fonderlac Country Club, may draw new residents and higher incomes to the watershed.

vii. Economic Patterns

The economic downturn of 2007 and 2008 continues to be felt within the watershed. Since the 2000 Census, the unemployment rate for the state more than doubled, rising from 3.2% to 9.7%(U.S. Census Bureau, 2014). This trend could also be felt within the watershed's counties. According to the 2010 census Mahoning County's unemployment rate rose from 3.7% in 2000 to its current 11.3%; Columbiana County's rate increased from 2.9% to 11.0%. Another indicator of the economic hardship endured within the watershed is the number of people whose income fell below the poverty level. The U.S. Census Bureau's Preliminary Weighted Average Poverty Thresholds for 2013 reports the poverty threshold for an individual is $11,892. The ACS's survey showed the recent percentage of people whose income in 2011 that fell below the threshold level was at 16.4% within the State of Ohio. *Table 11* illustrates the diversity of industry employs watershed residents.

Table 11: Industry

Industry of Yellow Creek Watershed	Number	Percent
Civilian Employed Population 16 years and over	11,414	100%
Agriculture, forestry, fishing and hunting, and mining	72	0.64%
Construction	669	5.92%
Manufacturing	1,241	10.98%
Retail	305	2.70%
Wholesale trade	1,548	13.70%
Transportation and warehousing, and utilities	557	4.93%
Information	319	2.82%
Finance and insurance, and real estate, rental and leasing	618	5.40%
Professional, scientific, and management, and administrative and waste management services	785	6.95%
Educational services, and health and social assistance	3,257	28.82%
Arts, entertainment, and recreation, accommodation and food services	984	8.71%
Other services, except public administration	640	5.66%
Public administration	419	3.71%

viii. Other Factors

Government

The watershed consists of several types of government. Depending on location, the watershed communities are governed by either county, city, village, or township forms of government.

Boardman Township is the only township within the watershed that is a Limited Home Rule government. Limited Home Rule government is one which provides a township government, of an ORC defined budget and population, a level of self government over their public affairs and services (Ohio Revised Code, 2014). On October 12, 1999, Boardman Township received home rule status and has since adopted several regulations pertaining to "quality of life" issues, such as regulation of stormwater retention and detention system maintenance. These regulations are

enforced by both the zoning and police departments. Current Home Rule Regulations enacted by Boardman Township can be viewed on their website, www.boardmantwp.com.

C. Geographic Locators

Refer to pg. 1 for a more detailed description of geographic locators and reference maps.

i. USGS Hydrologic Unit Codes

Watersheds in the United States are delineated into hydrologic units by the U.S. Geological Survey using a national standard hierarchical system based on surface hydrologic features. Each hydrologic unit is identified by a unique hydrologic unit code (HUC) consisting of two to twelve digits based on the six levels of classification: 2-digit HUC – region, 4-digit HUC – sub-region, 6-digit HUC – accounting unit, 8-digit HUC - cataloguing unit, 10-digit HUC – watershed and 12-digit HUC – subwatershed. The Yellow Creek Watershed is composed of two 12-digit HUCs. The watershed hierarchy is outlined in *Table 12* (U.S Geological Survey, 2010).

Table 12: Hydrologic Unit Codes

Level	HUC	Name
Region	05	Ohio
Sub-region	0503	Upper Ohio
Accounting Unit	050301	Upper Ohio-Beaver
Cataloguing Unit	05030103	Mahoning
Watershed	0503010308	Mill Creek-Mahoning River
Sub-watersheds	050301030805	Headwaters Yellow Creek
	050301030806	Burgess Run-Yellow Creek

ii. State 305(b) Identification Numbers

The Ohio EPA 305(b) report refers to Yellow Creek as River Code 18-007 and Burgess Run as River Code 18-008.

iii. Other (Coordinates)

The center of the Yellow Creek Watershed is located at 40°58'12.00"N, 80°36'36.00"W. The central point of the Headwaters Yellow Creek sub-watershed is 40°55'48.00"N, 80°37'12.00"W. The central point of Burgess Run-Yellow Creek sub-watershed is located at 41° 0'36.00"N, 80°35'60.00"W.

D. General Watershed Information

i. Previous and Current Watershed Activities

In 2001 the Mahoning County SWCD received funds through ODNR to hire a watershed coordinator to develop watershed action plans for three sub-watersheds in Mahoning County, among other duties. As per the requirements of the grant, planning for the development of the Yellow Creek, Mill Creek, and Meander Creek Watershed Action Plans (all individual plans) were to be established. Planning for the Yellow Creek and Mill Creek WAPs got underway simultaneously prior to 2003, with ad hoc committees formalized to assist in the plan's development. However, the Yellow Creek WAP did not materialize beyond committee meeting notes. Due to Mahoning County SWCD restructuring, funding issues, and loss of watershed coordinator position, the WAP for Yellow Creek did not reach its first draft stage as the Mill Creek WAP did. Since then, plans for the Yellow Creek WAP were on hold until funding became available again.

Acknowledging the need for a WAP for Yellow Creek, Eastgate developed its work program to update and complete the watershed action planning process for Yellow Creek. The Alliance for Watershed Action and Resource Education (AWARE) played an integral role in the initial Yellow Creek WAP and is partnering with Eastgate to complete the plan.

II. WATERSHED PLAN DEVELOPMENT

A. Watershed Partners

The development of the Yellow Creek Watershed Action Plan was led by the Eastgate Regional Council of Governments in partnership with the Alliance for Watershed Action and Resource Education (AWARE). Additional stakeholders were invited to participate in the planning process and have been partners in developing the Watershed Action Plan (*Table 13*).

The Alliance for Watershed Action and Resource Education (AWARE)

AWARE is the watershed group in Mahoning County focused on improving the water quality in the Yellow Creek, Mill Creek, and Meander Creek Watersheds. AWARE is a diverse group comprised of county and state governmental agencies, private corporations, local environmental groups, and citizens. AWARE serves as a forum for resource educators to provide technical assistance to partnering agencies and the public in dealing with water quality improvement and related educational activities. AWARE is a non-incorporated watershed group led by a member-elected chairperson and a steering committee. The steering committee is made up of the chair, a representative from Mill Creek MetroParks, the Mahoning County Soil and Water Conservation District, Youngstown State University; the chair from each of AWARE's standing committees, and two at-large members (at least one is not monetarily reimbursed for attendance).

Other Partners

Introductory meetings were held for governing agencies and officials and residents within the watershed on February 24, 2010 and March 1, 2010, respectively. The meetings introduced the watershed planning process, defined the role each official and resident has in the plan, and discussed and identified initial areas of concerns within the watershed.

Stakeholder meetings were held to further define the environmental issues and/or concerns within the watershed and to identify solutions to address them. The meetings were attended by governing agencies, watershed communities, and local watershed groups from both Mahoning and Columbiana Counties.

Table 13: Watershed Stakeholders

Name	Organization
Stephanie Dyer	Eastgate Regional Council of Governments
Bethaney Krzys	Eastgate Regional Council of Governments
Kirsten Peetz	Mill Creek MetroParks, AWARE
Justin Rogers	Mill Creek MetroParks, AWARE
George Warnock	Western Reserve Land Conservancy
Mark Bergman	Ohio EPA
Greg Orr	Ohio EPA
Jason Loree	Boardman Township
Larry Wilson	Boardman Township
Jay Groner	City of Columbiana
Paula Cope	Columbiana Co. General Health District
Lori Barnes	Columbiana Co. General Health District
Pete Conkle	Columbiana Soil & Water Conservation Dist.
Lisa Butch	Little Beaver Creek Land Foundation
Dan Hutton	Mahoning Co. District Board of Health
John Woolard	Mahoning Co. Engineers
Bob Lyden	Mahoning Co. Sanitary Engineers
Kathi Vrable-Bryan	Mahoning Soil &Water Conservation District
Sean McGuire	Mahoning Soil & Water Conservation District
Scott Kenreich	Natural Resource Conservation Service
Mayor Tim Sicafuse	Poland Village
Joe Mazur	Poland Village
Gary Ruggles	Mahoning Co. Farm Bureau
Andy Baltes	Mahoning Co. Farm Bureau
Zach Martin	Aqua Ohio
Dick Ames	Poland Village
Mary Helen Smith	Mahoning Co. District Board of Health
Rich DeLuca	Struthers Resident
Chrystaline McArdle	Mahoning Co. Planning Commission

B. Mission Statement

The Mission and Vision Statements of the lead planning partners are as follows:

Eastgate Regional Council of Governments
Mission Statement: Eastgate is committed to promoting cooperative regional efforts in the planning, programming, and implementation of public sector activities. Eastgate serves as a regional forum to discuss issues of mutual interest and concern, and to develop recommendations and plans to address those issues. All of this in hopes of leading to a common goal of improving the quality of life for the residents of the Mahoning Valley.

AWARE
Mission Statement: AWARE serves as an alliance of stewards for the Mill Creek, Yellow Creek, and Meander Creek watersheds by preserving green space and restoring and enhancing waterways through conservation easements, education, and technical resources for the community.

Vision Statement: To be a proactive organization regarded as a key resource producing tangible improvements in watersheds.

C. Structure, Organization, and Administration

Eastgate Regional Council of Governments
Eastgate Regional Council of Governments is responsible for a variety of federal, state, and local planning and project implementation programs. As the Metropolitan Planning Organization and Areawide Water Quality Management Agency for Ashtabula, Mahoning and Trumbull Counties, and the designated Economic Development District, Eastgate continues to maintain required certifications and planning documents to qualify the region for federal and state funding. Other major areas of responsibility include: air quality planning and air advisory day programs, State Capital Improvement Program administration for the District 6 Public Works Integrating Committee, administration of the Department of Defense Procurement Program, Intergovernmental review, administration of the regional Rideshare program, administration of the Clean Ohio Conservation & Revitalization Funds, and administration of the Local Development District of the Appalachian Regional Commission.

The Eastgate Development and Transportation Agency was created in 1973 as the result of combining the then Council of Governments with the Mahoning and Trumbull Comprehensive Transportation Study. EDATA, as the agency became known, was established as a regional Council of Governments with members in Ashtabula, Trumbull, Mahoning, and Columbiana Counties. The agency name reflected the primary role of the agency, transportation and economic development. As the agency has grown, its role and identity has also changed. It has become more than just a transportation and development planning agency, it has maintained a role as the regional voice of government.

Today, the Eastgate Regional Council of Governments is a voluntary association of local governments in northeast Ohio. Members include Ashtabula, Mahoning, and Trumbull Counties and all cities, villages, and townships within the counties. Although the members are unique, they share many common interests. Eastgate brings them together to create a unified voice in areas such as transportation, water and air quality, land use planning, and local infrastructure projects.

Eastgate has a number of boards and committees, but the policy making board of Eastgate is the General Policy Board (GPB). The GPB is composed of elected officials representing the political jurisdictions of the planning area. The duties of the GPB include recommending and coordinating local plans, policy statements, and service programs for implementation by Eastgate, member agencies, or contractors. For more information of Eastgate's boards, programs, or staff, visit Eastgate's website at www.eastgatecog.org.

The Alliance for Watershed Action and Resource Education (AWARE)

AWARE began as the Lake Newport Advisory Committee in 1997 to address sedimentation issues in Mill Creek Park's Lake Newport. The Lake Newport Advisory group realized in order to address the sedimentation problem in the lake, they had to look beyond the constraints of the MetroParks and into the watershed. In the fall of 1999, the advisory group reorganized to form the Alliance for Watershed Action and Riparian Easements. The group would focus on the three watersheds in Mahoning County: Meander Creek, Mill Creek, and Yellow Creek. In addition it would provide technical assistance to local agencies and the surrounding communities. In 2009, the group underwent a minor name change to better represent the purpose and active members of AWARE. Today, AWARE now stands for the Alliance for Watershed Action and Resource Education.

Several strategic planning efforts were undertaken by AWARE to define the group, outline the group's successes, produce tangible goals, and identify future objectives. The first strategic planning effort took place in 2001. Through this first session, the group secured an ODNR Watershed Coordinator Grant and hired a watershed coordinator who was employed at the Mahoning County SWCD. The purpose of the coordinator was to carry out the endeavors of AWARE and to prepare two watershed action plans- one for the Mill Creek and one for Yellow Creek Watersheds. After the grant expired and employment restructuring occurred at the Mahoning SWCD, AWARE lost the energy that drove the group's mission and vision. In 2005, a second strategic planning effort was initiated. Multiple, well attended meetings were held throughout 2005 and 2006 to analyze and discuss objectives, goals, mission and vision statements, membership, formal 501(c)3 organization, standing committees, maintaining stakeholders, marketing the group, educational outreach opportunities, and funding sources. The end result of the 2005 planning process yielded the current mission and vision statement for AWARE, as well as a list of goals and objectives for AWARE to implement.

Interest in becoming a 501(c)3 organization was shown by members of AWARE during the 2005 strategic planning sessions, but the idea never materialized. An ad hoc committee was formed to develop a set of bylaws for AWARE. The committee met on several occasions to discuss the structure of AWARE in terms of membership requirements, leadership composition, voting practices, and subcommittee organization. As a result, a formal set of bylaws was created. A copy of AWARE's bylaws can be obtained by contacting AWARE at (330) 702-3000.

Although AWARE's members continue to change, the core participants remain the same. AWARE is comprised of, but not limited to, the following organizations: Aqua Ohio, Audubon Society/Mahoning Valley, Eastgate Regional Council of Governments, Mahoning County District Board of Health, Mahoning County Engineers, Mahoning SWCD, Mahoning Valley Sanitary District, Mill Creek MetroParks, Ohio EPA, and Western Reserve Land Conservancy. A complete list of AWARE members can be viewed at http://awarewatershedgroup.blogspot.com.

AWARE's partners continue to support the endeavors of the group by providing tangible materials such as GIS maps and educational fact sheets. Aside from outreach materials, members also volunteer time to staff the group's display booth at the Canfield Fair, provide educational workshops, and provide landowner assistance. The member list posted on AWARE's website is the most current list of participants and will be updated as needed. We encourage those who wish to learn more about AWARE to visit the group's website, http://awarewatershedgroup.blogspot.com, or contact the Mill Creek MetroParks, 7574 Columbiana-Canfield Road, PO Box 596, Canfield, Ohio 44406; phone (330)702-3000.

D. General Plan Content

This plan was financed in part or totally through a grant from the Ohio Environmental Protection Agency (Ohio EPA) with the following funds: American Recovery and Reinvestment Funds (ARRA) contract agreement #ERCOGSTM9, Federal Section 604(b) Clean Water Act funds, and State of Ohio Biennium funds.

i. Outline of the Plan's Content

The Yellow Creek Watershed Action Plan was designed following the Ohio EPA's Appendix 8 format and in fulfillment of the U.S. EPA's *"Nine Essential Elements"* (Handbook for Developing Watershed Plans to Restore and Protect our Waters, U.S. EPA, 2008). The plan begins with an introduction to the watershed and is followed by a discussion of the plan's development, inventory of the watershed's key characteristics, and summary of critical areas.

ii. Endorsement of Plan by Key Watershed Partners

A draft copy of the watershed action plan will be submitted to Area Assistance Team for review. After comments and concerns provided by the assistance team are addressed, the plan will then be resubmitted for state endorsement. Once state endorsement is received, Eastgate will work to achieve plan endorsement by all the communities and stakeholders within the watershed.

iii. Endorsement of the Plan by Local Units of Government

As the point of contact for this WAP, Eastgate will distribute the document to all stakeholder organizations, as well as place it on Eastgate's website. Eastgate will seek endorsement of the watershed action plan by all participating and non participating governing entities within the watershed. A sample resolution will be available for all entities to use and is included in the plan. The official table of endorsers is included in this plan and can be found in Section X. The following is a list of local government stakeholders:

- Mahoning County Engineers
- Columbiana County Engineers
- Mahoning County District Board of Health
- Columbiana County General Health Department
- Mahoning County Soil and Water Conservation District
- Columbiana County Soil and Water Conservation District
- Mahoning County Commissioners
- Columbiana County Commissioners
- Mahoning County Sanitary Engineer
- Mahoning County Farm Bureau
- Columbiana County Farm Bureau
- City of Columbiana
- City of Struthers
- Village of New Middletown
- Village of Poland
- Beaver Township

- Boardman Township
- Fairfield Township
- Poland Township
- Springfield Township
- Unity Township

iv. Information/Education Component for Public Understanding of the Project

Education and Outreach will be an ongoing activity throughout the planning and implementation process. Currently general watershed education is limited to what agencies within the watershed can do with the resources available to them. Specific educational components of the plan are outlined in Section VII. In general, education will target those residents, educators, and officials within the watershed that can benefit the most from the listed action items. Educational tools include, but are not limited to stream cleanups and volunteer stream monitoring training. AWARE and its members will be responsible for most of the educational components due to the diversity of resource educators and ability to reach out to watershed leaders, communities, organizations, and schools. By members of AWARE performing the education and outreach, education efforts can be maximized to help to educate teachers, students, community officials and the general public about watersheds, water quality, and nonpoint source related topics. Many members of AWARE have educational programs in place (i.e. Green Team, SWCD) that can be tailored to meet each community's needs.

Following the completion of the planning process, watershed stakeholders will be kept informed of new developments in the watershed. Stakeholders and citizens will be invited to take part in activities that raise awareness such as stream clean ups, watershed festivals, and volunteer stream monitoring opportunities. Several agency websites and newsletters (i.e. Green Team's "Green Scene", SWCD's Facebook Page and Twitter, and Eastgate's quarterly newsletter "On the Move") will be used to highlight improvements made within the watershed as well as post education and outreach opportunities.

III. WATERSHED INVENTORY
A. Description of the Watershed
i. Geology
1. Topography

The Yellow Creek Watershed is located in the glaciated Allegheny Plateau region of the Appalachian Highlands. Specifically, it is located in the Killbuck-Glaciated Pittsburgh Plateau within the Allegheny Plateau region (*Figure 8*). The Killbuck-Glaciated Pittsburgh Plateau is composed of ridges and flat uplands generally above 1,200 feet, covered by thin drift and dissected by steep valleys. Valley segments alternate between broad drift-filled and narrow rock-walled reaches with elevations between 600 feet and 1,505 feet with moderate relief around 200 feet (Ohio Division of Geological Survey, 1998).

The headwaters of Yellow Creek are located in Unity Township, northern Columbiana County. Unity Township contains the highest terrain in the watershed, with a peak elevation of 1,287 feet. Elevations range from a high of 1,287 feet to a low of 809 feet in Struthers at the confluence of Yellow Creek and the Mahoning River (Figure 9).

Topography changes as Yellow Creek moves north toward the Mahoning River. The hills of Columbiana County and the pronounced valley of the Headwaters-Yellow Creek sub-watershed give way to the gently sloping plain of the Burgess Run-Yellow Creek sub-watershed in Mahoning County.

Figure 8: Physiographic Regions of Ohio

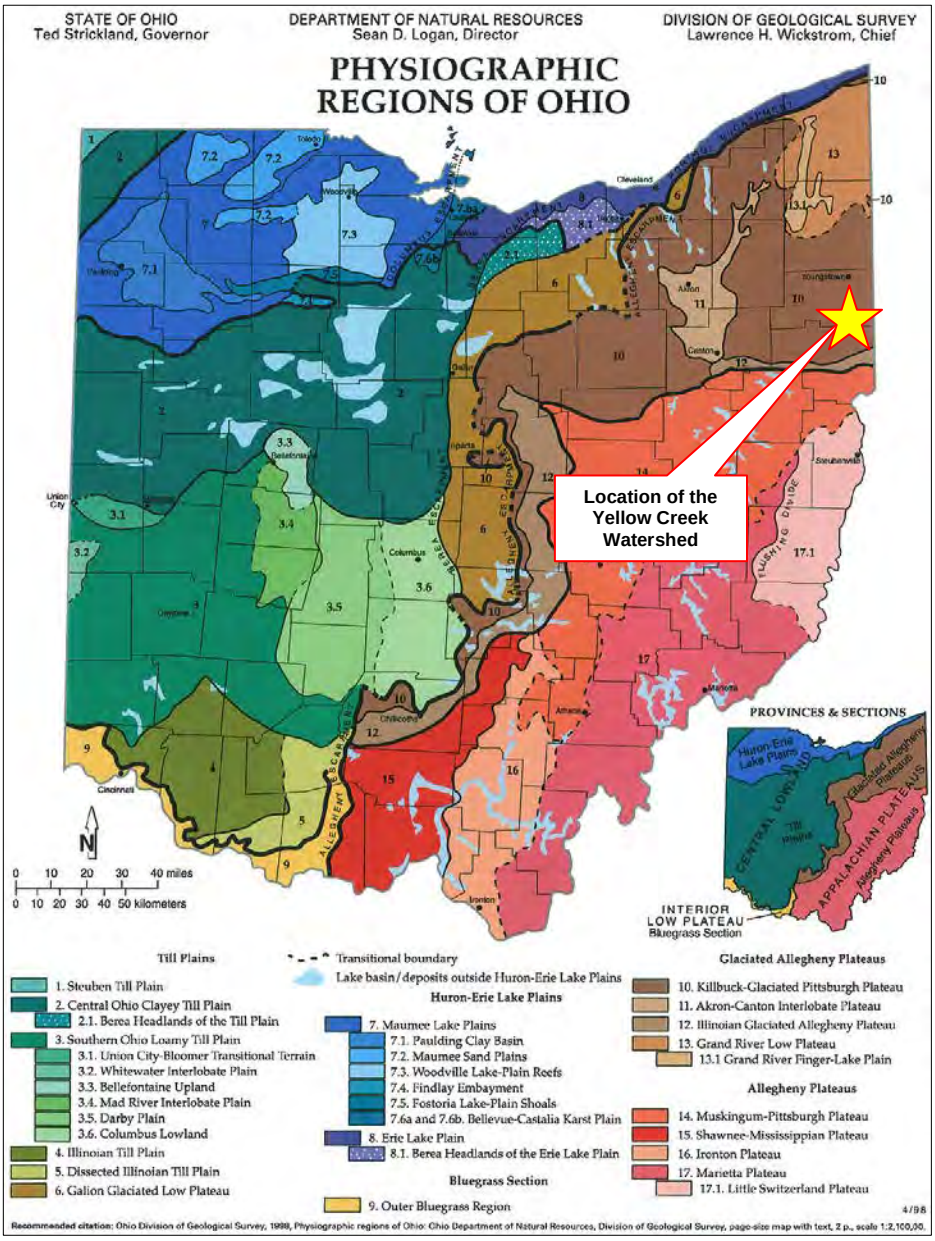
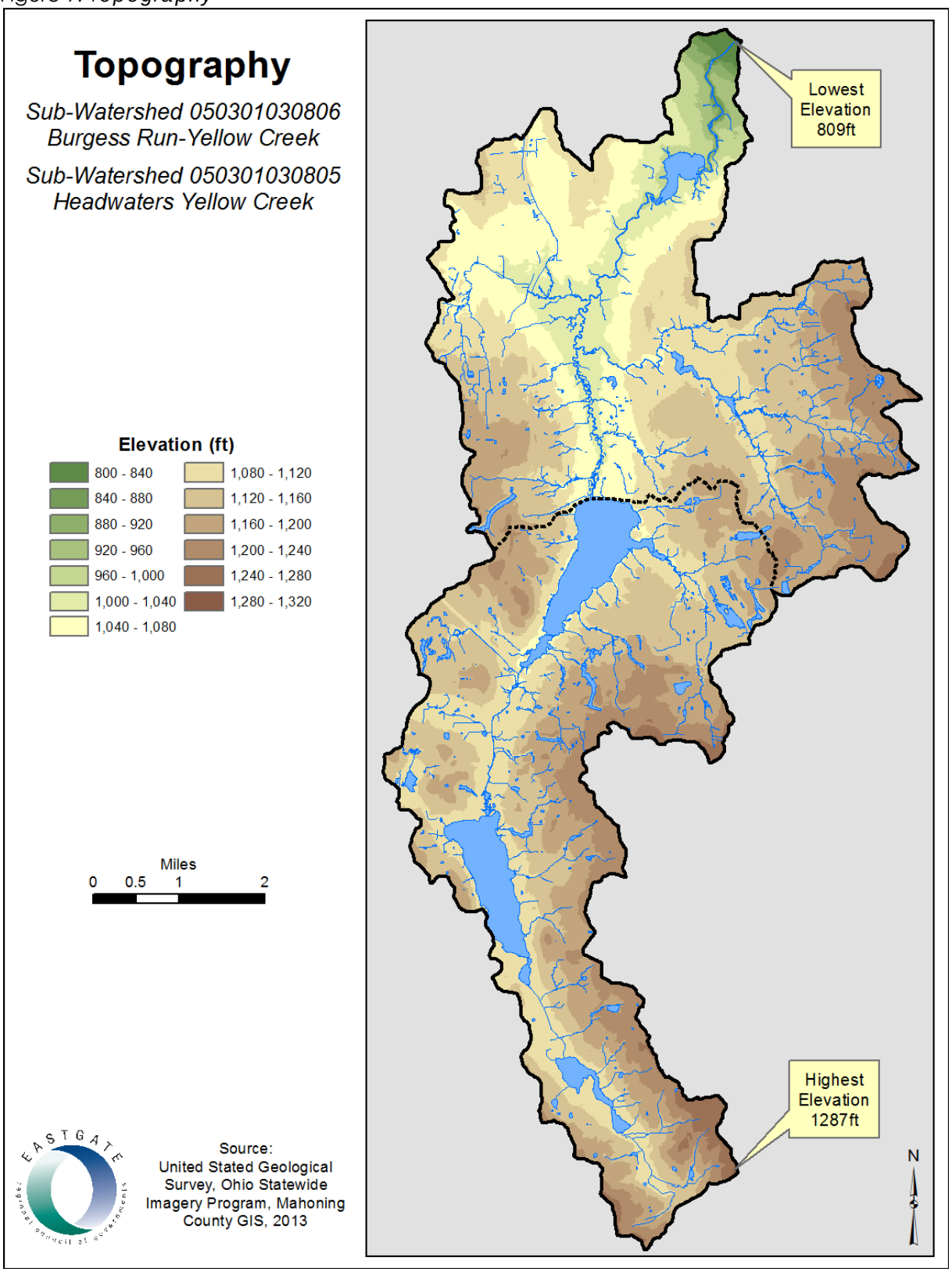


Figure 9: *Topography*



Refer to Appendix A for detailed maps of each Yellow Creek sub-watershed

2. Geological Features

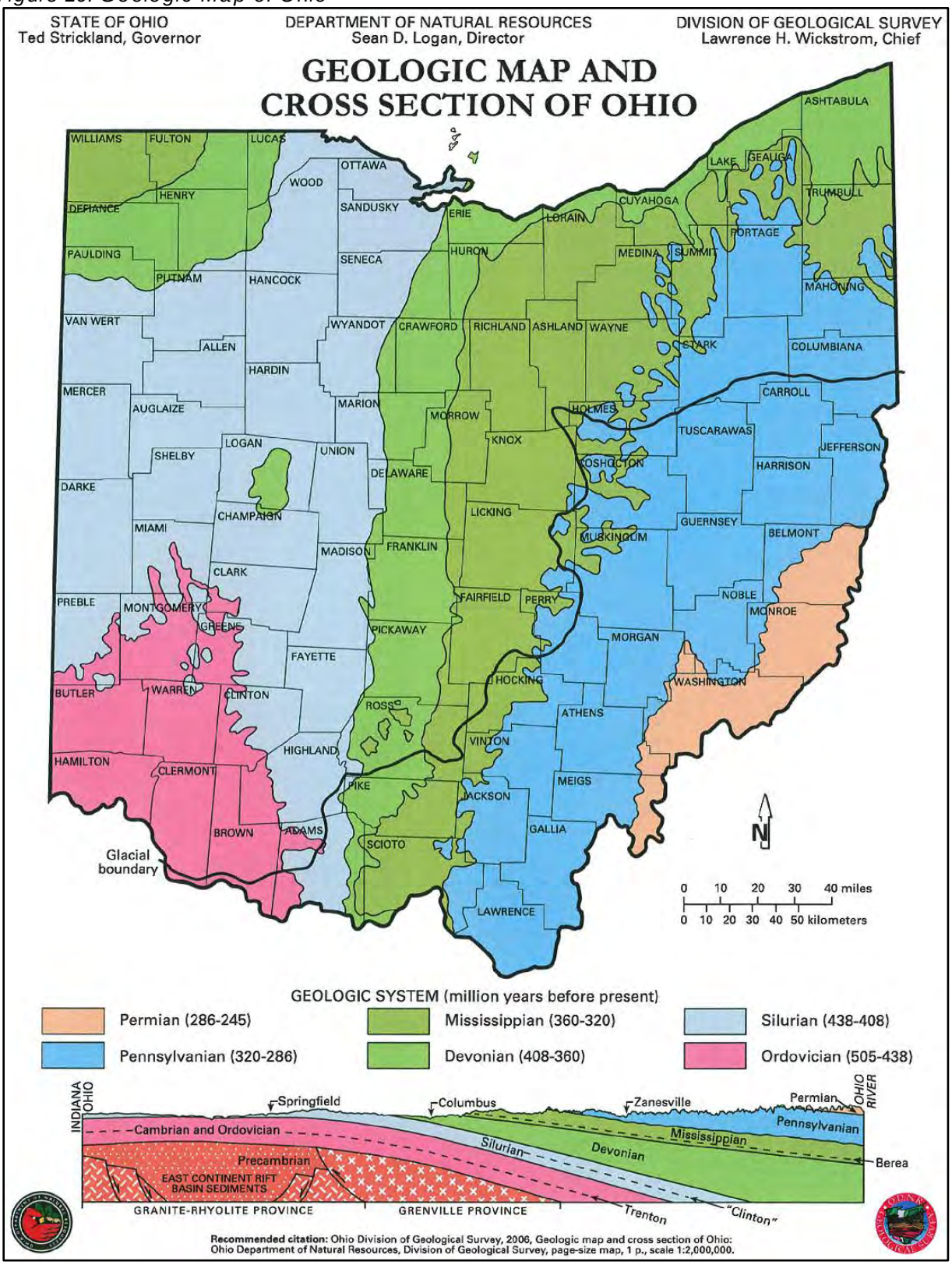
Geologic History

The bedrock underlying the watershed is primarily from the Pennsylvanian Period, but bedrock from the Mississippian Period is present in the northernmost portion of the watershed. The Mississippian Period began about 320 million years ago and lasted around 40 million years. The Pennsylvanian Period began after the Mississippian, around 286 million years ago. It lasted 34 million years and ended around 245 million years ago (*Table 14*). *Figure 10* shows location of bedrock from each geologic period and a cross section of Ohio (Ohio Division of Geological Surey, 2006).

Table 14: Geologic Eras

<table>
<tr><th>Millions of years before present</th><th>Geologic Eras and duration</th><th>Geologic Periods and duration in years</th><th colspan="2">Area of outcrop in Ohio and principal types of rock</th></tr>
<tr><td>0</td><td rowspan="2">Cenozoic Era
66+ million years</td><td>Pleistocene Epoch
1.5- 2 million years</td><td colspan="2">Northwestern 2/3 of Ohio.
Unconsolidated sand, gravel and clay on top of bedrock.</td></tr>
<tr><td>1.6</td><td>Tertiary Period
62.5 million years</td><td colspan="2" rowspan="3">Not Present In Ohio</td></tr>
<tr><td>66.4</td><td rowspan="3">Mesozoic Era
179 million years</td><td>Cretaceous Period
78 million years</td></tr>
<tr><td>144</td><td>Jurassic Period
64 million years</td></tr>
<tr><td>208</td><td>Triassic Period
37 million years</td><td colspan="2"></td></tr>
<tr><td>245</td><td rowspan="6">Paleozoic Period
67 million years</td><td>Permian Period
41 million years</td><td colspan="2">Southeastern most slice of Ohio.
Shale, sandstone, coal, clay, limestone.</td></tr>
<tr><td>286</td><td>Pennsylvanian Period
34 million years</td><td colspan="2">Eastern Ohio.
Shale, sandstone, coal, clay, limestone.</td></tr>
<tr><td>320</td><td>Mississippian Period
40 million years</td><td colspan="2">East-central, northeastern and northwestern most corner of Ohio.
Shale, sandstone, limestone.</td></tr>
<tr><td>360</td><td>Devonian Period
48 million years</td><td colspan="2">Central, northeastern lake shore and northwestern Ohio.
Shale, limestone.</td></tr>
<tr><td>408</td><td>Silurian Period
30 million years</td><td colspan="2">Western Ohio.
Dolomite, limestone, shale.</td></tr>
<tr><td>438</td><td>Ordovician Period
67 million years</td><td colspan="2">Southwestern corner of Ohio.
Shale, limestone.</td></tr>
<tr><td>505</td><td>Cambrian Period
65 million years</td><td rowspan="2">Not Exposed In Ohio</td><td>Cambrian sandstone and shale.</td></tr>
<tr><td>570</td><td colspan="2">Precambrian Period
3,400 million years</td><td>Precambrian sedimentary, igneous and metamorphic rocks present below the Cambrian rocks.</td></tr>
</table>

Figure 10: Geologic Map of Ohio



The Mississippian and Pennsylvanian Periods are referred together as the Carboniferous Period because large coal beds (carbon) were laid down during this time. In addition to coal, the geologic history of the area supported the formation of shale, sandstone, limestone, and conglomerates (Ohio History Central, 2005). Sedimentary deposits from the Mississippian and Pennsylvanian Periods resulted in an estimated 1,790 feet of rock today (*Table 15*) (Stout, 1944).

Table 15: Thickness and Strata of Ohio Bedrock

System	Total Thickness of Rocks (Feet)	Total Thickness of Sandstone and Conglomerate (Feet)
Permian	626	147
Pennsylvanian	1,115	355
Mississippian	675	375
Devonian	770	5
Silurian	800	20
Ordovician	2,095	0
Cambrian	720	360
Total	**6,801**	**1,105**

During the Early Mississippian Period, Ohio was covered by a shallow sea and located in equatorial latitudes. Through erosion of the Acadian Mountains to the east and the Canadian Shield to the north, the Ohio sea accumulated clay, silt and fine sand which would later become shale. Afterward, west-flowing streams contributed to thick deposits of sand and sandy shale (Ohio History Central, 2007).

Periodic withdrawals of the sea during the Middle and Late Mississippian allowed erosion to occur and valleys to form. Valley formation was facilitated by land rising in repose to the creation of the Appalachian Mountains at the end of the Mississippian. The Appalachians were formed by the collision of North America and Africa. As the land rose and the sea receded, erosion cut broad, deep valleys into the landscape (Ohio History Central, 2007). Today a major disconformity, representing a large interval of erosion, can be seen between rocks of the Mississippian Period and the Pennsylvanian Period.

The beginning of the Pennsylvanian age saw the deep valleys fill with pure quartz sand eroded from the Canadian Shield and the Appalachian Uplands. The forces of plate tectonics and the influence of glaciers allowed the sea to return periodically and deposit limestone and shale during the Pennsylvanian Period. At the same time, deltas and streams deposited sand. Coastal swamps, containing the plant material to form coal, were repeatedly inundated by water or buried by sediment.

The result of this ever changing landscape is multiple, thin, laterally discontinuous beds of limestone, shale, clay, sandstone, and coal in repetitive sequences (Ohio History Central, 2007). These thin lateral beds are depicted in a generalized column of Ohio bedrock units located in *Appendix A* (Ohio Division of Geologic Survey, 2004).

Geologic Features

Mississippian Age rock is almost buried entirely under the dominating Pennsylvania Age rock. The exception to this is at the confluence of Yellow Creek and the Mahoning River where the Mississippian Aged Cuyahoga formation is found.

Mississippian bedrock is known to be exposed along the Mahoning River near Youngstown (Ohio Division of Water, 2003). Thus, the nearby Yellow Creek and Mahoning River confluence may have outcrops of the Cuyahoga formation. The Cuyahoga formation was formed from sediments depositing into a quiet delta of the ancient Ohio sea. These deposited sediments included fine silts and clay and mud with thin beds of sand deposited by storms, floods, or in stream channels.

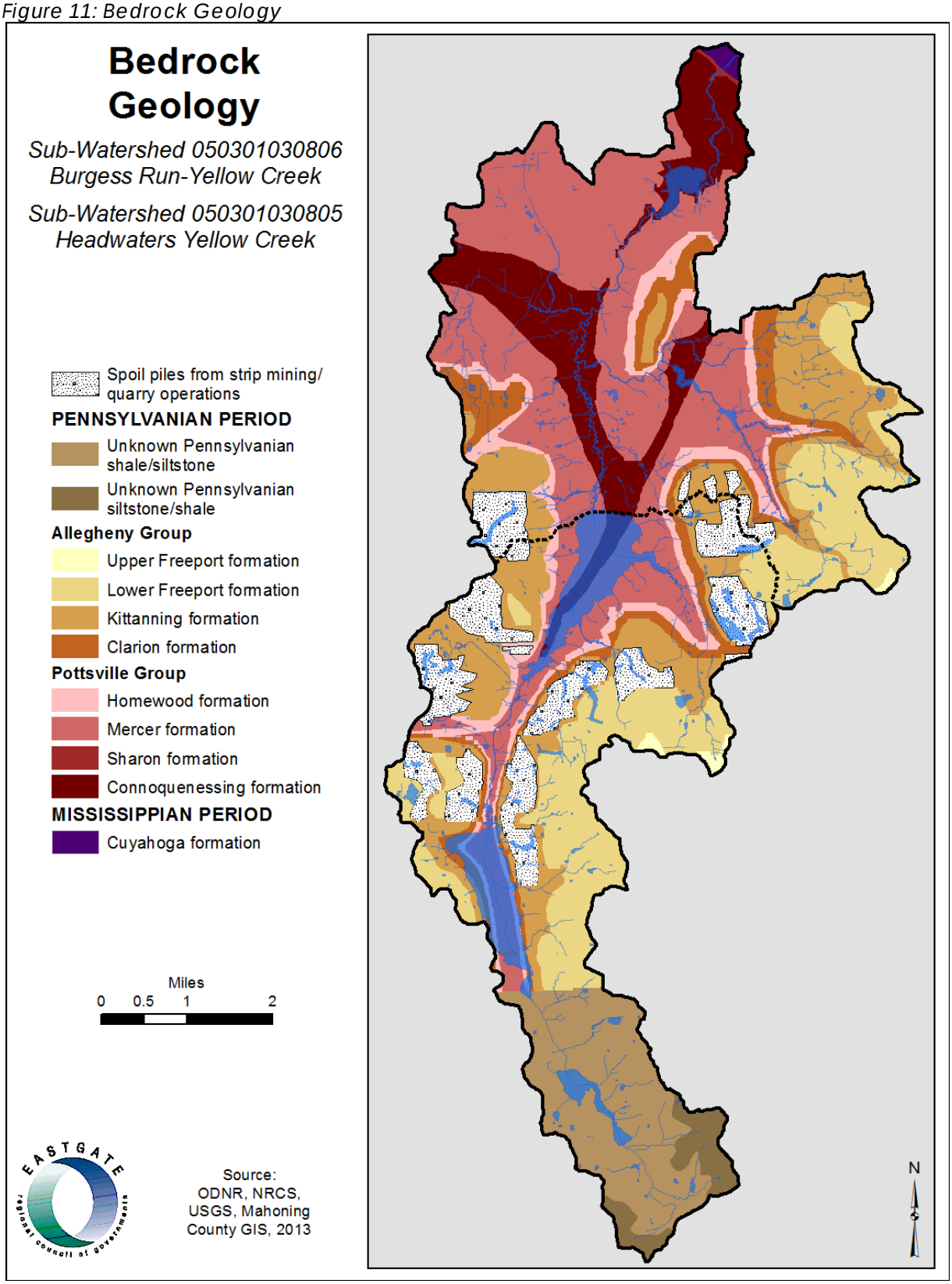
The Pennsylvanian bedrock found in Ohio is divided into four groups: Pottsville, Allegheny, Conemaugh and Monongahela. Only the Pottsville and Allegheny groups are present in the Yellow Creek Watershed. The Pottsville group is important for its mineral resources. One of the most noted formations in the Pottsville group is the Sharon formation. Its quartz pebbles, eroded from the Canadian Shield, and scenic features make it easily distinguishable.

The Allegheny group is important due to its clay beds and thick and persistent coals, its iron ores, shales, sandstones, and limestones (Stout, 1944). The bedrock of the Yellow Creek Watershed is outlined and described in *Table 16* (Ohio Division of Geological Survey, 1979).

Table 16: Bedrock Geology

Period	Group	Feature	Description
Pennsylvanian	Allegheny	Upper Freeport formation	Alternating sequences of coal, clay shale, and sandstone
		Lower Freeport formation	Alternating sequences of coal, clay, shale, and sandstone
		Kittanning formation	Alternating sequences of coal, clay, shale, and sandstone
		Clarion formation	Shale, sandy shale, coal, and underclay
	Pottsville	Homewood formation	Medium-grained sandstone (lower) and shale (upper), changing laterally from entirely sandstone to predominantly shale and siltstone
		Mercer formation	Interbedded shale, limestone, coal, and sandstone
		Sharon formation	Conglomerate (lower) and shale (upper)
		Connoquenessing formation	Sandstone with intervening shale
Mississippian	-	Cuyahoga formation	Interbedded shale, sandstone, and siltstone

Figure 11: Bedrock Geology



3. Soils

The general soil associations in the Yellow Creek watershed include the Wooster-Ravenna-Frenchtown-Chili-Canfield association, the Chili association, and the Ravenna-Morristown-Canfield association (*Table 17*, *Figure 12*).

Table 17: Soil Associations

Symbol	Name	Acres	Percent of Watershed
s6083	Wooster-Ravenna-Frenchtown-Chili-Canfield	13,514.54	53.43%
s6086	Chili	11,485.47	45.40%
s6546	Ravenna-Morristown-Canfield	295.62	1.17%
Total		**25,295.63**	**100%**

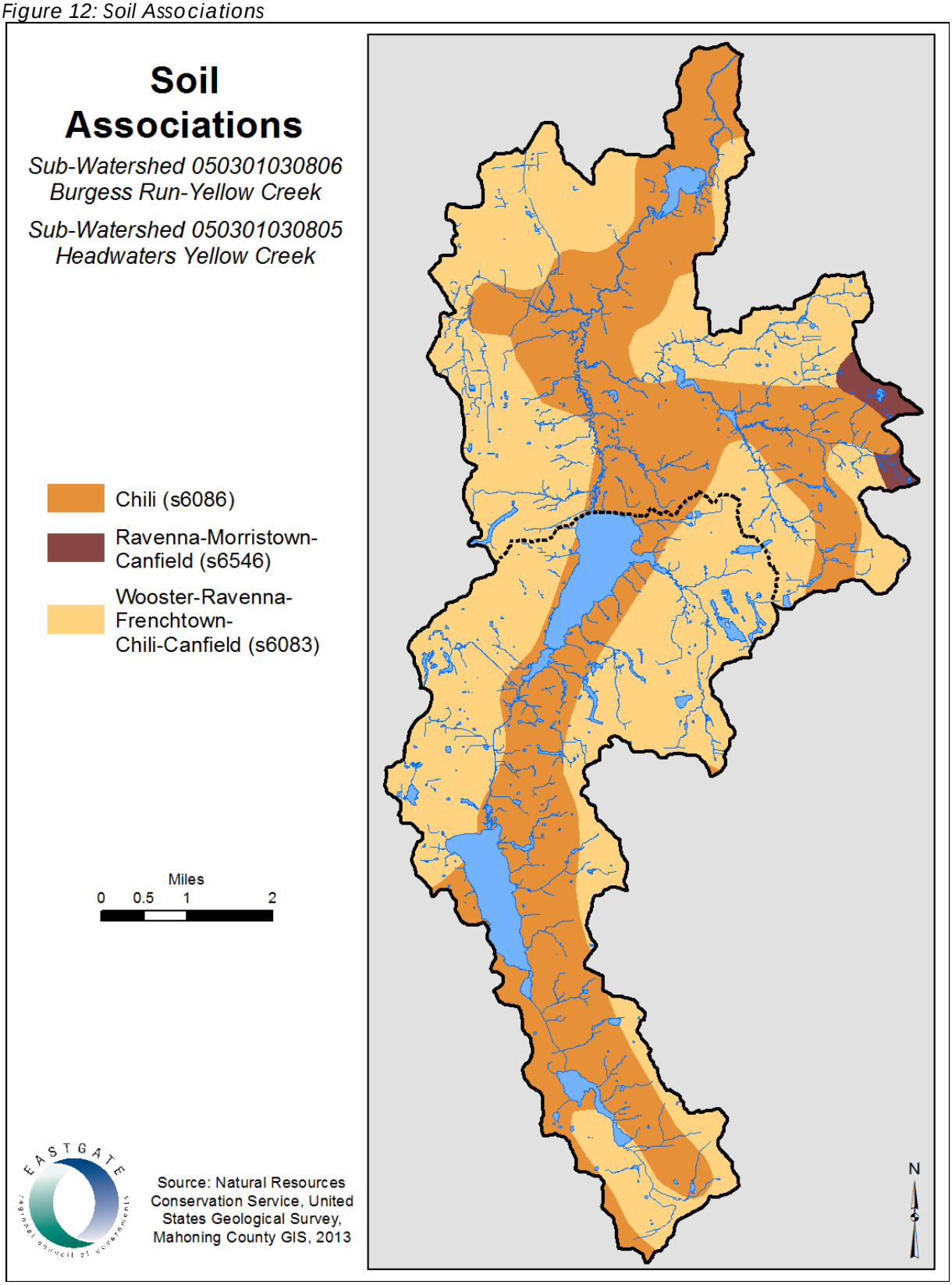
The Wooster-Ravenna-Frenchtown-Chili-Canfield (s6083) association is composed of mainly gently sloping, somewhat poorly drained to well-drained soils. It consists of loamy, deep, predominantly gently sloping soils underlain by loamy glacial till. Many soils in this association have a fragipan which restricts water movement through the lower part of the sub-soil. They are easily tilled, have a moderately deep root zone and favorable available moisture capacity, and are well suited for crops. There are few limitations to building, but some limitations to use as fields for disposing of effluent from septic tanks.

Higher and steeper areas of the Wooster-Ravenna-Frenchtown-Chili-Canfield association contain well-drained Wooster soils (25% of the association) and moderately well drained Canfield soils (30% of the association). Low areas and along drainage are typically where poorly drained Ravenna soils (15% of the association) and Frenchtown soils (10% of the association) can be found. Well drained Chili soils (12% of the association) are on areas of gravelly outwash.

The Chili association (s6086) is composed primarily of soils in the Chili series which represent 45% of the association. However, numerous other soils from a variety of series exist in small percentages in the association. The Chili series, which dominates the association, consists of very deep, well drained soils formed in Wisconsinan age outwash deposits, mainly of sandstone and shale with a large amount of quartz gravel. Permeability is moderately rapid in the subsoil and rapid in the substratum. Most areas having less than 12% slopes are cleared and used for general farming, specialty crops, or pasture. Steeper areas are mostly deciduous hardwood forest.

The Ravenna-Morristown-Canfield association is composed of 22% Ravenna soils, 49% Morristown soils and 17% Canfield soils. Ravenna and Canfield soils are very deep, level to steep, somewhat poorly drained and moderately well drained soils that formed in till on till plains. Morristown soils formed in calcareous regolith from surface mine operations. The regolith is a mixture of partially weathered fine earth and fragments of bedrock. Coarse fragments are mostly limestone and shale with some medium-grained sandstone and siltstone.

Figure 12: Soil Associations



The watershed contains 1,585.57 acres of hydric rated soil. Hydric soils are "formed under conditions of saturation, flooding or ponding long enough during the growing season to develop anaerobic conditions in the upper part (59 Fed. Reg. 35680, 7/13/94)." Hydric soils support the growth of hydrophytic vegetation, plants known to thrive in areas of prolonged inundation and/or soil saturation during the growing season.

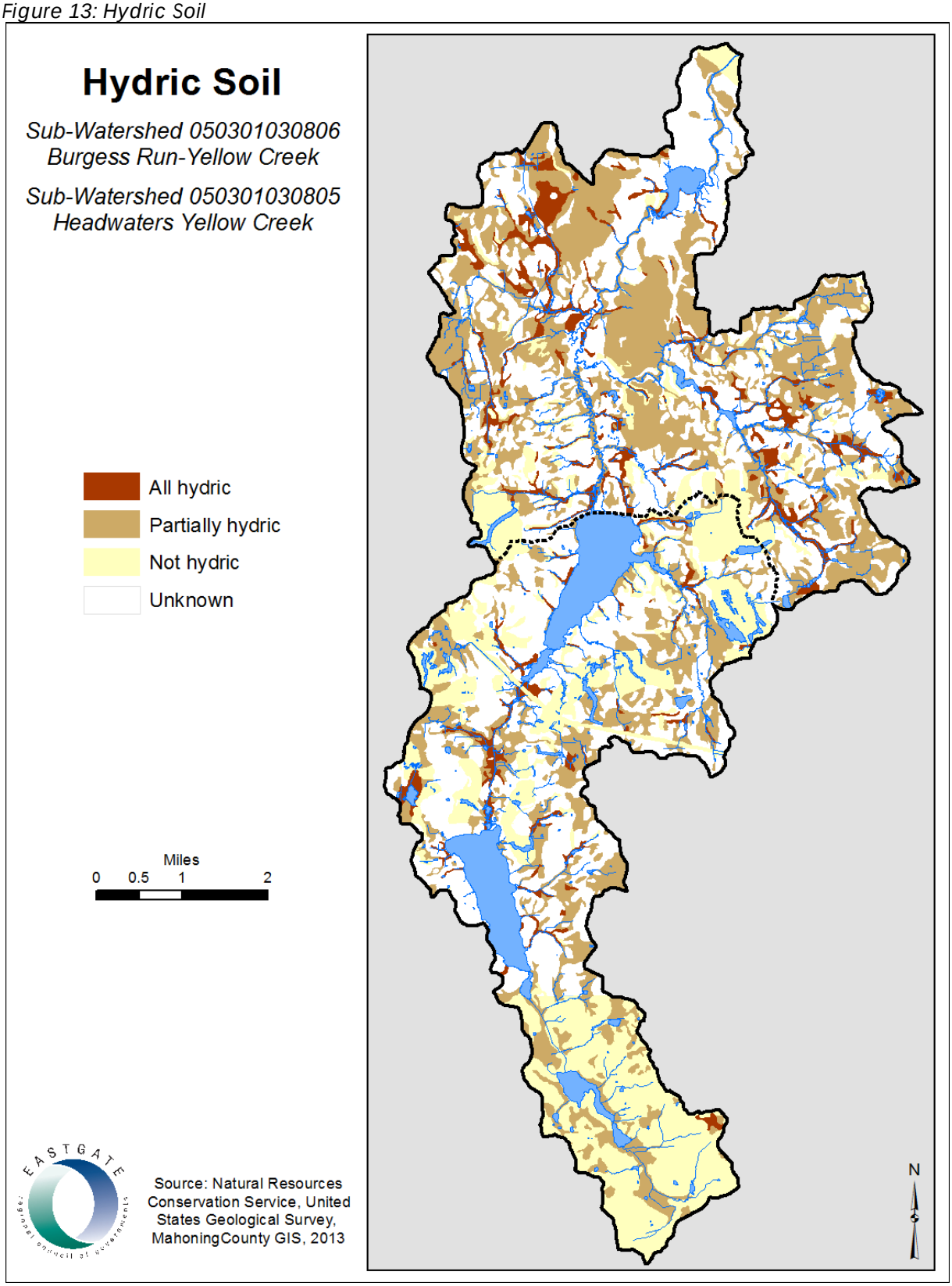
Hydric soil and hydrophytic vegetation are two of three required indicators for wetland designation (Mitsch & Gosselink, 2000). It is important to note wetlands must have hydric soils, but not all hydric soils contain wetlands. For more information on wetlands refer to pg. 50.

Because of frequent flooding or ponding, hydric soils pose limitations for development. However, hydric soils can and are developed through the use of ditches, canals, or diversion of upland surface runoff. A summary of hydric soil in the Yellow Creek Watershed is presented in *Table 18* and *Figure 13*.

Table 18: Soil Type and Hydric Rating

Hydric Rating	Acres	Percent of Watershed
All hydric	1,585.57	6.27%
Wayland silt loam	534.59	2.11%
Damascus loam	229.21	0.91%
Lorain silty clay loam	193.57	0.77%
Luray silty clay loam	139.86	0.55%
Papakating silt loam	130.97	0.52%
Luray silt loam	113.11	0.45%
Olmsted loam	88.88	0.35%
Marengo silty clay loam	47.20	0.19%
Carlisle muck	30.13	0.12%
Damascus loam, till substratum	25.93	0.10%
Papakating silty clay loam	23.01	0.09%
Frenchtown silt loam, 0 to 2 percent slopes	17.19	0.07%
Canadice silty clay loam	11.23	0.04%
Kerston muck	0.69	0.00%
Not hydric	5,073.30	20.06%
Partially hydric	7,557.50	29.88%
Unknown	11,079.26	43.80%
Total	**25,295.63**	**100%**

Figure 13: Hydric Soil



Refer to Appendix A for detailed maps of each Yellow Creek sub-watershed

Hydrologic soil groups refer to the runoff potential of a particular soil group. Soils are assigned to one of four groups based on their rate of water infiltration when soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long duration storms. The four main soil groups are as follows:

Group A: Includes soils with high infiltration rates (low run off potential) when thoroughly wet. These soils consist mainly of deep, well drained to excessively drained sands or gravely sands. Group A soils have a high rate of water transmission.

Group B: Includes soils with a moderate infiltration rate when thoroughly wet. These soils consist of moderately deep or deep, moderately drained or well drained soils with moderately fine texture to moderately coarse texture. Group B soils have a moderate rate of water transmission.

Group C: Includes soils having a slow infiltration rate when thoroughly wet. They consist of mainly of soils with a layer that prevents the downward movement of water or soils of moderately fine texture or fine texture. Group C soils have a slow rate of water transmission.

Group D: Includes soils with a very slow infiltration rate (high runoff potential) when thoroughly wet. The soils consist mainly of clays that have a high shrink-swell potential, soils that have a high water table, soils with claypan or a clay layer at or near the surface, and shallow soils over a nearly impervious material. Group D soils have a very slow rate of water transmission.

Certain wet soils are placed into Group D due to the presence of a water table within 60 cm of the surface even though the saturated hydraulic conductivity may be favorable to water transmission. If such soils can be adequately drained, then they are assigned to dual hydrologic soil groups (A/D,B/D, and C/D) based on their saturated hydraulic conductivity and the water table depth when drained. Only soils in their natural condition in Group D are assigned dual classes.

Table 19 summarizes the hydrologic soil types within the watershed. Soils within the watershed are made up of Group C soils. These soils are typically between 20 and 40 percent clay and less than 50 percent sand and have loam, silt loam, sandy clay loam, clay loam, and silty clay loam textures.

Table 19: Hydrologic Soil Groups

	Soil Groups						
	A	**A/D**	**B**	**B/D**	**C**	**C/D**	**D**
Acres	164	8	157	331	515	271	246

4. Glacial History

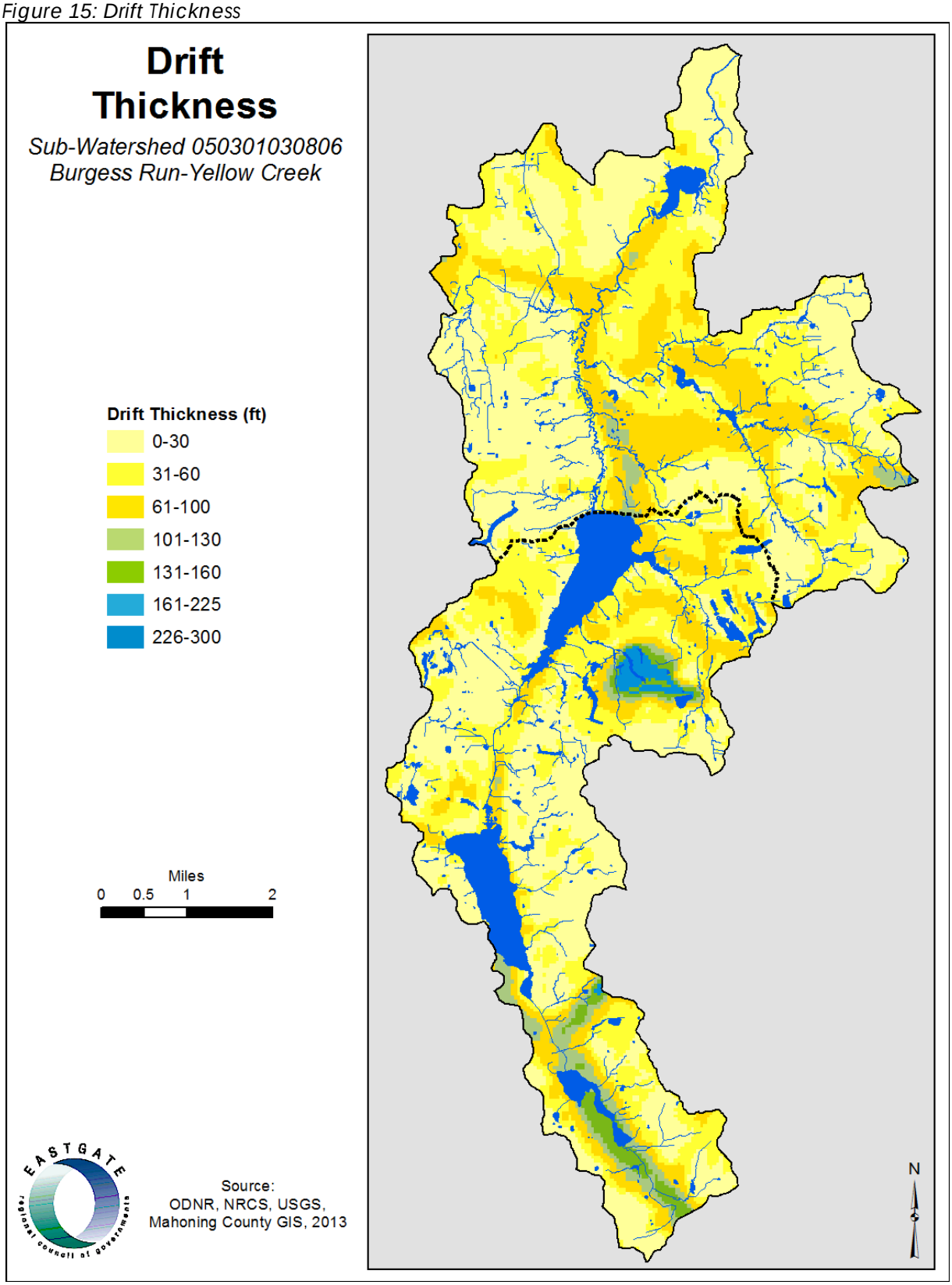
The Pleistocene Epoch began about 2 million years ago when the Earth's climate cooled sufficiently to allow great ice sheets to form in Canada and spread south across North America. Ice sheets formed, spread, and then melted back more than a dozen times during the Pleistocene.

Ohio was affected by the last two recent ice advances, the Wisconsinan and the Illinoian, and also a number of pre-Illinoian glaciations. The Wisconsinan glaciation occurred from 24,000 to 14,000 years ago and covered the northern, central, and western portions of Ohio (Hansen, 1997)(*Figure 14*). Ice altered Ohio topography by scouring the landscape, leaving sediment behind, and changing drainage patterns. Each major ice advance covered deposits left by the previous, therefore most landforms seen in Ohio today can be attributed to the most recent Wisconsinan glaciation.

Figure 14: Maximum glacial extent in Ohio.

Sediment left behind after the glacial retreat, known as glacial drift, are composed of boulders, cobbles, sand, silt, clay that were scoured from the landscape over which the ice passed. This material was deposited either directly by the ice or by glacial meltwater. The thickness of glacial drift and post-glacial stream sediments in the Yellow Creek Watershed is shown in *Figure 15*.

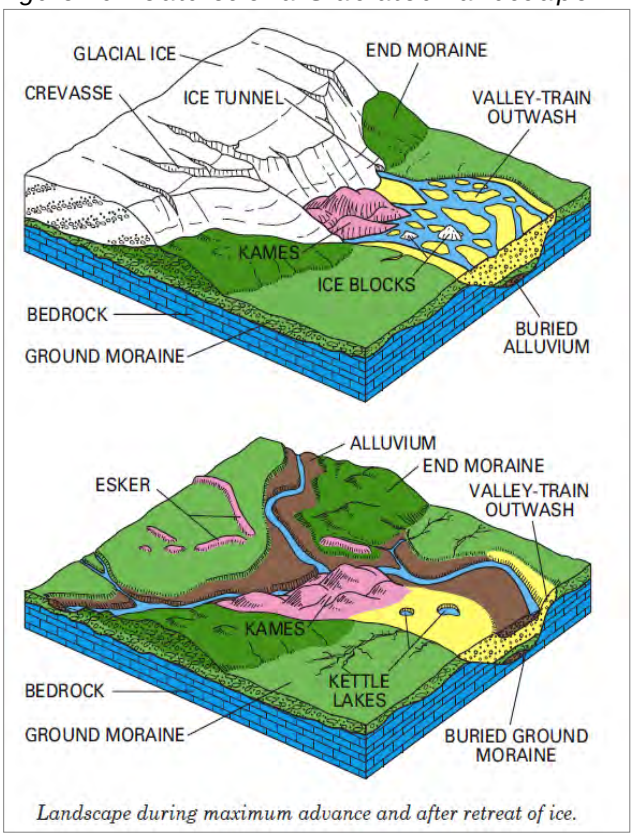
Figure 15: Drift Thickness



Unsorted sediment deposited either at the bottom of the advancing ice or left behind during glacial retreat is called till. Till is formed into parallel ridge moraines at locations where a glacier stops for a period of time. During a glacial retreat, till forms a blanket over the landscape known as ground moraine.

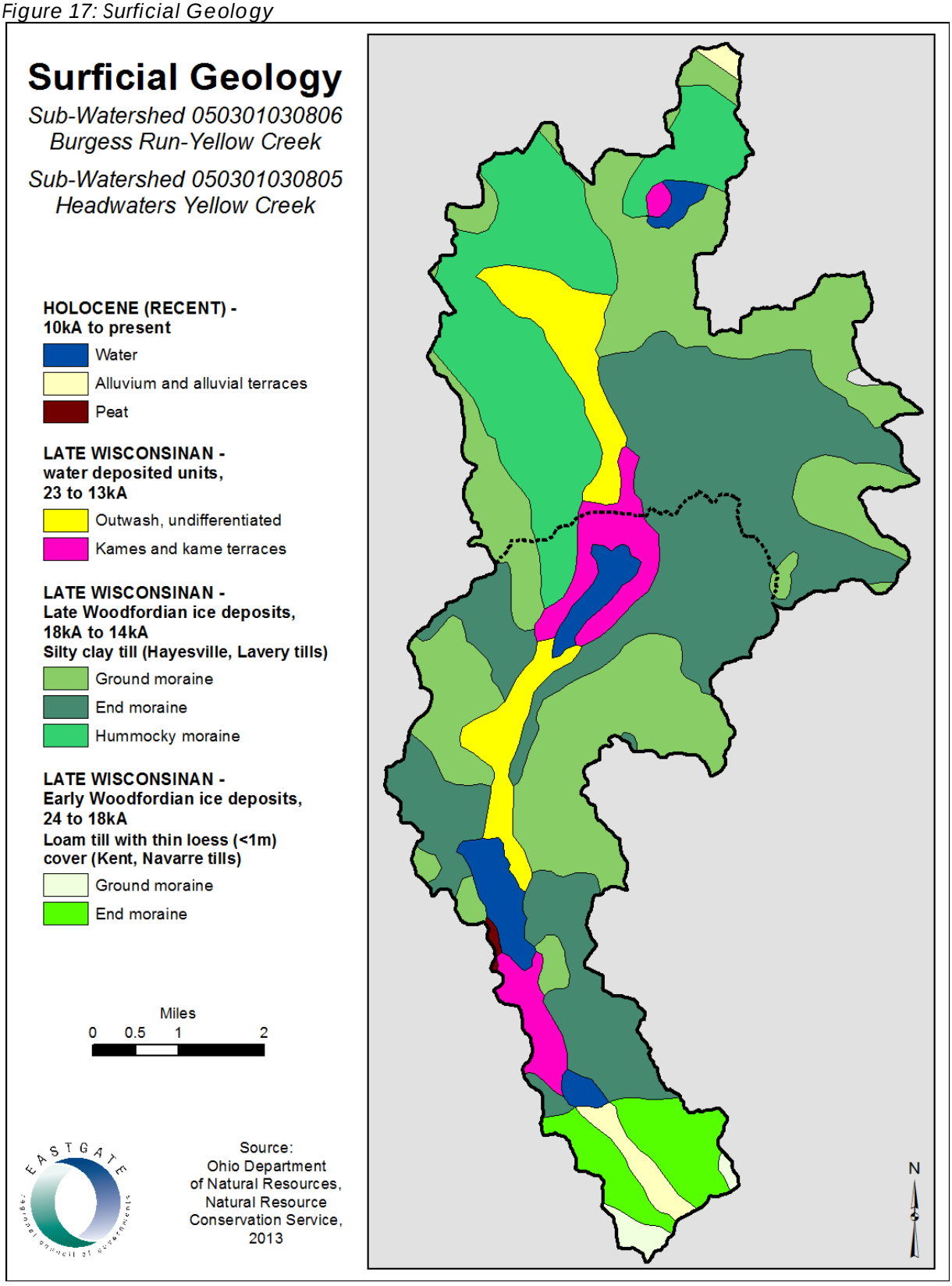
Sediments are also deposited by meltwater from on, in, or under the ice. Kames are mounds of sand and gravel formed when sediment on top of the ice is carried by meltwater and fills in crevices and holes in the ice near the glacial margin. Eskers are long, linear or sinuous ridges of sand and gravel marking the location of former rivers. As glaciers melt and retreat, alluvium or loose unconsolidated sediment is deposited in river valleys. Meltwater also moves and deposits sediment far from the glacial margin, known as outwash areas (Hansen, 1997). *Figure 16* identifies these common features of glaciated terrain.

Figure 16: Features of a Glaciated Landscape



The Yellow Creek Watershed is unique because it is near a boundary of maximum glacial extent. As a result, the watershed displays features characteristically occurring at glacial margins including ridge moraine, hummocky moraine, kames, and outwash deposits (*Figure 17*). The till, which composes the moraines in the watershed, include silty clay Hayesvlle and Lavery tills and loamy Kent and Navarre tills.

Figure 17: Surficial Geology



ii. Biological Features

Ohio is divided into five eco-regions: Lake Plains, Glaciated Appalachian Plateau, Till Plains, Unglaciated Appalachian Plateau, and Bluegrass. Each eco-region is defined by its own geological profile and similar biological communities and natural resources. The Yellow Creek Watershed is located within the Erie/Ontario Drift and Lake Plain eco-region (Level III). Vegetation within this region typically includes hardwood, beech-maple, and elm-ash forests.

1. Rare, Threatened, and Endangered Species

The Natural Heritage Database, managed by the Division of Natural Areas & Preserves (DNAP) Natural Heritage Program, was started in 1976. It now contains more than 17,000 records representing known locations for Ohio's rare plants and animals, high quality plant communities and other natural features. Data is obtained from a broad range of sources throughout the state and is used by DNAP for environmental review processes. Data is also provided to consulting firms, federal, state and local government agencies, researchers, conservation groups, and private citizens.

A review of DNAP for the Yellow Creek Watershed did not produce a list of rare, threatened, or endangered fish, mussels, invertebrates, mammals, birds, reptiles or amphibians for the watershed. However lists of presumed mammals, birds, and reptiles were created in December 2003 by Dan McMillen, a private Lands Biologist with ODNR's Division of Wildlife.

A cross reference with ODNR's list of "Wildlife that are Considered to be Endangered, Threatened, Species of Concern, Special Interest, Extirpated, or Extinct in Ohio" was performed to determine which from Dan's list were Endangered, Threatened, or Species of Concern. The following section details the findings and a letter next to the scientific name indicates if the species is one of Concern (C), Threatened (T), or Endangered (E).

Mammals

Table 20: Mammals

Common Name	*Scientific Name*
White-tailed Deer	*Odocoileus virginianus*
Eastern Coyote	*Canis latrans*
Gray Fox	*Urocyon cinereoargenteus*
Least Weasel	*Mustela rixosa*
Long-tailed Weasel	*Mustela fernata*
Mink	*Mustela vison*
Raccoon	*Procyon lotor*
Red Fox	*Vulpes fulva*
Striped Skunk	*Mephitis mephitis*
Big Brown Bat	*Eptesicus fuscus*
Eastern Pipistrelle	*Pipistrellus subflavus*
Hoary Bat	*Lasiurus cinereus*
Little Brown Bat	*Myotis lucifugus*
Red Bat	*Laiurus borealis*
Silver-haired Bat	*Lasionycteris noctivagens*
Eastern Mole	*Scalops aquaticus*
Hairy-tailed Mole	*Parascalops breweri*
Star-nosed Mole	*Condylura cristata- C*
Least Shrew	*Cryptosis parva*
Short-tail Shrew	*Blarina brevicauda*
Cottontail Rabbit	*Sylvilagus floridanus*
Virginia Opossum	*Didelphis marsupialis*
Beaver	*Castor canadensis*
Deer Mouse	*Peromyscus maniculatus*
Eastern Chipmunk	*Tamias striatus*
Fox Squirrel	*Sciurus niger*
Gray Squirrel	*Sciurus carlinensis*
Red Squirrel	*Tamiasciurus hudsonicus*
House Mouse	*Mus musculus*
Meadow Vole	*Microtus pennsylvanicus*
Meadow Jumping Mouse	*Zapus hudsoniaus*
Muskrat	*Ondatra zibethica*
Norway Rat	*Rattus norvegicus*
Southern Flying Squirrel	*Claucomys colans*
White-footed Mouse	*Permoysucs leucopus*
Woodchuck	*Marmota monax*
River Otter	*Lutrans Canadensis*
Black Bear	*Ursus americanes- E*

Birds

Table 21: Birds

Common Name	*Scientific Name*
Wood Duck	*Aix sponsa*
Blue-Winged Teal	*Anas discors*
Green-Winged Teal	*Anas crecca*
Mallard	*Anas platyrhychos*
Lesser Scaup	*Aythya affinis*
Ring-necked Duck	*Aythya collaris*
Gadwall	*Anas strepera*
Redhead	*Aythya americana*
Canvasback	*Aythya valisineria*
American Widgeon	*Mareca americana*
Common Goldeneye	*Bucephala clangula*
Bufflehead	*Bucephala albeola*
Common Merganser	*Mergus merganser*
Hooded Merganser	*Lophodytes cucullatus*
Northern Pintail	*Anas acuta*
Northern Shoveler	*Anas clypeata*
Black Duck	*Anas rubripes*
Canada Goose	*Branta canadensis*
Chimney Swift	*Chaetura pelagica*
Ruby-Throated Hummingbird	*Archilochus colubris*
Common Nighthawk	*Chordeiles minor*
Killdeer	*Characdrius vociferus*
Great Blue Heron	*Ardea herodias*
Green Heron	*Butorides striatus*
Mourning Dove	*Zenaida macroura*
Rock Dove	*Columba livia*
Belted Kingfisher	*Ceryle torquata*
American Kestrel	*Falco sparverius*
Coopers Hawk	*Accipiter cooperii*
Red-tailed Hawk	*Buteo jamaicensis*
Red-Shouldered Hawk	*Buteo lineatus*
Broad-Winged Hawk	*Buteo platypterus*
Sharp-shinned Hawk	*Accipiter striatus- C*
Bald Eagle	*Haliaeetus leucocephalus-T*
Northern Harrier	*Circus cyaneus-E*
Osprey	*Pandion haliaetus- T*
Sharp-shinned Hawk	*Cathartes aura*
Virginia Rail	*Rallus limicola- C*
Sora Rail	*Porzana Carolina- C*
Ring-necked Pheasant	*Phasianus colchicus*
Wild Turkey	*Meleagris gallopavo*
Arcadia Flycatcher	*Empidonax virescens*
American Crow	*Corvus brachyrhynchos*

Common Name	***Scientific Name***
American Goldfinch	*Carduleis tristis*
American Redstart	*Septophaga ruticilla*
American Robin	*Turdus migratorius*
Black-billed Cuckoo	*Coccyzus erythropthalmus*
Black-Capped Chickadee	*Parus atricapillus*
Blue Jay	*Cyannocitta cristata*
Bobolink	*Dolichonyx oryzivorous- C*
Brown Creeper	*Certhia familiaris*
Brown Thrasher	*Toxostoma rufum*
Pied-billed Grebe	*Podilymbus podiceps*
Horned Grebe	*Podiceps auritus*
Double-crested Cormorant	*Phalacrocorax auritus*
Mute Swan	*Cygnus olor*
Tundra Swan	*Olor columbianus*
Ruddy Duck	*Oxyura jamaicensis*
Red-breasted Merganser	*Mergus serrator*
American Coot	*Fulica americana*
Common Gallinule	*Gallinula chloropus*
American Egret	*Casmerodius albus*
American Woodcock	*Philehela minor*
Common Snipe	*Capella gallinago*
Short-Billed Dowitcher	*Limnodromus griseus*
Long-billed Dowitcher	*Limnodromus scolopaceus*
Greater Yellowlegs	*Tringa melanoleuca*
Lesser Yellowlegs	*Tringa flavipes*
Spotted Sandpiper	*Actitis macularia*
Ruffed Grouse	*Bonosa umbellus*
Common Bobwhite Quail	*Colinus virginianus*
Great Horned Owl	*Bubo virginianus*
Barred Owl	*Strix varia*
Screech Owl	*Otus asio*
Red-Headed Woodpeckeer	*Melanerpes erythrocephalus*
Pileated Woodpecker	*Dryocopus pileatus*
Common Flicker	*Colaptes auratus*
Red-Bellied Woodpecker	*Melanerpes carolinus*
Downy Woodpecker	*Picoides pubescens*
Hairy Woodpecker	*Picoides villosus*
Eastern Kingbird	*Tyrannus tyrannus*
Eastern Pewee	*Contopus virens*
Eastern Phoebe	*Sayornis phoebe*
Purple Martin	*Progne subis*
Cliff Swallow	*Pertochelidon pyrrhonota*
Barn Swallow	*Hirundo rustica*
Tree swallow	*Iridoprocne bicolor*
Bank Swallow	*Riparia riparia*
Tufted Titmouse	*Parus bicolor*
Carolina Chickadee	*Parus carolinensis*

Common Name	***Scientific Name***
White-Breasted Nuthatch	*Sitta carolinensis*
House Wren	*Troglodytes aedon*
Gray Catbird	*Dumetella carolinensis*
Northern Mockingbird	*Mimus polyglottos*
Eastern Bluebird	*Sialia sialis*
Wood Thrush	*Hylocichla mustelina*
Cedar Waxwing	*Bombycilla cedrorum*
Red-eyed Vireo	*Vireo olivaceus*
Prothonotary Warbler	*Protonotaria citrea- C*
Yellow Warbler	*Dendroica petechia*
Hooded Warbler	*Wilsonia citrina*
Red-winged Blackbird	*Agelaius phoeniceus*
Brown-headed Cowbird	*Molothrus ater*
Common Grackle	*Quiscalus quiscalus*
Eastern Meadowlark	*Sturnella magna*
European Starling	*Sturnus vulgaris*
Northern Oriole	*Icterus galbula*
Scarlet Tanager	*Piranga olivacea*
House Sparrow	*Passer domesticus*
Northern Junco	*Junco hyemalis*
Northern Cardinal	*Cardinalis cardinalis*
House Finch	*Carpodacus mexicanus*
Indigo Bunting	*Passerina cyanea*
Rose-Breasted Grosbeak	*Pheucticus ludovicianus*
Rufus-Sided Towhee	*Pipilo erythrophthalmus*
White-Crowned Sparrow	*Zonotrichia leucophrys*
Chipping Sparrow	*Spizella passerina*
Field Sparrow	*Spizella pusilla*
Swamp Sparrow	*Melospiza geogiana*
Grasshopper Sparrow	*Ammodramus savannarum*
Vesper Sparrow	*Pooecetes gramineus*

Reptiles and Amphibians

Table 22: Reptiles and Amphibians

Common Name	*Scientific Name*
Snakes	
Black Rat Snake	*Elaphe obsoleta*
Black Racer Coluber	*constrictor constrictor*
Eastern Garter Snake	*Thamnophis siralis*
Eastern Milk Snake	*Lampropeltis triagulum*
Eastern Ribbon Snake	*Thamnophis sauritus*
Smooth Green Snake	*Opheodrys vernalis*
Five-lined Skink	*Eumeces fasciatus*
Northern Brown Snake	*Storeria dekayi*
Northern Water Snake	*Nerodia sipedon*
Queen Snake	*Natrix harteri*
Eastern Hognose Snake	*Heterodan platyrhinos*
Northern Ringneck Snake	*Diadophis punctatus*
Turtles	
Common Snapping Turtle	*Chelydra serpentina*
Eastern Box Turtle	*Terrapene Carolina- C*
Midland Painted Turtle	*Chrysemys picta marginata*
Common Musk Turtle	*Stinkpot Sternotherus odoratus*
Spiny Softshell Turtle	*Trionyx spiniferus*
Frogs and Toads	
American Toad	*Bufo americanus*
Bullfrog	*Rana catesbeiana*
Gray Treefrog	*Hyla vericolor*
Green Frog	*Rana clamitans*
Northern Leopard Frog	*Rana pipiens*
Spring Peeper	*Hyla crucifer*
Western Chorus Frog	*Pseudacris triseriata*
Wood Frog	*Rana slyvatica*
Salamanders	
Jefferson's Salamander	*Ambystoma jeffersonianum*
Marbled Salamander	*Ambystoma opacum*
Spotted Salamander	*Ambystoma maculatum*
Eastern Red-backed Salamander	*Plethodon cinereus*
Slimy Salamander	*Plethodon glutinosus*
Two-lined Salamander	*Eyrycea bisleneata*
Red-Spotted Newt	*Notophthalmus viridescens v.*
Four-toed Salamander	*Hemidactylium scutatum- C*
Northern Dusky Salamander	*Desmognathus fuscus*
Mudpuppy	*Necturus maculosus*

DNAP identified the following state endangered plant species in the Yellow Creek Watershed:

- Spreading Globeflower, *Trollius Laxus*
- Clinton's Wood Fern, *Dryopteris clintoniana*
- Heart-leaved Plantain, *Plantago cordata*

The Western Reserve Land Conservancy (WRLC)adds another state endangered species, Flat-leaved Rush (*Juncus platyphyllus*); and two state threatened plant species: Five-angled Dodder, *Cuscuta pentagona* and Simple Willow-herb, *Epilobium strictum*.

Eastgate contacted the Ohio EPA's Northeast District Office to obtain an Ecological Assessment Unit (EAU) report for the watershed. According to the district an EAU is not available for the watershed, but one should begin in 2013.

2. Invasive Nonnative Species and Potential Impacts

Invasive species damage the lands and waters native plants and animals need to survive. Invasives contributed directly to the 42% decline of threatened and endangered species in the United States. The annual cost to the United States economy is estimated at $120 billion a year, with over 100 million acres (an area roughly the size of California) suffering from invasive plant infestations.

On their home turf, plant and animal populations are kept in check by natural controls such as predators and food supply. However, when a species is introduced, accidentally or intentionally, into a new landscape that is not used to its presence, the consequences can be devastating.

Plants

Approximately 700-800 species of plants in Ohio are not native to the state. About 100 non-native plants invade woodlands and displace native spring wildflowers. Others impact wetlands, grasslands and prairies. The degree to which invasive plant species affect Ohio natural areas varies, but some invasives pose serious threats to native species and the ecological integrity of Ohio's native biological diversity. Although no formal invasive surveys exist within the Yellow Creek Watershed, it is probable the following species of invasive plants may be found:

- Reed Canary Grass, *Phalaris arundinacea*
- Purple Loosetrife, *Lythrum salicaria*
- Multiflora Rose, *Rosa multiflora*
- Japanese Knotweed, *Polygonum cuspidatum*
- Japanese Honeysuckle, *Lonicera japonica*
- Garlic Mustard, *Alliaria petiolata*
- Common Reed Grass, *Phragmites australis*
- Buckthorn, *Rhamnus fragula*
- Bush Honeysuckle, *Lonicera maakii, L. tatarica, L. morrowii*
- Autumn-olive, *elaeagnus umbellate*

In order to protect Ohio's natural areas from threats, organizations and agencies team up, as part of the Ohio Invasive Plants Council, and serving as a resource for public land managers regarding invasive species related issues.

Management measures have been taken to eliminate Purple Loosetrife and Garlic Mustard in Yellow Creek Park and Poland Woods, by the Mill Creek MetroParks and the Poland Municipal Forest volunteers.

The following lists of invasive plants were retrieved from The Nature Conservancy's, *Invasive Plant Distribution Database 01-29-2002:*

Targeted Species (13 out of 13)
Alliaria petiolata (Garlic mustard)
Elaeagnus umbellate (Autumn olive)
Lonicera japonica (Japanese honeysuckle)
Lonicera maackii (Amur honeysuckle)
Lonicera morrowii (Morrow honeysuckle)
Lonicera tatarica (Tatarian honeysuckle)
Lythrum salicaria (Purple loosestrife)
Phalaris arundinacea (Reed canary grass)
Phragmites australis (Reed grass)
Polygonum cuspidatum (Japanese knotweed)
Rhamnus cathartica (European buckthorn)
Rhamnus frangula (Glossy buckthorn)
Rosa multiflora (Multiflora rose)

Well-established Species (30 out of 38)
Agropyron repens (Quack grass)
Ailanthus altissima (Tree-of-heaven)
Berberis thunbergii (Japanese barberry)
Bromus inermis (Smooth brome)
Cirsium arvense (Canada thistle)
Conium maculatum (Poison hemlock)
Convolvulus arvensis (Field bindweed)
Daucus carota (Queen Anne's lace)
Dipsacus laciniatus (Cut-leaved teasel)
Dipsacus sylvestris (Common teasel)
Elaeagnus angustifolia (Russian olive)
Epilobium hirsutum (Hairy willow-herb)
Euonymus alatus (Winged euonymus)
Euonymus fortunei (Wintercreeper)
Festuca pratensis (Meadow fescue)
Hemerocallis fulva (Day-lily)
Hesperis matronalis (Dame's rocket)
Iris pseudacorus (Yellow flag)
Ligustrum vulgare (Common privet)
Lysimachia nummularia (Moneywort)
Melilotus alba (White sweet-clover)
Melilotus officinalis (Yellow sweet-clover)
Myriophyllum spicatum (Eurasian water-milfoil)
Najas minor (Lesser naiad)
Nasturtium officinale (Water-cress)
Potamogeton crispus (Curly pondweed)
Saponaria officinalis (Bouncing Bet)
Typha X glauca (Hybrid cattail)
Viburnum opulus var. opulus (European cranberry-bush)
Vinca minor (Periwinkle)

Watch List Species (3 out of 14)
Lonicera X bella (Showy pink honeysuckle)
Ornithogalum umbellatum (Star-of-Bethlehem)
Rosa canina (Dog rose)

iii. Water Resources

1. Climate and Precipitation

Northeast Ohio is classified as Dfa (humid continental) by the Köppen-Geiger climate classification system (the world's most widely used climate classification system). A hot (or very warm) version of a continental climate features an average temperature of at least 22 °C (71.6 °F) in its warmest month. The warmest month is usually July, though it some cases it may be August. Average July afternoon temperatures generally average above 26 °C (79 °F), while the average temperature of the coldest month is −3 °C (26.6 °F) or colder. In some instances, the average temperature of the coldest month can be well below −3 °C (26.6 °F). Climate averages for the Yellow Creek area are detailed in Table 23 and Figure 18 to Figure 24.

Table 23: Youngstown, OH Climate - 1971-2000

Normal Monthly Precipitation (Inches)													
YRS	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
30	2.34	2.03	3.05	3.33	3.45	3.91	4.1	3.43	3.89	2.46	3.07	2.96	38.02
Normal Daily Mean Temperature, Deg F													
YRS	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
30	24.9	27.7	36.7	47.4	57.6	65.9	69.9	68.4	61.5	50.8	40.7	30.4	48.5
Snowfall - Average Total In Inches													
YRS	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
59	13.2	10.9	10.9	2.4	0.1	T	T	0	T	0.6	5.4	12.3	55.8
Average Relative Humidity (%) Morning(M), Afternoon(A)													
YRS	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
	M A	M A	M A	M A	M A	M A	M A	M A	M A	M A	M A	M A	M A
55 55	81 72	80 68	80 63	77 56	79 54	82 56	85 56	89 57	89 59	85 58	82 67	82 72	83 61

Figure 18: Average Temperature in Youngstown, Ohio

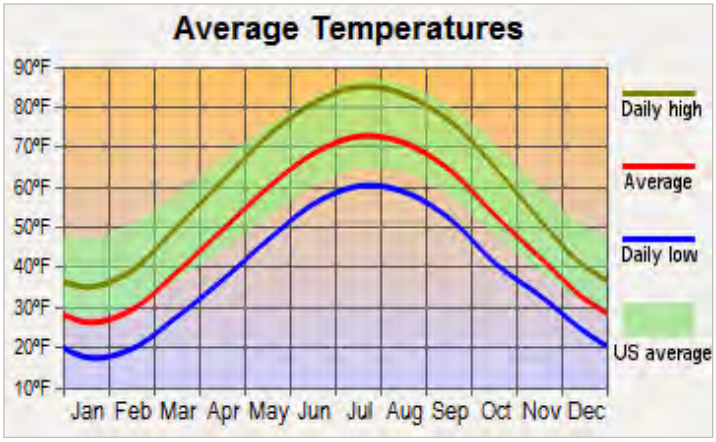


Figure 19: Average Precipitation in Youngstown, Ohio

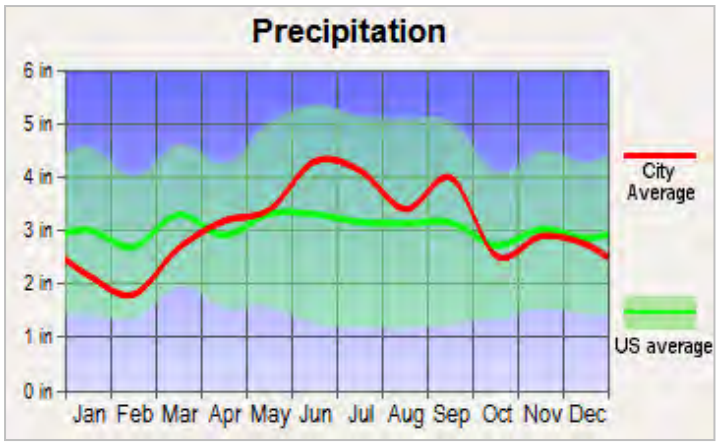


Figure 20: Average Humidity in Youngstown, Ohio

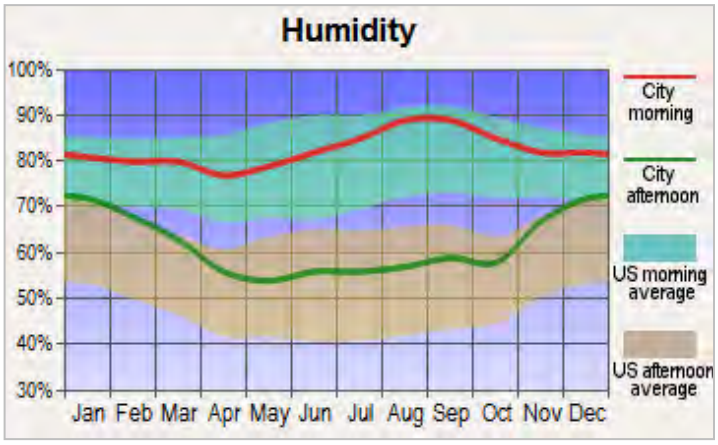


Figure 21: Average Wind Speed in Youngstown, Ohio

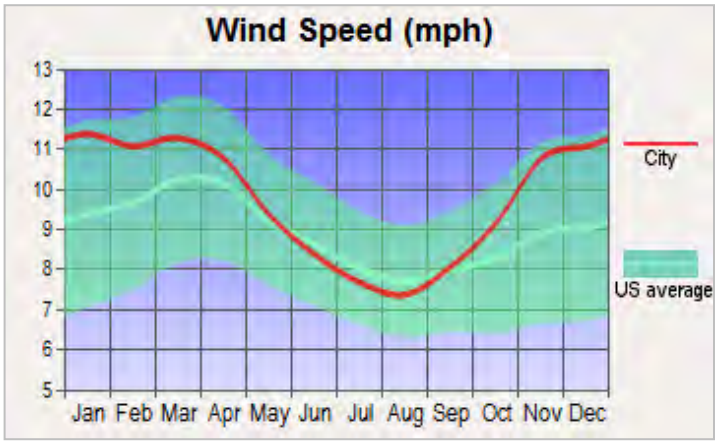


Figure 22: Average Snowfall in Youngstown, Ohio

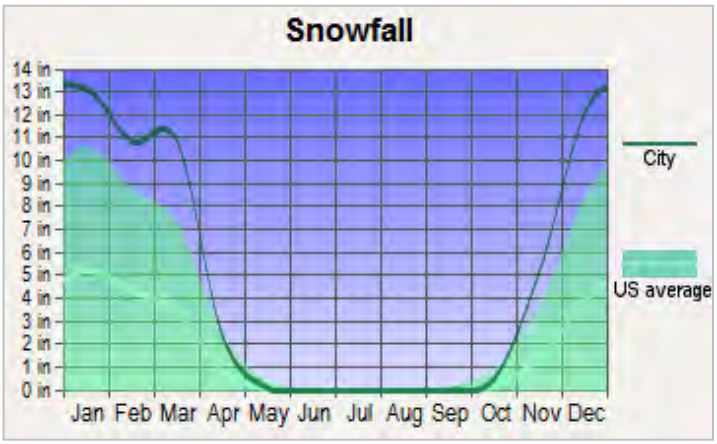


Figure 23: Average Sunshine in Youngstown, Ohio

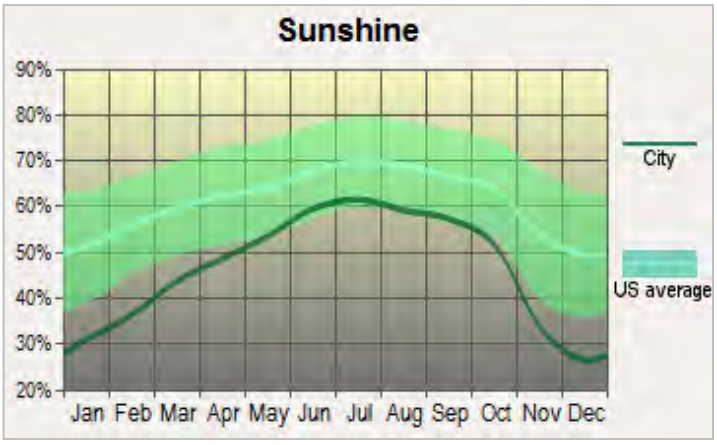
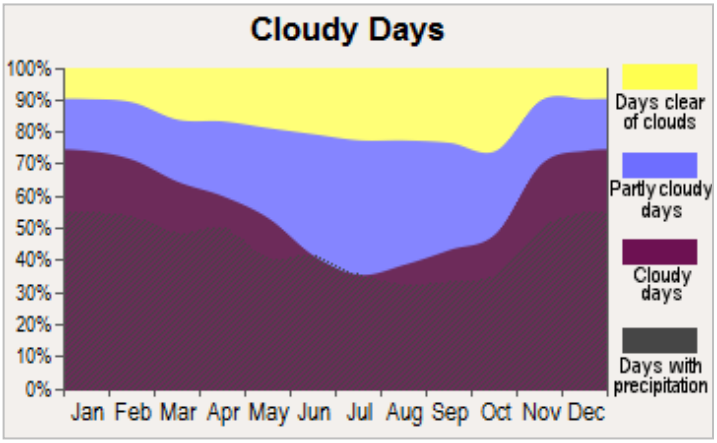


Figure 24: Average Cloudy Days in Youngstown, Ohio



2. Surface Water

Wetlands

A wetland is land saturated with water long enough to develop unique plant and soil characteristics. Wetlands range in size from a few acres to a few hundred kilometers and can be an obvious expansion of shallow marsh or have the appearance of a regular forest. There are five main wetland types: Marine, associated with oceans; Estuarine, influenced by ocean water and freshwater from land; Riverine, confined to a channel; Lacustrine, often in a topographic depression and lacking extensive vegetation; and Palustrine, freshwater dominated by vegetation. Palustrine wetlands are the predominant type of inland wetland. All wetlands must have hydrophytic vegetation, hydric soils and wetland hydrology.

Hydrophytic vegetation are plants adapted to living in water or saturated soils. Hydrophytic vegetation is present if more than 50% of the dominant species are obligate wetland, facultative wetland or facultative on the National List of Plant Species or other lists of plant species that occur in wetlands. Obligate and facultative refer to the probability of the plant living in a wetland (Mitsch & Gosselink, 2000).

Hydric soils are "formed under conditions of saturation, flooding or ponding long enough during the growing season to develop anaerobic conditions in the upper part (59 Fed. Reg. 35680, 7/13/94)." Refer to pg. 31 for more information on hydric soil. Wetland hydrology is considered present by observation of water sources, drainage patterns, sediment deposition, watermarks, stream gage data, saturated soils and inundation (U.S. Army Corps of Engineers Environmental Laboratory, 1987).

Wetland locations were acquired from the National Wetland Inventory (NWI) and the Ohio Wetland Inventory (OWI). NWI data was obtained from Ducks Unlimited. Ducks Unlimited is updating the NWI for the states in its Great Lakes/Atlantic Region, in consultation with the U.S. Fish and Wildlife Service and state governments. The updated NWI data is in draft form, but OWI data was obtained from the Ohio Department of Natural Resources.

The NWI is primarily from aerial photograph interpretation and limited field verification. The Fish and Wildlife Service used high altitude black and white photography to make the first NWI maps, but as technology developed better resolution images, color infrared data, and stereoscopic image interpretation was used (Tiner, 1999). The updated NWI from Ducks Unlimited uses recent imagery to revise the original NWI.

Because the NWI was created from aerial photo interpretation, it can be subject to error. Large wetlands are accurately mapped by the NWI. Small wetlands were frequently omitted because NWI maps have a scale of 1:24,000 (1999). The NWI classifies wetlands based on the Cowardin Wetland Classification System (Cowardin, 1979).

The Ohio Wetland Inventory (OWI) was created from visual interpretation of Landsat Thematic Mapper images in 1987. Landsat imagery has a resolution of $30m^2$. Therefore, wetlands under that size are unmapped by the OWI. The OWI divides potential wetland areas into categories: woods on hydric soil, open water, shallow marsh, farmed wetland, shrub/scrub wetland, or wet meadow.

Since the OWI and NWI maps were created, significant suburban development occurred in the watershed. As a result, the OWI and NWI maps show wetland locations that no longer exist. For example, many former wetland locations are now big box store parking lots. The OWI and NWI data were edited to reflect these changes and to better represent the actual amount of wetlands in the watershed. The OWI and NWI data was edited for accuracy using 2008 color aerials with .25-foot resolution and 2006 color infrared aerials with 1-meter resolution.

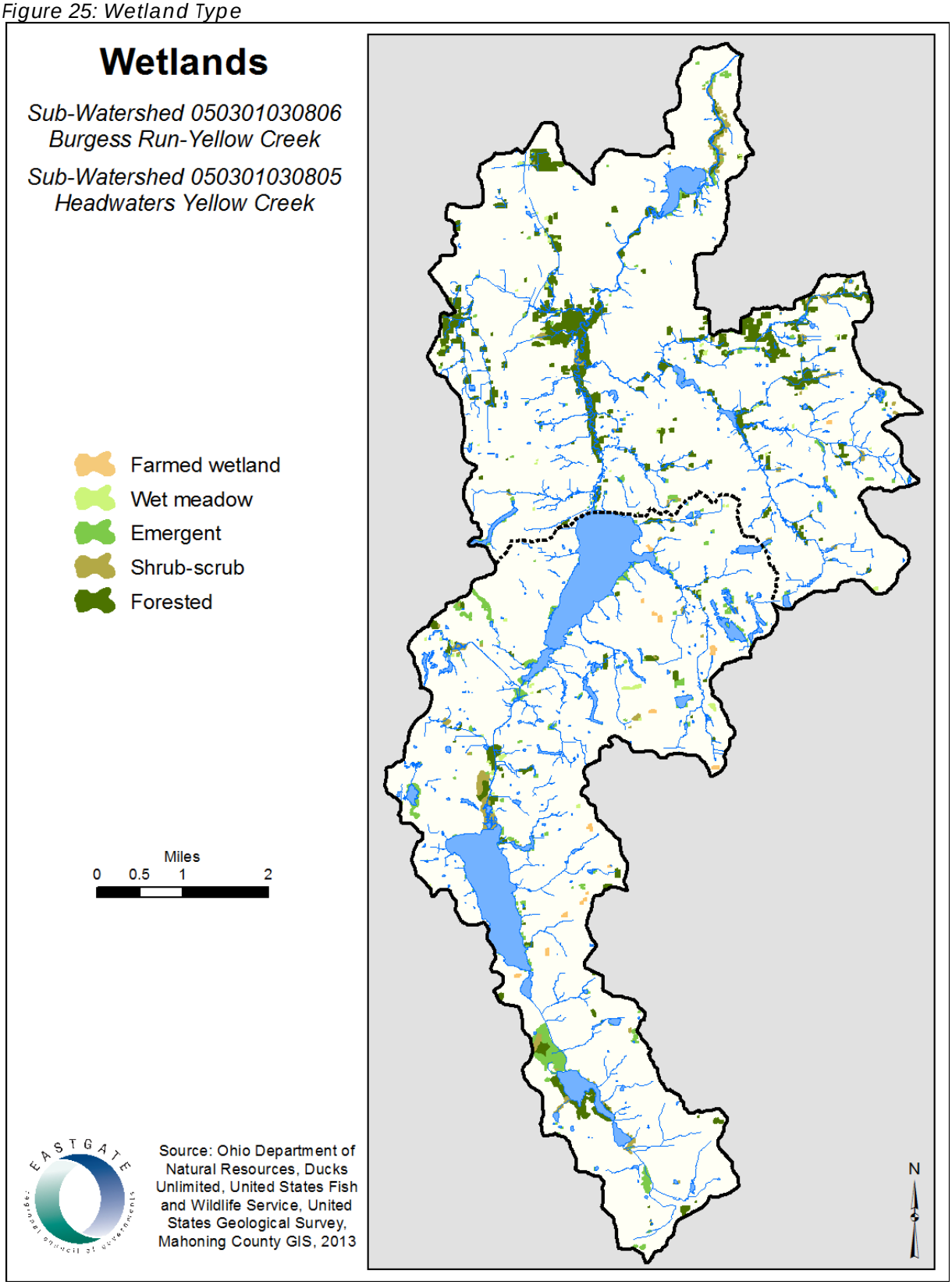
According to the raw OWI data, the Yellow Creek Watershed has 784.53 acres of wetlands. After editing, the OWI was reduced to 641.25 acres. The raw NWI data identified 678.48 acres of wetlands. After editing, the NWI was reduced to 622.47 acres of wetlands.

The edited wetland data from the NWI and the OWI were combined to remove overlap between the datasets and give a more accurate representation of wetland acreage in the Yellow Creek Watershed. The wetland categories of the NWI and OWI were summarized and consolidated into five general types. The resulting wetland summary for the Yellow Creek Watershed is outlined in *Table 24. Figure 25* illustrates wetland location and type.

Table 24: Wetland Type

Wetland Type	Acres
Forested Wetland	761.66
Emergent Wetland	192.67
Shrub-scrub Wetland	120.86
Wet Meadow	27.75
Farmed Wetland	16.67
Total	**1,119.61**

Figure 25: Wetland Type



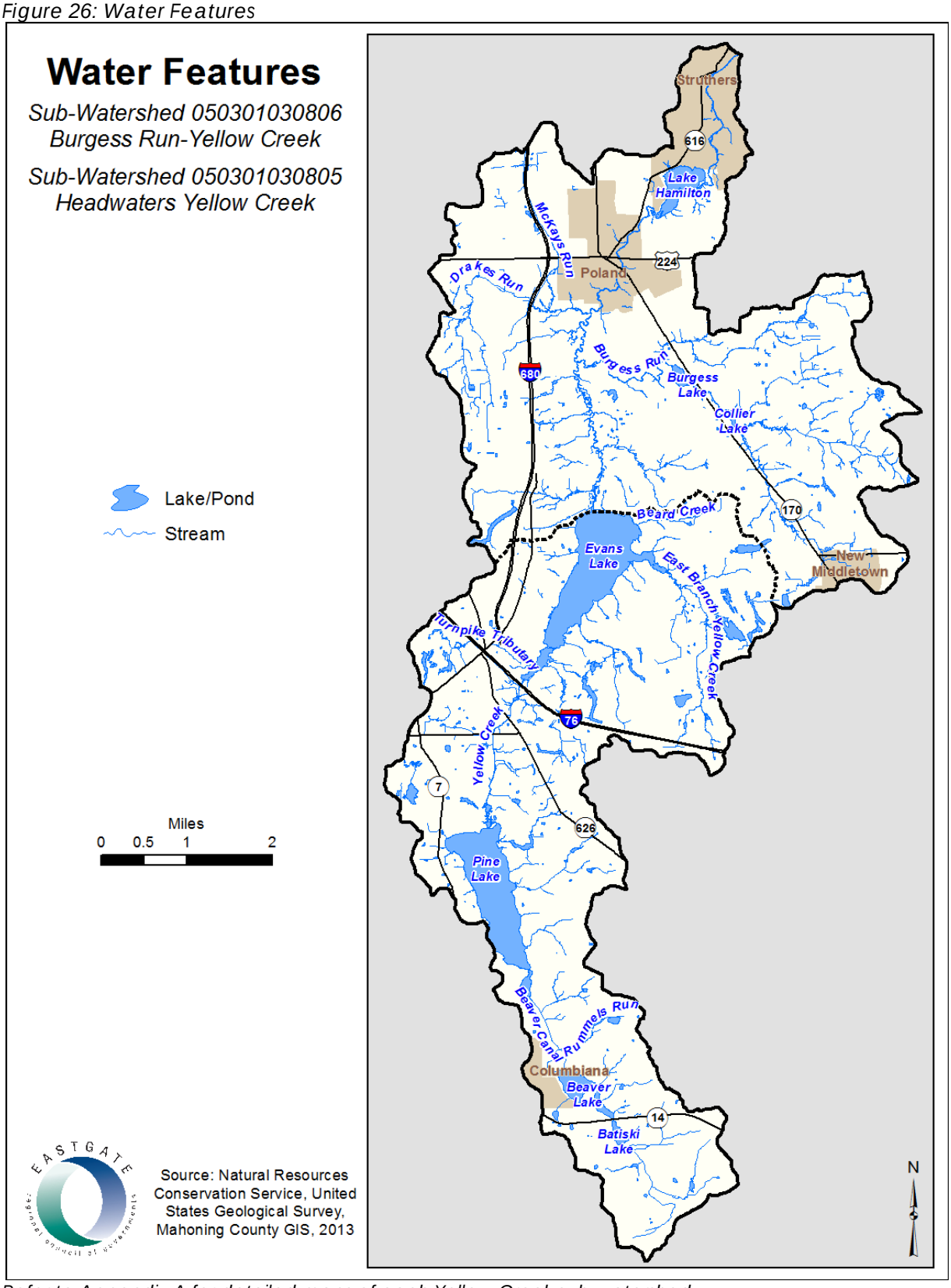
Refer to Appendix A for detailed maps of each Yellow Creek sub-watershed

Streams

The Yellow Creek watershed contains a total of 149.39 miles of streams. The mainstem of Yellow Creek is 22.11 miles (including headwaters) of the total calculation. Though the watershed has numerous streams, the Gazetteer of Ohio Streams only recognizes two: Yellow Creek and Burgess Run. Other streams locally recognized within the watershed include Skunk Cabbage Run, Beard Creek, East Branch Yellow Creek, Turnpike Tributary, Rummels Run, and Beaver Canal. One stream shares two different names, but the name depends on the stream's physical location: McKays Run is located in Boardman Park, but once it enters Poland Woods from the west (under I-680) it becomes Drakes Run. *Figure 26* illustrates the location of the named streams.

The Geographic Names Information System (GNIS) is the federal and national standard for geographic nomenclature. The USGS developed GNIS in support of the U.S. Board on Geographic Names as the official repository of domestic geographic names data. The database contains federally recognized names of each feature and defines the feature by state, county, USGS topographic map, and geographic coordinates. Based on a search of GNIS, there are no additional named streams within the watershed.

Figure 26: Water Features



Refer to Appendix A for detailed maps of each Yellow Creek sub-watershed

Tributary Features

According to a review of the United States Geologic Society's (USGS) website, no gauging stations exist on Yellow Creek or its tributaries. Therefore, Real- Time Water Data, including 10 year low flow and cfs information, is not available. Tributary drainage area (*Table 25*, *Figure 28*) was calculated by the USGS Stream Stats interactive map (http://water.usgs.gov/osw/streamstats/ohio.html). Length was calculated using Geographic Information Systems (GIS). The remaining tributary features were determined using aerial photograph and local knowledge.

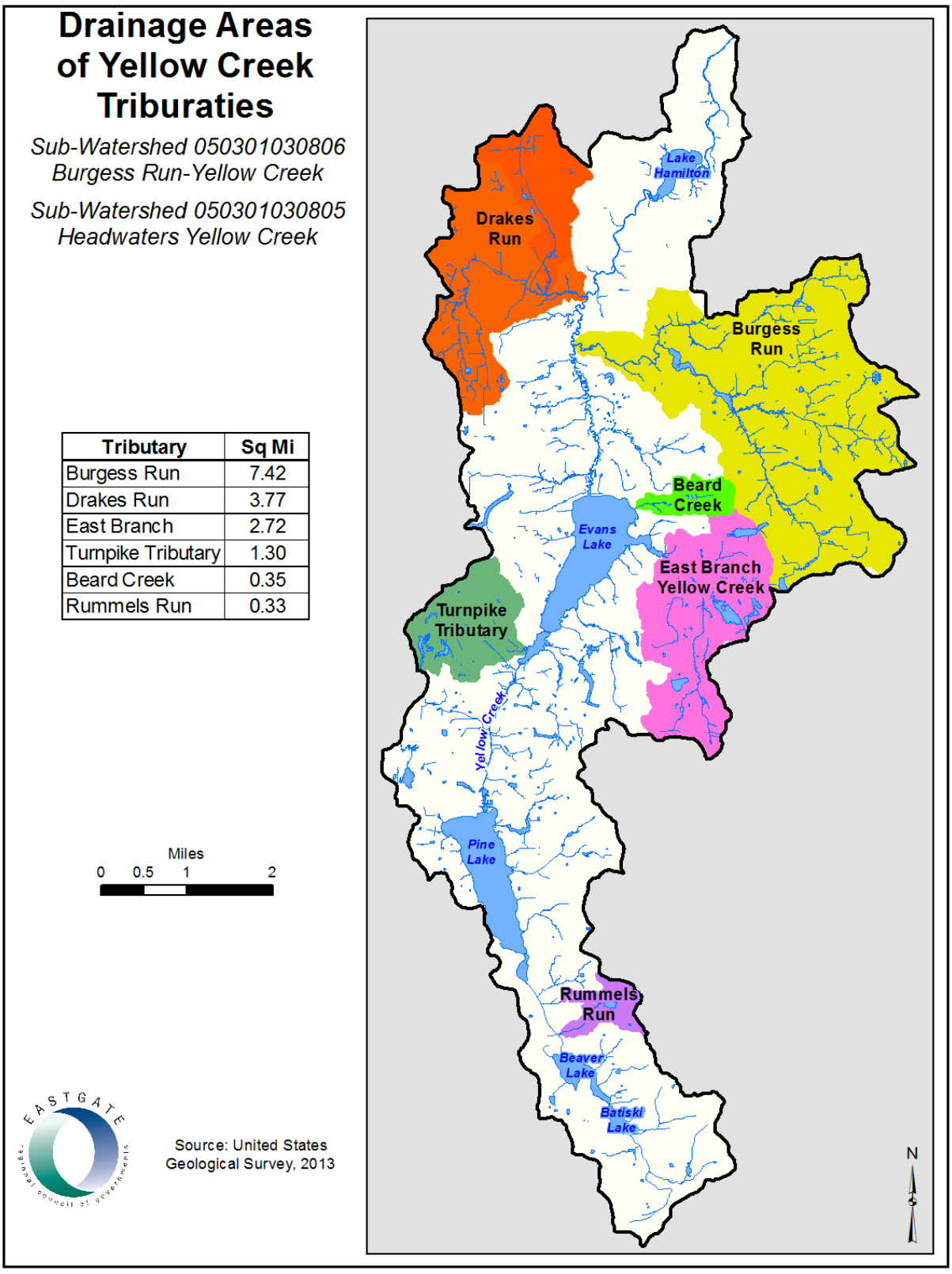
Table 25: Tributary Features

Tributary	Length	Drainage Area	Floodplain Access	Sinuosity	Entrenchment
Burgess Run	6.56 mi	7.40 mi^2	Yes	Natural	Unknown
Drakes Run	4.43 mi	3.77 mi^2	Partial	Natural	Unknown
McKays Run	1.96 mi	1.13 mi^2	None	Channelized	Unknown
Beard Creek	0.94 mi	0.35 mi^2	Yes	Natural/ Channelized	Unknown
East Branch Yellow Creek	2.74 mi	2.65 mi^2	Yes	Natural	Unknown
Turnpike Tributary* (E of I-76)	0.76 mi	0.63 mi^2	Yes	Natural/ Channelized	Unknown
Turnpike Tributary* (W of I-76)	1.41 mi	0.65 mi^2	Partial	Natural/ Channelized	Unknown
Rummels Run	0.93 mi	0.33 mi^2	Yes	Natural	Unknown

Turnpike Tributary appears to have been split into two sections as result of Interstate 76. The section west of I-76 meanders naturally until it reaches I-76. It then turns sharply southwest into a roadside ditch leading to Yellow Creek. The section east of I-76 leads directly to Evans Lake. The USGS National Hydrography Dataset, used by the USGS StreamStats website, displays the original course of the stream across I-76 and not current conditions. Therefore, drainage areas for each section were approximated.

Figure 27: Turnpike Tributary

Figure 28: Tributary Drainage Areas



Tributary Use Designation, Utilizing Ohio's Water Quality Standards.
The OAC 3745-1-25 provides use designations for water bodies within the Mahoning River drainage basin. Yellow Creek and Burgess Run were discussed specifically within Table 25-1, while the watershed's other waterbodies are listed under the category of "all other segments". The following is a summary of Table 25-1:

- Yellow Creek at river miles (RMs) 2.0 and 8.40 (Campbell and Struthers Public Water Supply Intake locations respectively) is designated a warmwater habitat; listed as a public, agricultural, and industrial water supply; and is considered a primary contact recreation source;

- Burgess Run at RM 2.0 (Struthers public Water Supply Intake location) is designated a warmwater habitat, listed as a public, agricultural, and industrial water supply, and is considered a primary contact recreation source; and

- All other segments are designated as warmwater habitats and listed as agricultural and industrial water sources, and considered primary contact recreation waters.

Lakes and Reservoirs (Size, Uses, Watersheds, Detention Time)
In 1980, ODNR completed an inventory of lakes in Ohio. The Ohio Water Inventory Report No. 26, "Inventory of Ohio's Lakes, lists all known water impoundments, by county, that are 5 acres or greater in size". The report lists the following seven lakes:

Table 26: Lakes and Reservoirs

Lake	Useful Purpose	Surface Area (acreage)	Year Built
Batiski Lake	Recreation	5.4	1957
Beaver Lake	Water Supply	103	1916
Pine Lake	Water Supply, Recreation	474	1917
Collier Lake	Recreation	10	1958
Burgess Lake	N/A	20	1915
Lake Hamilton	Recreation	104	1905
Evans Lake	Water Supply, Recreation	566	1948

An update to the inventory, produced in 1991 by ODNR's Leonard Black (Division of Water) lists the natural lakes within the State of Ohio. According to the update, a "natural" lake is a "body of water deep enough to stratify thermally and with adequate fetch (distance across) to create wave action". Based on a review of the inventory, there are no natural lakes within the watershed.

Research to determine the detention times for each lake was performed, but information could not be found.

Surface Water Source Water Assessment Plan (SWAP)
Two surface drinking water sources exist within the watershed, Evans Lake and Lake Hamilton. Both are owned by Aqua Ohio and used to provide drinking water to residents within the watershed. Aqua Ohio operates and manages a private water system providing drinking water from Evans Lake to approximately 45,000 customers in townships and municipalities within the Burgess Run-Yellow Creek subwatershed; Lake Hamilton provides drinking water to residents outside the watershed. A SWAP was developed for Aqua Ohio by Burgess and Niple in 1998 and submitted to the Ohio EPA in 2004. Aqua Ohio is currently updating the 1998 plan.

3. Ground Water

According to the Ohio State University Extension publication, *Water Resources of Mahoning County*, "As water moves through the sandstone, shale, and sand and gravel aquifers underlying Mahoning County, it dissolves the minerals contained in these formations and carries them in solution (Stamm, 2010)". The publication summarizes some of the county's natural ground-water quality aspects.

Human activities, such as agricultural production, domestic waste disposal, and lawn and turf care may have some influence on the county's ground-water quality. In a 1987 study by Heidelberg College, 417 wells in the county were sampled for nitrate-nitrogen content, an indicator of water quality. Results showed that 360 wells (86 percent of total) contained nitrate-nitrogen concentrations in the range of 0 to 0.3 parts-per-million (ppm). This range is assumed to represent natural background levels. Forty-three wells (10 percent) tested in the range of 0.3 to 3.0 ppm, values that may or may not indicate human influence. The 10 wells (two percent) that tested in the range of 3.0 to 10 ppm may indicate elevated concentrations resulting from human activities. Only four wells (0.01 percent) tested over the safe drinking-water standard of 10 ppm nitrate-nitrogen. The average nitrate-nitrogen concentration for the 417 wells tested was 0.4 ppm. The design, location, and condition of a well, combined with the characteristics of the soils and geologic formations in which the well is constructed, influence the potential for pollutants to enter the well. In 1995, at the request of mortgage lenders, the Mahoning County General Health District tested septic tanks and wells at 65 private residences; 31 of the wells tested positive for coliform bacteria. For more information about bacteriological water sampling, contact the Mahoning County District Board of Health (2810 Market Street., Youngstown, Ohio 44507)." Since the time AEX-480.50-97 was written, the Mahoning County District Board of Health moved to a new location: 50 Westchester Drive., Youngstown, Ohio 44515; 330-270-2859.

Aquifers (location, recharge rates, uses)

Aquifers within Mahoning County vary and provide a range of yields. *Figure 29* shows a general map of groundwater yields. The largest groundwater source in terms of area is a sandstone aquifer located under unconsolidated deposits that produces yields of 10 to 25 gallons per minute (gpm). At a sufficient rate for residential and agricultural use, this aquifer can be found throughout 50% of Mahoning County. Higher yields of 50 to 80 gpm are found under glacial deposits in the majority of Springfield Township. According to ODNR's Groundwater Resources for Mahoning County map, groundwater yields range from 3 gpm near the southwestern corner of Pine Lake up to 100 gpm just east of Pine Lake prior to exiting the watershed's boundary. However, the majority of the watershed's ground water production falls within the yield range of 10 to 25 gpm.

Aquifers in Columbiana County are influenced by glacial deposits. *Figure 30* shows the locations of unconsolidated aquifers in the watershed resulting from glacial deposits. The highest yielding aquifers are those that consist of thick sand and gravel deposits from streams carrying glacial meltdown. The northern portions of Columbiana County contain thick glacial deposits that overlie sandstone and bedrock. Groundwater wells dug within this glacial type average 10 to 25 gpm and are suitable for domestic and farm supplies. According to the ODNR's Groundwater Resources for Columbiana County map, the watershed falls within the area where 10 to 25 gpm groundwater yields are available.

In general, the yield of a well varies depending on the age and depth of the well, well construction, well casing diameter, pump capacity and age, and the properties of geologic formation. A brief discussion on Mahoning County's and Columbiana County's groundwater resources can be found in the Ohio State University Extension's Factsheet AEX 480.50-97 and AEX 480.15-97(respectively).

Figure 29: Groundwater Yield

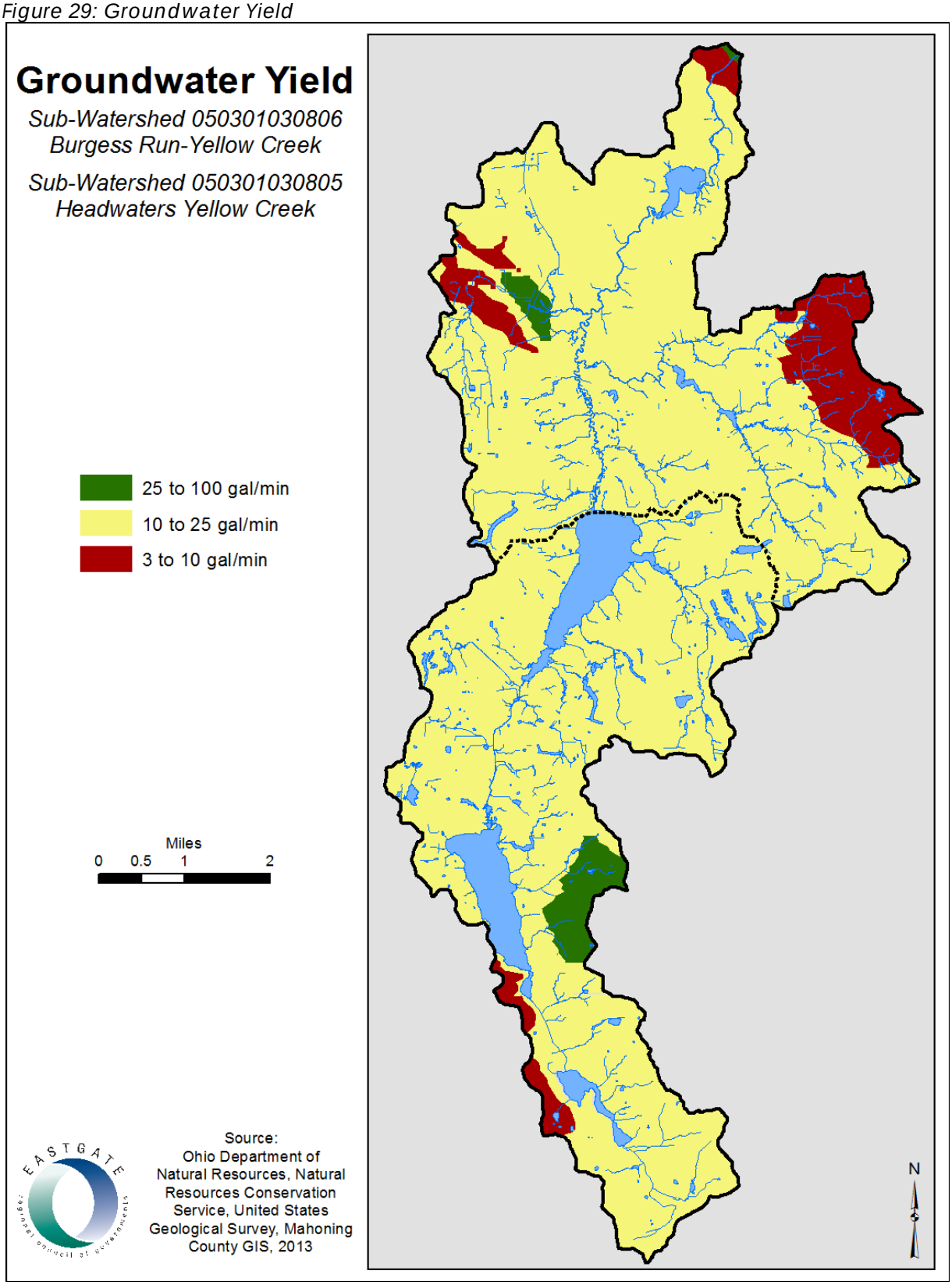
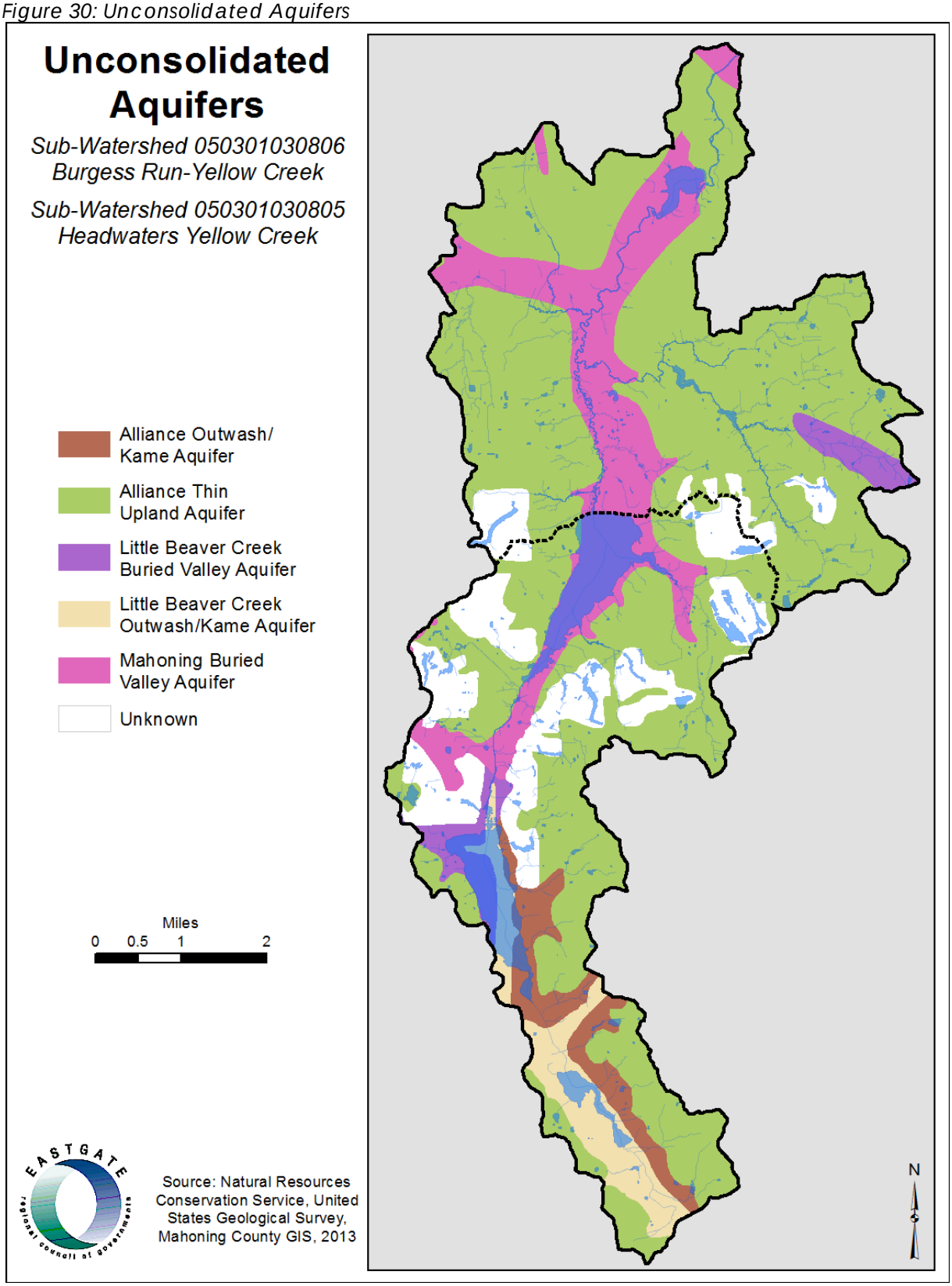


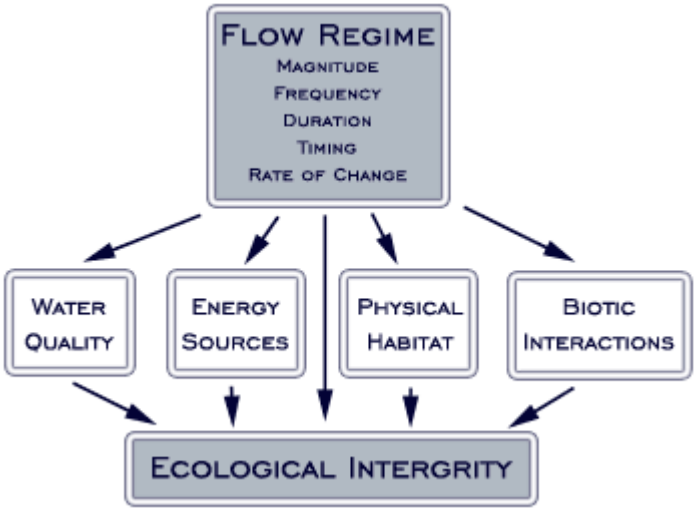
Figure 30: Unconsolidated Aquifers



Flow Regime

"Flow regime" describes the pattern of flow variability for a particular river or region. Flow acts as a master variable, influencing the ecological integrity of river ecosystems. *The Natural Flow Regime: A paradigm for river conservation and restoration* (Poff et al., 1997) describes the many biological consequences of altered flow regimes.

Figure 31: Variables and Biological Consequenses of Altered Flow Regimes



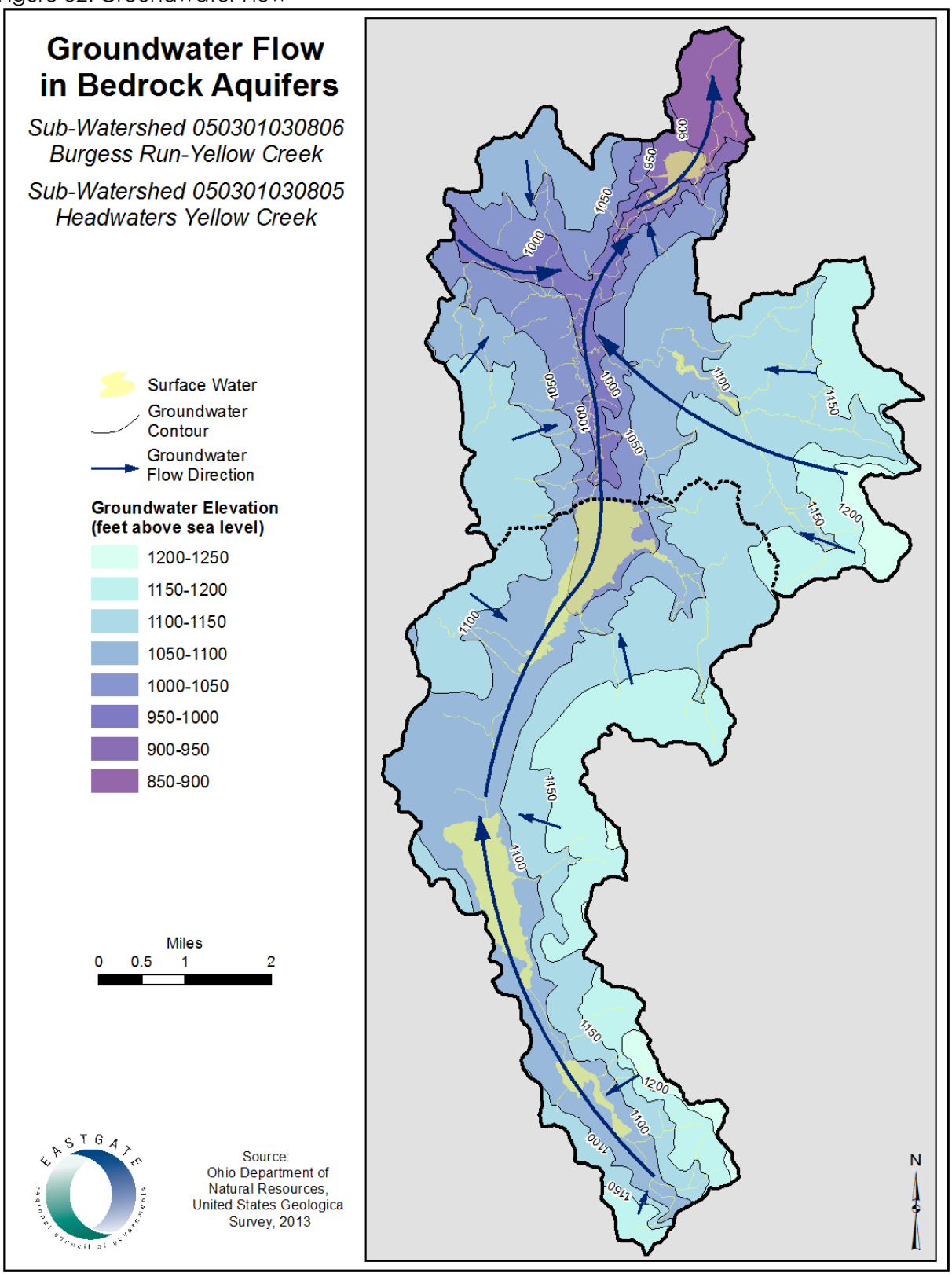
ODNR produced Potentiometric Surface Maps for both Mahoning and Columbiana Counties. The maps contain contour lines, similar to those on a topography map, indicating the elevation and direction of groundwater flow. Based on a review of the Potentiometric Surface Maps, groundwater flow within the watershed is a general south to north flow. *Figure 32* provides an illustration of the watershed's groundwater flow.

Potentiometric Surface Mapping in Ohio – Fact Sheet.

Ground Water Source Water Assessment Plan (SWAP)

Eastgate applied for access to the Ohio EPA's SWAP database in order to review SWPs within the watershed. Based on a review of the database, there are no public ground water systems within the watershed.

Figure 32: Groundwater Flow



Groundwater Sensitivity

The ODNR Division of Water developed Groundwater Pollution Potential Reports and maps for the counties within Ohio (*Figure 33*). Utilizing the DRASTIC system of mapping, ODNR identifies pollution potential based on hydrogeologic settings that influence pollution potentials. The DRASTIC method evaluates the pollution potential of an area assuming any contaminant with water-like mobility is introduced on the surface and permeates into the ground water table.

Groundwater Pollution Potentials for Columbiana County (report No. 35) and Mahoning County (report No. 51) were developed in 1994 and 2003, respectively. The reports identified 8 hydrogeologic settings in Mahoning County and 9 settings in Columbiana County. The prevalent setting in both counties was Glacial Till Over Bedrock Sedimentary Rock (7Aa), and is located throughout the watershed. However, Buried Valleys (7D) and Outwash (7Ba) were located along the mainstem of Yellow Creek from Beaver Lake to Pine Lake and from Pine Lake to Evans Lake; and Alluvium Over Sedimentary Rock (7Ec) is located along Burgess Lake and Burgess Run. *Figure 33* illustrates the watershed's Groundwater Pollution Potential settings.

According to both reports, the glacial till over bedrock sedimentary rock (7Aa) is variable and widespread throughout the watershed. Though it is the predominant setting, the description of it varies slightly in each county. Topography ranges from rolling, low relief area in the southern, Columbiana portion of the watershed to steep, high relief areas in Mahoning County. In Columbiana, the hydrogeologic setting consists of interbedded sandstones, shales, limestone, and coal of the Pennsylvania, Pottsville, and Allegheny Groups; the setting in Mahoning is described as thin interbedded shales, sandstones, siltstones, limestones, clay, and coal of the Pottsville and Allegheny groups of the Pennsylvanian System and interbedded shale, siltstones, and fine grained sandstones of the Mississippian Cuyahoga Formation. Yields range from 3 to 25 gpm for wells developed in the rocks of the Pottsville Group, lower Allegheny Group, and Cuyahoga Formations. Yields of up to 100 gpm are available for massive, fractured sandstones in the Pottsville Group. Till coverage within the watershed typically ranges in thickness of 20 to 30 feet. However, it may reach 70 feet within end moraines. The depth to water averages 30 to 50 feet and has a recharge rate of low to moderate, depending on the slope, thickness of till cover, and depth to water.

Ground Water Pollution Potential (GWPP) index values for the glacial till over bedded sedimentary rocks setting ranges from 72 to 123 in Columbiana County and 76 to 139 in Mahoning County. A total number of GWPP index calculations equal 79 for Columbiana and 110 for Mahoning. The surface contamination potential to ground water is depicted on the map by a color range from cool to warm colors. These colors indicate the level of groundwater vulnerability. Given the index values and associated index color, the majority of the watershed's potential falls under a low or to low-moderate level of vulnerability to contamination.

Although not numerous within the watershed, it is equally important to note the other settings due to their level of vulnerability to contamination. These hydrogeologic settings include Buried Valley (7D), Outwash (7Ba), and Alluvium Over Sedimentary Rock (7Ec).

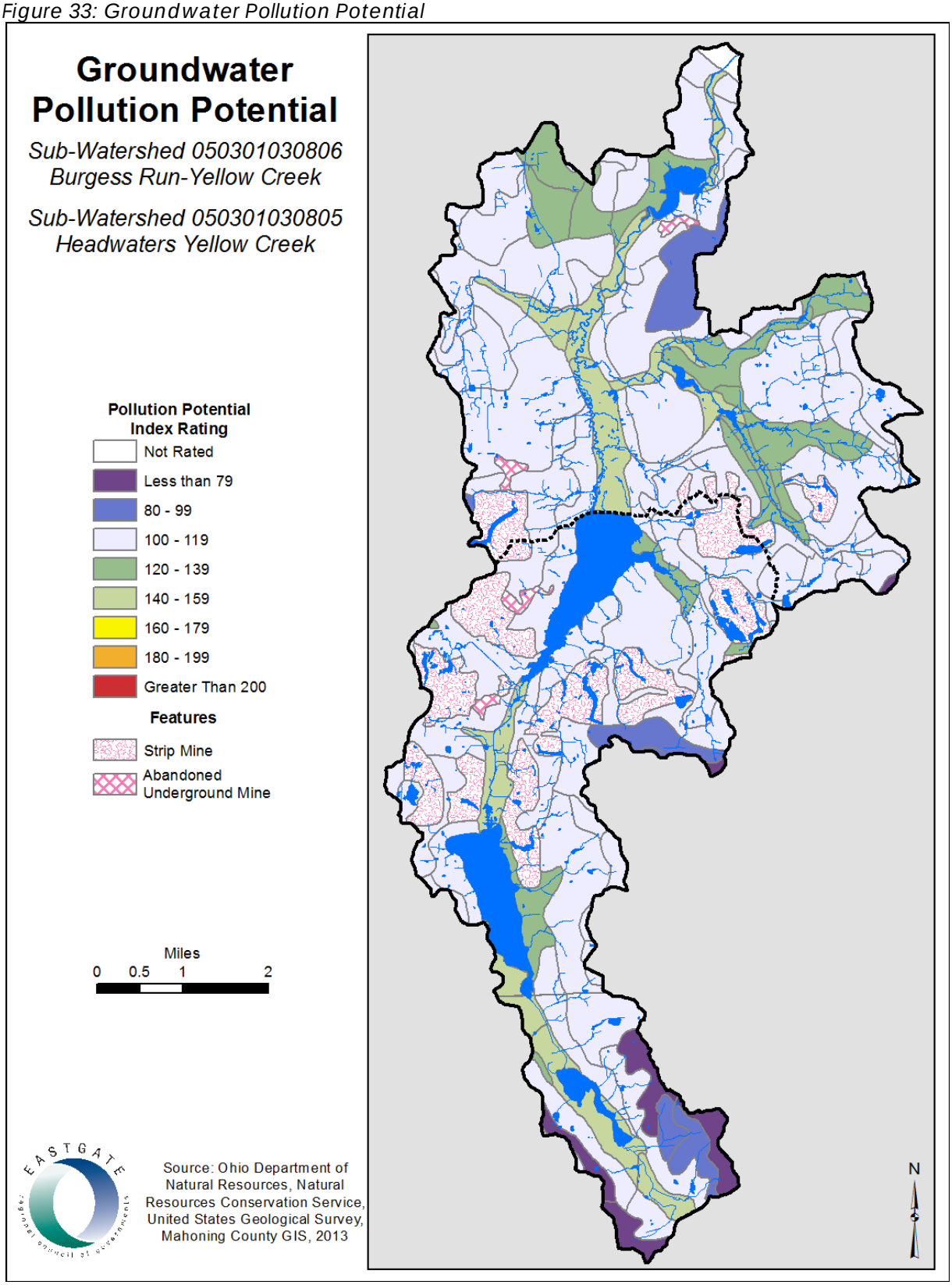
The buried valley setting is found surrounding the headwaters and mainstem of Yellow Creek from Beaver Lake to Pine Lake and from Evans Lake to Lake Hamilton. There are two types of buried valleys in both counties, but the setting prevalent within the watershed is occupied by a modern stream valley. The modern stream valley consists of abundant outwash or kame deposits and is distinguishable from the surrounding steep bedrock and till uplands. The valleys contain variable sand and gravel thickness and finer-grained till and lacustrine sediments. Sand and gravel comprise the upper 20 to 30 feet of the upper level. Typical yields are in the 25 to 100 gpm range with a high recharge rate due to permeable soils and vadose, the shallow to moderate depth to water, and relatively flat topography. In Mahoning County, the GWPP index value for this setting ranges from

106 to 168; Columbiana County has a range 104 to 173. In both counties, the areas of the watershed containing buried valleys fall under the upper moderate level of vulnerability to contamination.

Outwash (7Ba) settings are typically located at the margins of buried valleys and characterized by flat-lying to gently rolling topography and low relief. Aquifers consist of sand and gravel outwash deposits. Average yields range from 10 to 25 gpm with a maximum of up to 100 gpm. A shallow depth to water may be indicative of the direct connection with overlying streams. Thus, recharge is good due to relatively flat topography, permeable soils and vadose media, and the shallow depth to water. Located in Mahoning County, the GWPP index, the vulnerability level for this setting is within the moderate to upper- moderate range.

Alluvium over Sedimentary Rock (7Ec) is located in southern and eastern upland areas of Mahoning County which contain small tributary streams and thin glacial cover. Aquifers consist of fractured, interbedded sandstones, shales, limestones, and coals of the Pennsylvania System and interbedded shales, siltstones, and fine-grained sandstones of the Mississippian System. Average yields are developed from the fractures and bedding bedrock planes and range from 10 to 25 gpm. A shallow depth to water, averaging 10 to 30 feet, flat lying topography, proximity to modern streams, and moderately low permeability allows for moderate to high recharge. Located mainly within the Burgess Run-Yellow Creek subwatershed of Yellow Creek, the vulnerability level is within the moderate range.

Figure 33: Groundwater Pollution Potential



Refer to Appendix A for detailed maps of each Yellow Creek sub-watershed

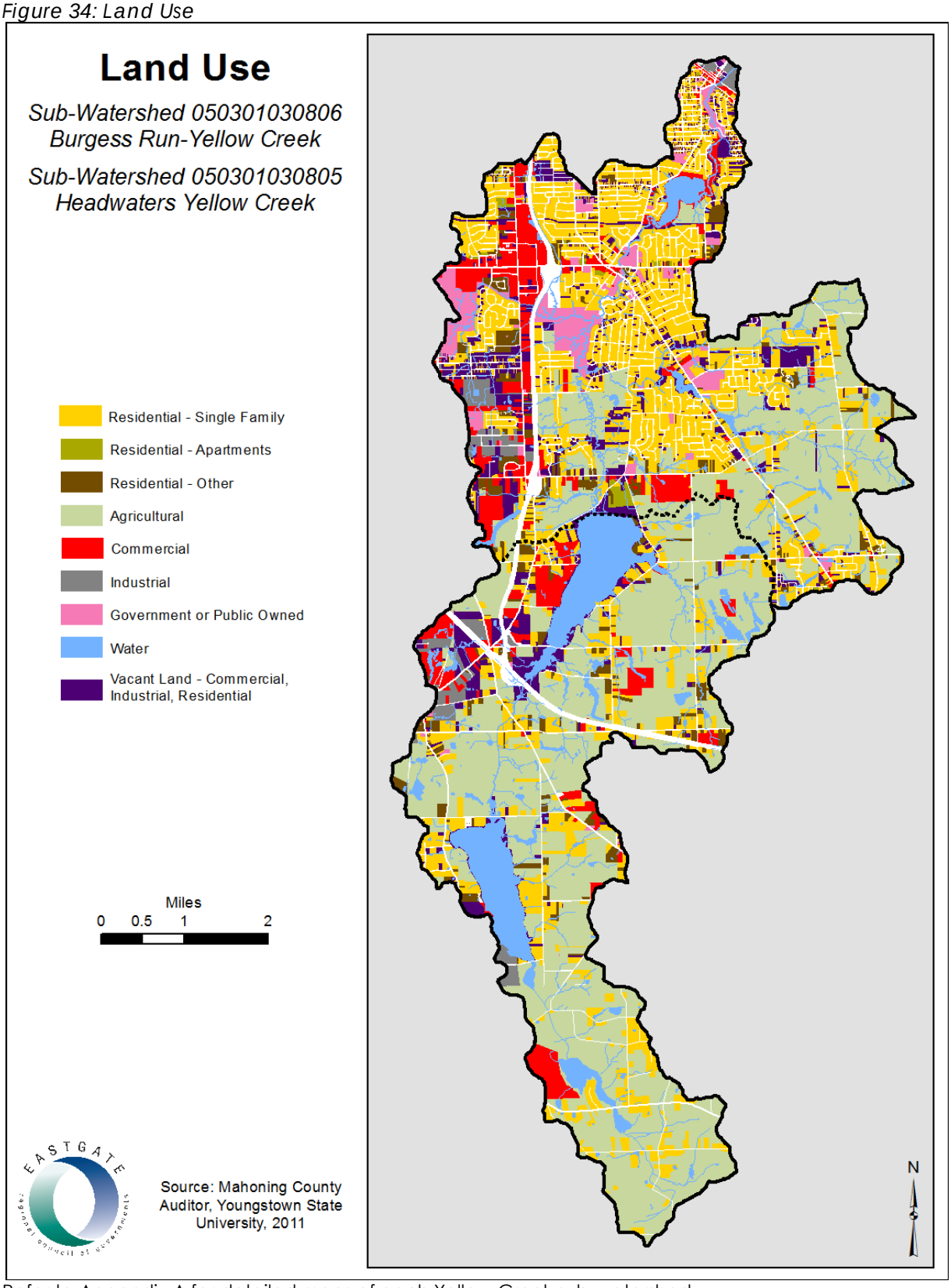
iv. Land Use/Land Cover

Land use in the Yellow Creek Watershed is composed of agricultural, residential, and commercial (*Table 27, Figure 34*). The Headwaters-Yellow Creek subwatershed is mainly agricultural, while the Burgess-Run Yellow Creek subwatershed contains more residential and commercial land uses. Overall, the watershed has a small amount of commercial, industrial, or vacant properties. The land designated as "Unclassified" is mostly road right-of-way and not classified by the auditor.

Table 27: Land Use

Land Use	Headwaters Yellow Creek 050301030805		Burgess Run-Yellow Creek 050301030806		Total	
	Acres	Percent	Acres	Percent	Acres	Percent
Agricultural	7,000.14	56.54%	3,337.57	25.84%	10,337.71	40.87%
Residential- Single Family	1,893.86	15.30%	4,495.9	34.81%	6,389.76	25.26%
Vacant Land	1,534.97	12.40%	1,196.46	9.26%	2,731.43	10.80%
Commercial	695.08	5.61%	1,106.77	8.57%	1,801.85	7.12%
Unclassified	26.44	0.21%	1,058.58	8.20%	1,085.02	4.29%
Residential- Other	406.71	3.28%	520.57	4.03%	927.28	3.67%
Government or Public Owned	17.38	0.14%	733.8	5.68%	751.18	2.97%
Water	590.12	4.77%	146.55	1.13%	736.67	2.91%
Industrial	217.07	1.75%	221	1.71%	438.07	1.73%
Residential-Apartments	0	0%	96.66	0.75%	96.66	0.38%
Total	**12,381.77**	**100%**	**12,913.86**	**100%**	**25,295.63**	**100%**

Figure 34: Land Use



Refer to Appendix A for detailed maps of each Yellow Creek sub-watershed

According to ODNR's 2007 Land Cover Data, the Yellow Creek Watershed contains 7 land cover types: Agricultural/Open Urban, Barren Land, Non-Forested Wetland, Open Water, Shrub/Scrub, Urban, and Wooded. *Table 28* and *Table 29*, and *Figure 35* display ODNR's land cover classification for the watershed. ODNR land cover data was created using Landsat Thematic Mapper satellite imagery from 1994 with a resolution of 30-meters and shows the general land cover of large areas. As a result of the low resolution, the land cover acreages are not exact. For example, the Village of Poland is depicted as a wooded area. The streets and residential properties in Poland have numerous trees which hide the urban areas at a low resolution.

Table 28: ODNR Land Cover Classification

Landcover (ODNR)	Headwaters Yellow Creek 050301030805		Burgess Run-Yellow Creek 050301030806		Total	
	Acres	Percent	Acres	Percent	Acres	Percent
Wooded	5,736.94	46.33%	8,064.36	62.45%	13,801.30	54.56%
Agriculture/ Open Urban	4,795.74	38.73%	3,233.22	25.04%	8,028.96	31.74%
Urban	388.51	3.14%	1,309.97	10.14%	1,698.48	6.71%
Open Water	1,087.34	8.78%	126.11	0.98%	1,213.45	4.80%
Non-forested Wetlands	213.31	1.72%	102.3	0.79%	315.61	1.25%
Shrub/Scrub	153.75	1.24%	77.9	0.60%	231.65	0.92%
Barren	6.18	0.05%	0.0	0.00%	6.18	0.02%
Total	**12,381.77**	**100%**	**12,913.86**	**100.00%**	**25,295.63**	**100%**

As a supplement to the ODNR land cover data, Eastgate performed a land cover classification using 4-band aerial imagery. The higher resolution imagery allowed for better detection of specific boundaries (i.e. urban versus forested). However, the limited spectral information of aerial photography combined with a higher resolution made some land cover categories more difficult to detect. Land cover classification is different from land use classification in the fact that land cover relies on satellite imagery to report what is present on the ground surface. The figures reported for land cover should be viewed with a little more skepticism than the watershed's land use figures. The results of Eastgate's classification are displayed in *Table 29* and *Figure 36*.

Table 29: Eastgate Land Cover Classification

Landcover (aerial classification)	Headwaters Yellow Creek 050301030805		Burgess Run-Yellow Creek 050301030806		Total	
	Acres	Percent	Acres	Percent	Acres	Percent
Forest	5,717.80	46.18%	7,105.39	55.02%	12,823.19	50.69%
Field (non-leafy crop, shrub/scrub, plowed)	3,422.63	27.64%	1,979.25	15.33%	5,401.88	21.35%
Grass/Field (leafy crop/vegetation)	985.64	7.96%	1,221.07	9.46%	2,206.71	8.72%
Urban	458.62	3.70%	1,606.77	12.44%	2,065.39	8.17%
Open water	1,402.61	11.33%	275.14	2.13%	1,677.75	6.63%
Forested Wetland	139.38	1.13%	622.28	4.82%	761.66	3.01%
Non-forested Wetland	255.09	2.06%	102.86	0.80%	357.95	1.42%
Barren	0.0	0.00%	1.10	0.01%	1.10	0.00%
Total	**12,381.77**	**100%**	**12,913.86**	**100.00%**	**25,295.63**	**100%**

Figure 35: ODNR Land Cover

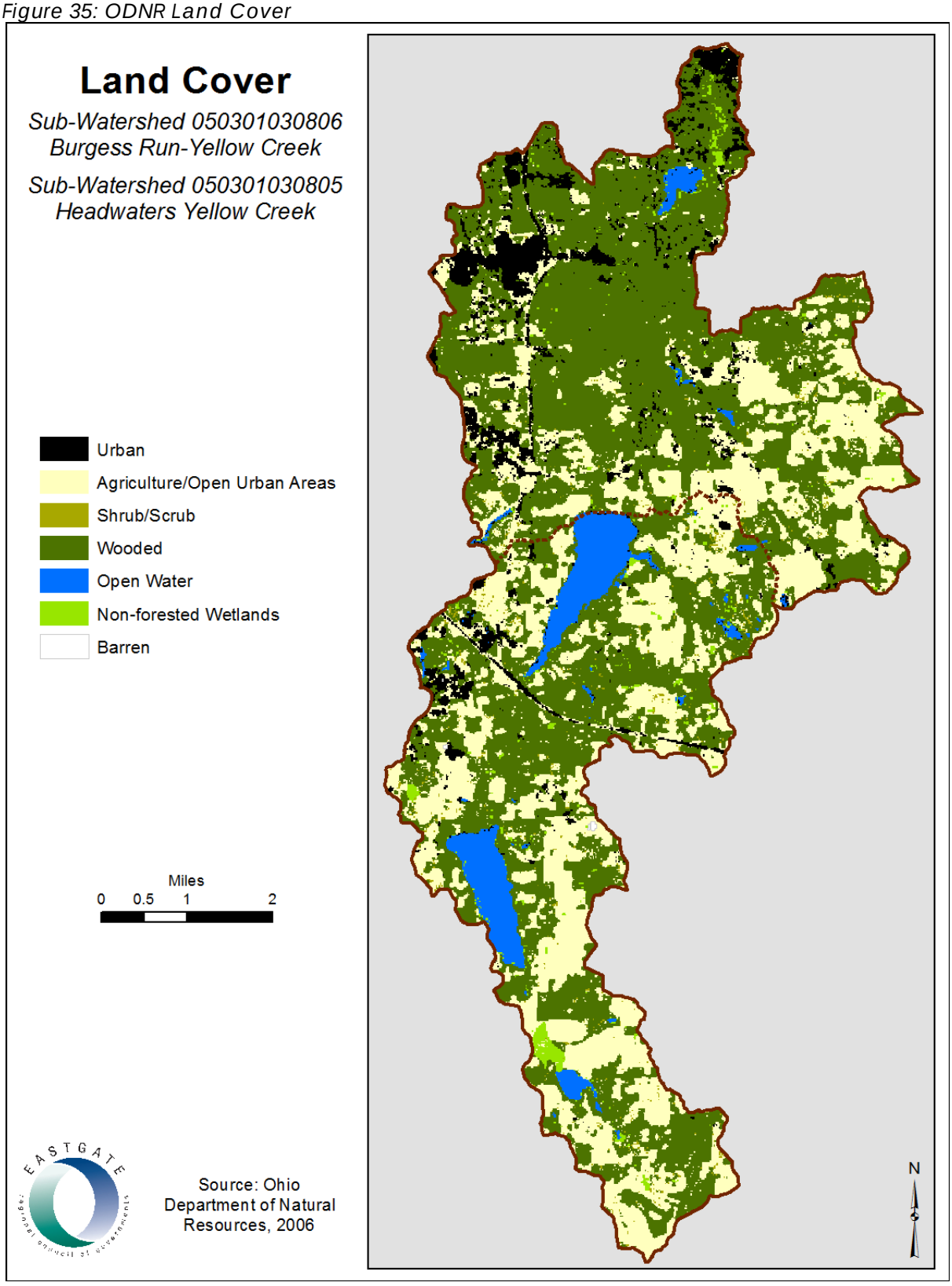
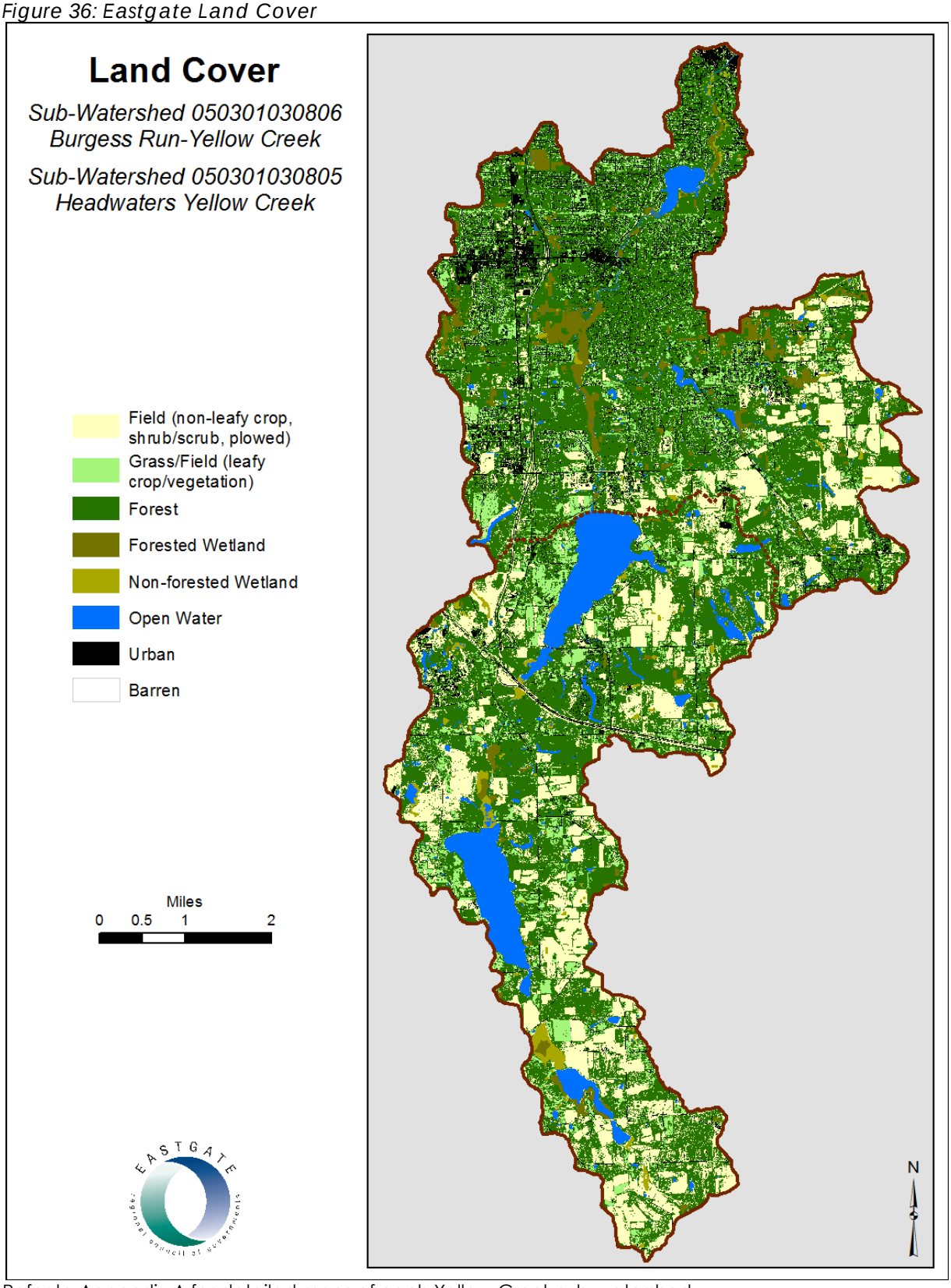


Figure 36: Eastgate Land Cover



Refer to Appendix A for detailed maps of each Yellow Creek sub-watershed

Based on aerial photograph observation, the Headwaters-Yellow Creek subwatershed, is predominantly agricultural in nature with some residential development around Pine Lake, Evans Lake, and a northern portion of the Village of New Middletown. However, as the watershed expands north from Evans Lake to the Mahoning River, the land coverage becomes more developed with a mix of residential and commercial development.

1. Urban

The Burgess Run-Yellow Creek is the urbanized region of the watershed. Urban growth begins at Evans Lake and trends north to Yellow Creek's confluence with the Mahoning River. The City of Struthers, the Village of Poland, and Boardman and Poland Townships have the highest urban concentration within the watershed with the City of Struthers and Village of Poland being the watershed's oldest urban areas.

Impervious Surfaces

The percentage of impervious surface within each 12-digit HUC was unable to be analyzed due to file size and processing limitations of the data from the 2011 National Land Cover Database. Therefore, the following information was based on the lack of an impervious surface category existing in either the land use or land cover data, and assuming the amount of impervious surface closely resembles the figures for the urban category. *Table 29* breaks down the land cover classification within the watershed. The table lists 2,065.39 acres of urban land cover present in the watershed. This figure may or may not be 100% accurate due to the use of satellite imagery, but one can assume for every house, commercial and industrial development there are related impervious surfaces (parking lots, driveways, roof tops, etc).

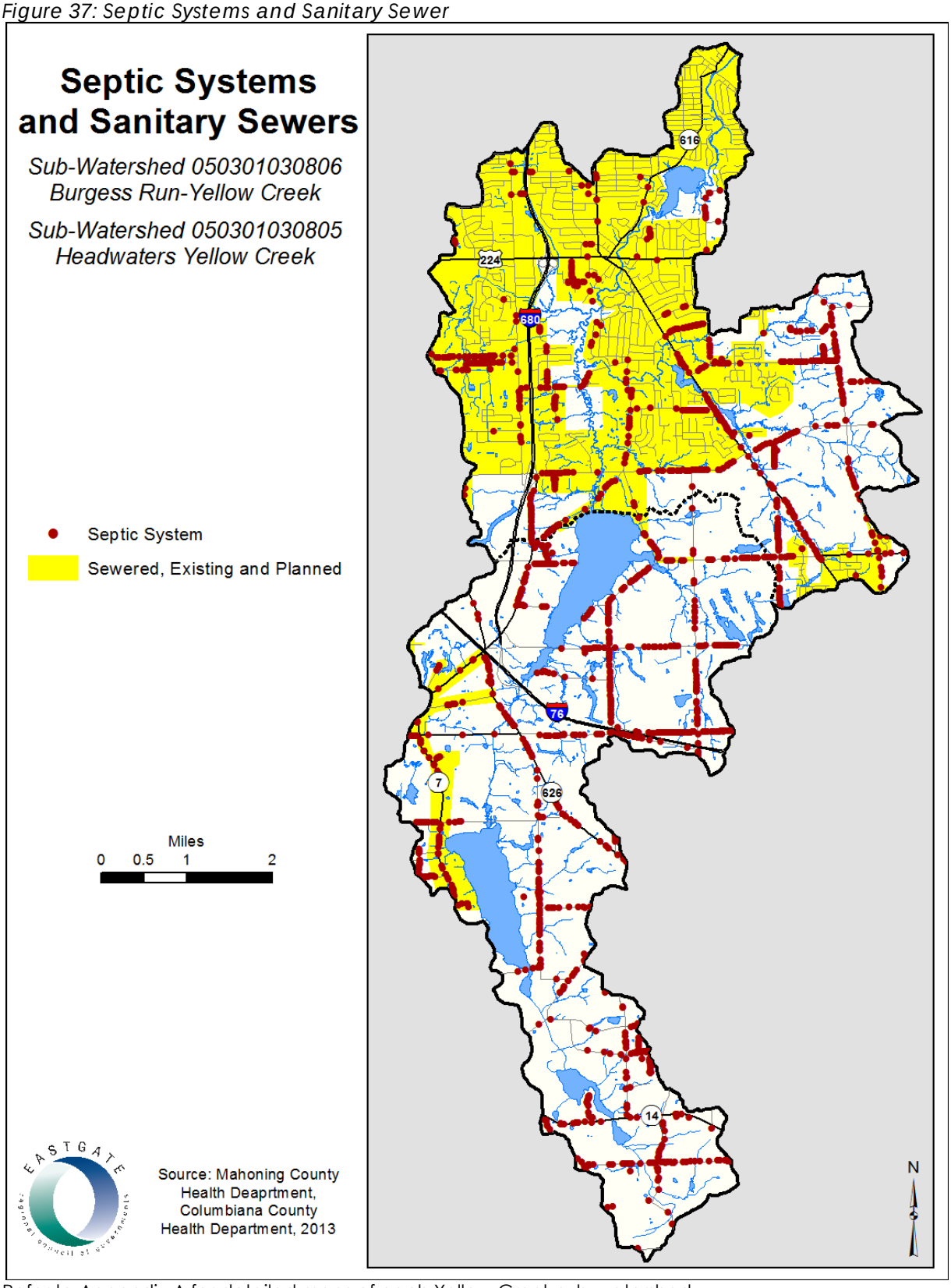
Sewer Overflows

According to the Mahoning County Sanitary Engineer and the City of Struthers, no sanitary sewer overflows (SSO) or combined sewer overflows (CSO) exist within the watershed.

Home Sewage Treatment Systems (HSTS)

In Mahoning and Columbiana Counties septic tanks with leach fields, or soil absorption systems, are traditionally recognized HSTSs, unless soil and site constraints indicate otherwise. Other systems may include aeration to leach field and septic tank to mound systems. The Yellow Creek watershed contains 1,716 HSTSs, of which 1,547 are recorded in Mahoning County. Located mainly within the Headwaters-Yellow Creek subwatershed, there are neighborhoods within the Burgess Run-Yellow Creek subwatershed that rely on HSTSs for wastewater treatment. *Figure 37* illustrates the watershed's HSTS.

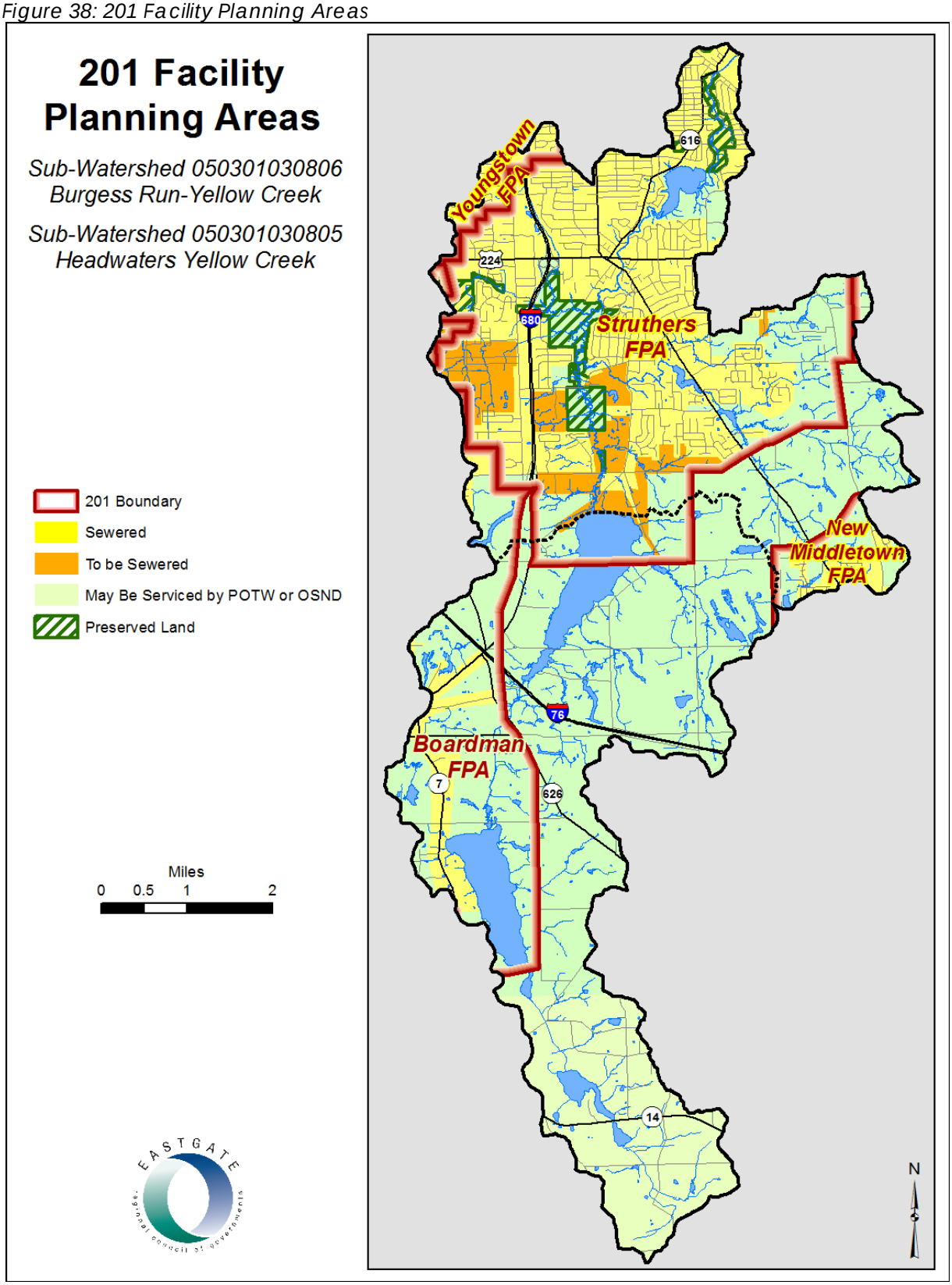
Figure 37: Septic Systems and Sanitary Sewer



Refer to Appendix A for detailed maps of each Yellow Creek sub-watershed

Within the Struthers and Boardman 201 FPAs are color coded wastewater treatment options that define how wastewater will be treated, via publically owned treatment plant (POTW) or individual HSTS. *Figure 38* illustrates the Boardman 201 FPA and Struthers 201 FPA's color codes: areas that are currently sewered (yellow), areas to be sewered (orange), and areas that may be serviced by an onsite non-discharging HSTS system or a POTW (green). Although the urbanized area of the watershed is sewered, there are instances (i.e. Boardman Township) where a few residences are still serviced by an HSTS.

Figure 38: 201 Facility Planning Areas



Refer to Appendix A for detailed maps of each Yellow Creek sub-watershed

2. Forest

Although forested land cover makes up 55.42% of the total land cover for the watershed, a glance at aerial photographs, as well as land use statistics of the watershed indicate otherwise. Aerial photographs indicate the forested areas are located along the mainstem of Yellow Creek with the largest concentration of forests in Boardman Park, Poland Woods, Yellow Creek Park and the mainstem of Yellow Creek located between Pine and Evans Lake.

3. Agriculture

The Headwaters Yellow Creek subwatershed is largely agricultural. A 1969 Mahoning Soil Survey shows the land within the Yellow Creek Watershed contains five soil associations that are primarily clay over sandstone or glacial till. The general layout is gently sloping to steep or gently sloping to level. The soil is somewhat poorly drained.

Crop Type

According to the Mahoning County OSU Extension Office and the watershed's SWCD personnel, the primary crops in the Yellow Creek Watershed are corn, winter wheat, soybean and hay (foyage). According to the 2013 Census of Agriculture, there were 51,384 acres of cropland harvested in Mahoning County and 78,489 in Columbiana County.

Tillage

According to the OSU Extension Office, tillage is mostly no-till on contoured field configurations. The Conservation Technology Information Center (CTIC) was consulted to further determine tillage transect data for Columbiana and Mahoning Counties. *Table 30* and *Table 31* display the tillage transect data provided by CTIC.

Table 30: Columbiana County Tillage Transect Data

Crop Type	Total Acres	No-Till (Acres)	Reduced-Till (Acres)	Intensive-Till (Acres)
Corn*	23,500	5,405	5,875	12,220
Oats	5,100	3,417	0	0
Soybeans (Full Season)	13,400	0	0	0
Winter Wheat	5,400	4,050	0	1,350
Total Acres in Conservation Reserve Program: 632				

*Includes Full Season and Double Cropped

Table 31: Mahoning County Tillage Transect Data

Crop Type	Total Acres	No-Till (Acres)	Reduced-Till (Acres)	Intensive-Till (Acres)
Corn*	14,600	4,380	5,110	5,110
Oats	2,800	2,240	0	560
Soybeans (Full Season)	10,700	0	0	0
Winter Wheat	2,800	1,540	0	1,260
Total Acres in Conservation Reserve Program:168				

*Includes Full Season and Double Cropped

Rotations

According to the OSU Extension, there is crop rotation of corn and soy beans in effect.

Livestock Inventory

Table 32 lists the livestock and poultry inventory for each county based on county figures from the 2012 Census of Agriculture. According to the watershed SWCD's the watershed has approximately 19 beef operations, 12 horse operations, 5 beef and horse operation, and 2 unidentified operations (beef and/or horse). These figures represent an operation total for the watershed. However, the SWCDs estimate the total head of cattle to be approximately 200 heads and approximately 50 heads for horses. No formal inventory or head count, was taken and/or available for this plan.

Table 32: Livestock and Poultry Inventory.

Livestock Type	Mahoning County	Columbiana County
Cattle	15,345	27,910
Pigs/Hogs	658	5,225
Chickens	2,218,863	3,474,112
Lamb/Sheep	422	1,753

Grazing

The 2012 Census of Agriculture reports there are 74,966 acres of farms in Mahoning County and 127,846 in Columbiana County. According to the census 65 farms in Mahoning County and 178 farms in Columbiana County implementing rotational or management-intensive grazing.

Chemical Use Patterns

Herbicides used on commodity crops are predominately glyphosate (Roundup). There is minimal use of fungicide as corn disease is evident. Farmers using triple stacked seed do not need insecticide. However, those using conventional seed use minimal products as cutworm and corn bore damage is evident. *Table 33* summarizes the chemical use information obtained from the 2012 Census of Agriculture survey for Ohio.

Table 33: Fertilizer and Chemicals in Use.

Fertilizer Type	Columbiana County		Mahoning County	
	Farms	Acres Treated	Farms	Acres Treated
Commercial fertilizer, lime and/or soil conditioners	468	56,706	302	38,025
Manure	325	20,926	184	9,143
Chemical Type				
Insecticide	170	20,193	108	6,807
Herbicide	412	52,940	269	37,539

Irrigation

The 2012 Census of Agriculture reports there are 924 acres of irrigated land in Mahoning County (41 farms) and 263 in Columbiana (44 farms). Facilities having the capacity to withdraw 100,000 gallons of water per day are required to register their withdrawal with ODNR's Division of Soil and Water Resources. Based on information provided by ODNR those facilities registered within the watershed included Aqua Ohio and The Lake Club. No agricultural facilities within the watershed are registered with ODNR.

4. Water

Out of the 39.53 square miles that make up the watershed, only 2.76 square miles are occupied by surface water (lakes, ponds, mainstems). Aside from the mainstem of Yellow Creek and the numerous tributaries and small streams, the watershed houses two major surface drinking water sources for residents within the Mahoning County: Evans Lake and Lake Hamilton. Aqua Ohio, a private water supplier, owns both lakes. Aqua draws and treats raw water from Evans Lake and distributes it to approximately 45,000 residents within the watershed. The City of Campbell draws and treats raw water from Lake Hamilton and distributes it to residents in the city and parts of the City of Youngstown. *Figure 39* illustrates Aqua Ohio's distribution area within the watershed.

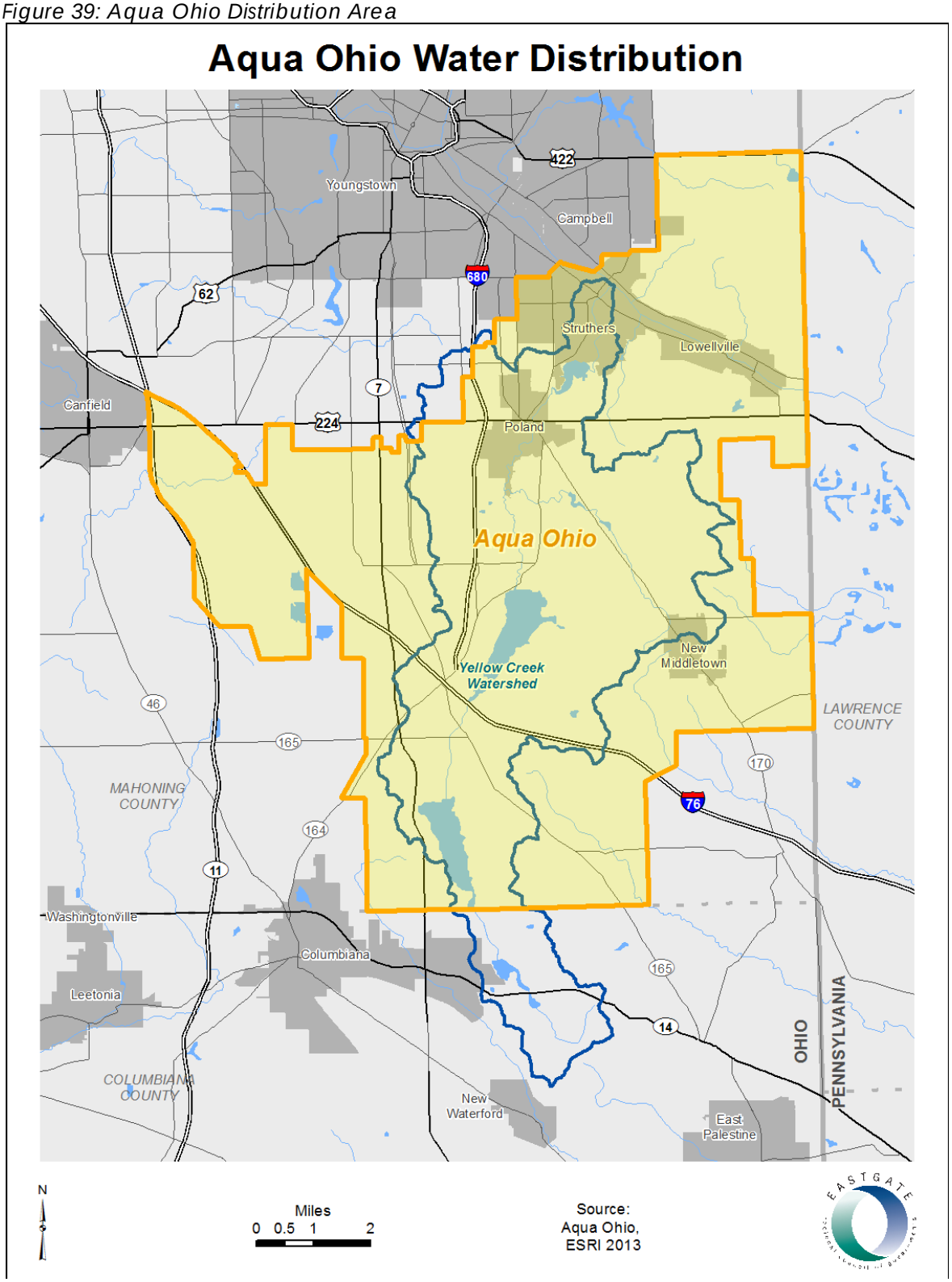
The lakes are part of a larger water system that is connected to one another via the mainstem of Yellow Creek and/or its tributaries. The extended lake system consists of, from north to south, Beaver Lake in Columbiana County, and Pine Lake, Evans Lake and Lake Hamilton, Mahoning County. Burgess Lake is located east of Yellow Creek and is connected to Yellow Creek via Burgess Run.

Non-Transient Non-Community (NTNC) Public Water Systems and Transient Non-Community (TNC) Public Water Systems exist within the watershed. An NTNC is a public water system regularly serving at least 25 of the same people for over 6 months per year (i.e. schools, places of employment, etc.). TNC public water systems serve at least 25 people for at least 60 days per year (i.e. churches, campgrounds, gas stations). *Table 34* represents the NTNCs and TNCs located in watershed.

Table 34: NTNCs and TNCs

Water System Name	System ID	County	Population Served	Water Source Type	System Status	System Type
Arnolds Lounge	OH504011	Mahoning	50	Groundwater	Active	NC
Boardman Park	OH504581	Mahoning	150	Groundwater	Active	NC
Boardman Park	OH504591	Mahoning	600	Groundwater	Active	NC

Figure 39: Aqua Ohio Distribution Area



5. Non-Forested Wetlands

Table 24 breaks down the types of wetlands within the watershed. According to the table, a total of 357.95 acres of non-forested wetlands exist within the watershed. This category includes the totals listed under emergent, shrub-scrub, wet meadow, and farmed wetlands.

6. Barren

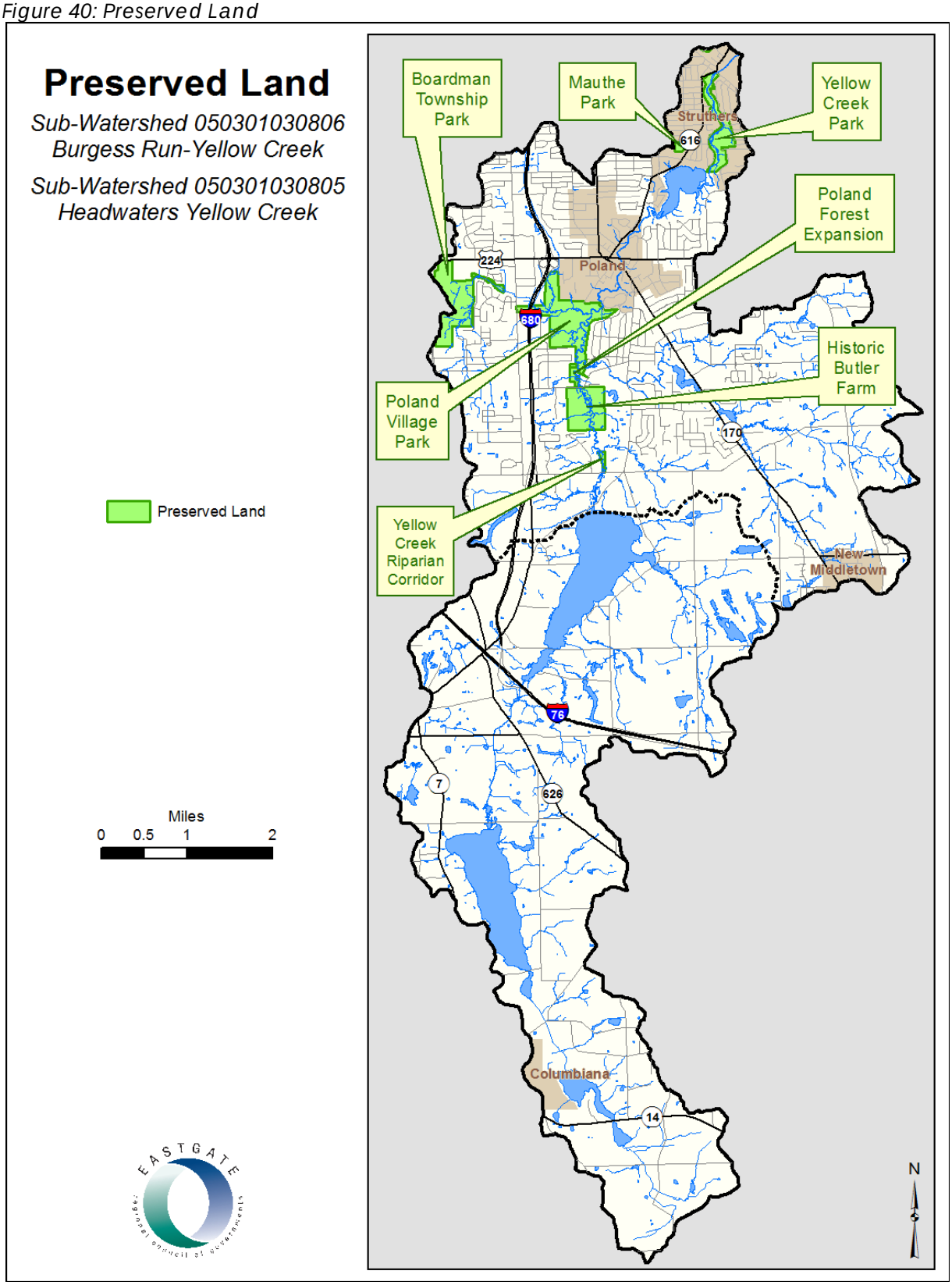
According to *Table 29*, 1.10 acres of barren land exists within the watershed.

7. Protected Lands

There are currently 711.05 acres of protected lands within the Yellow Creek Watershed. The Clean Ohio Conservation Fund has allowed for protection of 21.302 acres of that total. *Figure 40* illustrates the watershed's protected lands that are discussed below:

- **Yellow Creek Riparian Corridor-** Plans are in place for an easement along the mainstem of Yellow Creek as part of a development and coordinating effort between the developer and Boardman Township.
- **Poland Forest Expansion**- The southern border of the Poland Forest was expanded by 11.5 acres with the help of funding from Clean Ohio. The Clean Ohio fund allowed Poland Village to preserve the undeveloped land along Yellow Creek.
- **Poland Forest Riparian Zone Protection Project**- Poland Village received Clean Ohio funding to acquire a contiguous parcel of land, connecting two existing protected parcels along Yellow Creek.
- **Historic Butler Farm Conservation Easement on Yellow Creek**- The Mill Creek MetroParks co-holds the easement with the Mahoning County Soil and Water Conservation District. Purchased in 2000 with a Nature Works Grant, the easement encompasses 130.12 acres and contains over 5000 linear feet of Yellow Creek.

Figure 40: Preserved Land



City, County, District, State, or National Public Forests or Parks
In addition to the parks listed on pg. 5, Struthers' Fifth Street playground is a smaller park located two blocks west of Struthers High School. The playground has limited children's recreational activities.

Land Protected by Private Foundations or Land Trusts
There are no lands protected by private foundations or land trusts within the watershed.

8. Status and Trends (Historical, Current, Projected)
The Land Trust Alliance reports on the status and success of land trusts since its founding in 1982. The National Land Trust Census measures the pace and quality of the important conservation work of local, state, and national land trusts in the United States. The *2010 National Land Trust Census* report shows land conservancy by nonprofit land trusts across the United States conserved more than 10 million acres of land from 2005 to 2010 (Land Trust Alliance [LTA], 2011). The report also indicates Ohio's trend in conservation increased in acreage of land conserved by 132% during the 2005-2010 period (LTA, 2011). Specifically, Ohio's conservation trends include:

- 113,146 acres of land have been protected since 2005 (as of December 31, 2010);
- Ohio ranks 27th in the nations and 4th in the Midwest region for number of acres conserved;
- 44 land trusts operate in Ohio; and
- Ohio's land trusts drew upon the work of 1,229 active and the contributions of 16,871 members and financial supporters.

The Land Trust Alliance's Ohio summary report can be found at http://www.landtrustalliance.org/land-trusts/land-trust-census/state-factsheets/ohio-fact-sheet.

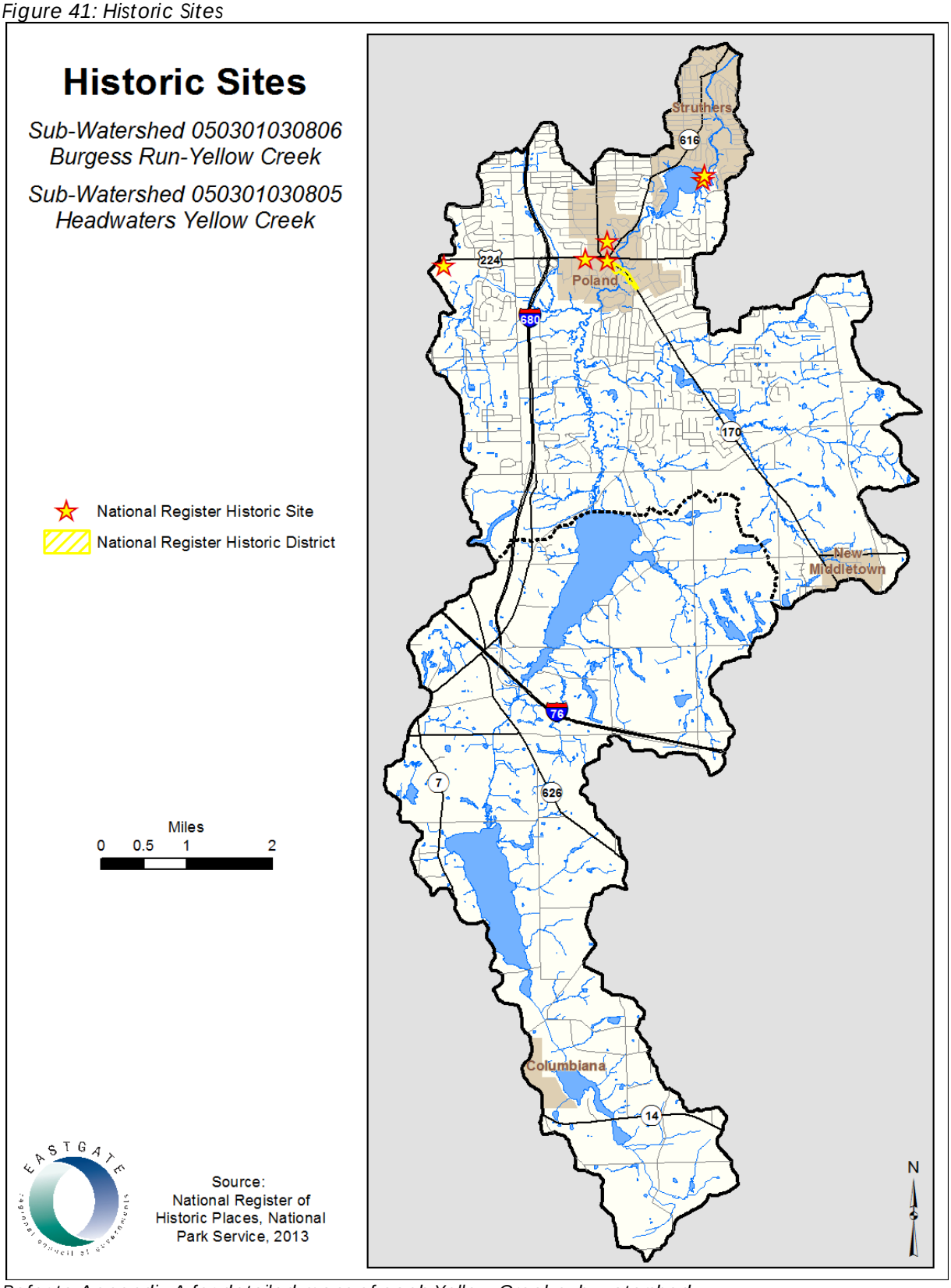
Cultural Resources
"Cultural Resources" defines those prehistoric and historic archeological sites, historic bridges, and historic building sites and districts that are of significant value to the history/cultural heritage of the watershed. The Yellow Creek Watershed includes several sites of historical significance, all located within the Burgess Run subwatershed. The National Register of Historic Places lists the following historical sites:

- **St. James Episcopal Church**- Known as the St. James Meeting house and located within the Boardman Township Park, this church was built between 1827 and 1828 and was formerly located at the southeast corner of where SR 7 (Market Street) and SR 224. St. James was the first Episcopal Church in Ohio and the oldest Episcopal parish in the Connecticut Western Reserve;
- **Hopewell Furnace**-Built in 1804 of local sandstone, the Hopewell Furnace was the one of the first blast furnaces in Ohio and the first west of the Allegheny Mountains;
- **Jared P. Kirtland House**- The Kirtland House was home to abolitionist Jared P. Kirtland and was a stopping point along the Underground Railroad;
- **Lake Hamilton Dam**- Youngstown Sheet and Tube Company financed the construction of the lake's dam. Built in 1906, the dam was intended to increase the water supply for industrial (steel production) and domestic purposes;

- **White Bridge**- The White Bridge is located at the northwest entrance to Poland's Riverside Cemetery. According to historic records, the bridge was associated with the Elkanah Morse's dam, known as Morse's Dam (Poland Centennial Committee, 1966). The dam, which no longer exists, provided power to saw mills located near the bridge. The Bridge was originally a wooden bridge set on a series of piles that spanned across Yellow Creek and connected the property owned by Morse; and

- **South Main Street District**- The Main Street District was the business district during the early beginnings of Poland Village. The district was home to The Old Stone Tavern (which still stands today) and one of President McKinley's childhood home.

Figure 41: Historic Sites



Refer to Appendix A for detailed maps of each Yellow Creek sub-watershed

B. Previous and Complementary Efforts

i. Previous Water Quality Efforts

Aside from referenced studies performed by YSU students and professors, several management plans and programs have been established and completed within the Yellow Creek Watershed. The following list is a sample of the efforts developed:

- Mahoning County, Mill Creek MetroParks, and the Townships of Austintown, Beaver, Boardman, Canfield, Coitsville, Poland and Springfield Final Stormwater Management Plan. URS Corporation. March, 2003;
- Village of Poland Storm Water Abatement Advisory Team;
- City of Struthers Stormwater Water Education Project;
- Mahoning County Land Use Plan, Mahoning County Planning Commission, January 2001.
- Mahoning County Drainage and Erosion and Sediment Control Rules, April 2005;
- 208 Water Quality Management Plan, Eastgate Regional Council of Governments, Updated June 2008;
- Establishment of Riparian Setbacks by Mahoning County (adopted April 2005), Beaver Township, Boardman Township, and Poland Township and Village;
- Mahoning County Engineers mapping of all publically owned outfalls for all MS4 communities (includes Beaver, Boardman, Poland, and Springfield Township), 2007;
- Aqua Ohio Source Water Protection Plan;
- Boardman Township Stormwater Study (2004); and
- Salinity of Drake Run in the Poland Municipal Forest, 2013.

ii. Current Water Quality Efforts

Aside from the efforts mandated under Phase II requirements listed on pg. 8, the following is a list of voluntary efforts currently in effect to help improve water quality within the watershed.

Riparian Setbacks

A riparian setback is a specified distance from a stream or river bank designed to protect their naturally vegetated areas (riparian zone). The setbacks regulating uses and developments within the riparian zone in order to reduce flooding and pollutants, stabilize streambanks, prevent streambank erosion, and provide streamside habitat.

Several zoned Mahoning County communities incorporate riparian setbacks along Yellow Creek and its tributaries. Boardman Township was one of the first Yellow Creek Watershed communities to establish riparian setbacks. Their regulations were adopted March 27, 2006. Following Boardman, Poland Township adopted the State of Ohio's regulations for streams within their township.

In 2007 Mahoning County incorporated riparian setbacks within the subdivision regulations of the "Mahoning County Erosion and Sediment Control Rules". The setbacks take effect when one (1) acre or more of earth is disturbed and include a 25'-125' riparian setback, depending on the contributing drainage area of the development site.

Stormwater Utility

The City of Struthers adopted a stormwater utility in 2007. The utility generates approximately $150,000.00 per year. The monies generated are used to implement the six Phase II stormwater measures.

C. Physical Attributes that Support Water Quality

i. Early Settlement Conditions

The Burgess Run subwatershed is located in what was called the Connecticut Western Reserve. In 1786, Connecticut sold its western lands to the Federal Government. These lands now comprise what is known as northeastern Ohio. This "reserve" spanned 5,700 square miles and "bounded on the east by Pennsylvania, on the south by latitude forty-one, on the west by a line running from latitude forty-one to the international boundary paralleling the PA state line, 120 miles west, and on the north by the international boundary" (Poland Bicentennial Committee [PBC], 1996). In 1796, work began on surveying land at the southeast corner of the reserve, Township One of Range One. A marker, which still exists, was erected at the location of the southeast corner of the reserve in what is now Poland Township. Surveyors sent the following description of the township back to the Connecticut Land Company directors:

"*About twelve miles below the (Pennsylvania) line of Big Beaver there was an excellent set of mills, and about twenty-five miles below the line there was a town building rapidly, where provisions of all kinds could be procured and carried up the river into the heart of the Connecticut Reserve*" (PBC, 1996).

And so the legacy of the Mahoning River and lower Yellow Creek began with the placement of various sawmills, gristmills and steel mills and the growth of the Cities of Youngstown (founded in 1796) and Struthers (gained city status in 1920). Yellow Creek, within the confines of Poland Village, supported the saw and gristmill industry.

In the early 1800's Yellow Creek became the site of the Hopewell furnace, the first blast furnace west of the Allegheny Mountains. Historians credit the Hopewell as the birthplace of the iron and steel industry in the Mahoning Valley and Ohio. Although the Hopewell furnace ceased operations shortly after the War of 1812 began, the watershed did not cease supplying the industry with its needed elements. The Iron and steel industry continued to grow adjacent to the stream, but finally settled along the Mahoning River. There the industry grew, while the surrounding communities grew to house steel mill employees and employers.

The headwaters subwatershed portion of Yellow Creek remained predominantly rural in nature (History of Columbiana County, n.d.). Agriculture was the principle industry for the southern portion of the watershed, but also supplied the ingredients needed for the iron and steel industry: limestone deposits, coal, timber, and water.

ii. Channel and Floodplain Condition

A formal inventory of the watershed's floodplain and stream channel conditions has not been performed. However, the Ohio EPA's Qualitative Habitat Evaluation Index (QHEI) provides an insight to the channel morphology and floodplain/riparian quality through the QHEI scoring metrics. The Channel Morphology metric, metric 3, classifies stream segments as never been channelized, recovered (from channelization), recovering(from channelization), or recent or no recovery. According to the Ohio EPA's QHEI score, the mainstem of Yellow Creek, within the Headwaters subwatershed, exhibits signs of channelization. One location along the mainstem of Yellow Creek and along Burgess Run, do not exhibit any signs of channelization. Yellow Creek at E. Western Reserve Rd. shows signs of recovery from past channelization.

Though not directly discussed, floodplain conditions are incorporated in QHEI assessments. Metric 4, Bank Erosion and Riparian Zone, analyzes stream erosion, riparian width, and the floodplain quality. Based on the final metric score, the floodplain quality of Yellow Creek and Burgess Run in the Burgess Run-Yellow Creek subwatershed are mainly good due to the protection afforded by the surrounding forested land. The floodplain quality of Yellow Creek in the Headwaters subwatershed has been altered and affected by the adjacent agriculture lands.

A 1999 Youngstown State University graduate thesis by Robert A. WIlliamson, titled "*Analysis of Riparian Forest and Floodplain Quality in the Yellow Creek Watershed Using the Qualitative Habitat Evaluation Index*". The thesis examined the floodplain quality of the streams and lakes using a tool he developed overlaid on top of an aerial of the watershed. Each stream and lake within the watershed was analyzed using the tool and assigned a score corresponding to the scoring methodology in the QHEI's metric 4. Results from his study indicated 31.8% of segments contained poor floodplain quality, 63.6% had moderate quality and the remaining 4.6% scored in the excellent range. The stream segments with poor floodplain quality reflected those segments within the developing/developed areas of the watershed and the developed Lakeside properties, while the excellent segments corresponded to those found mainly within Poland Woods. *Figure 42* taken from Williamson's thesis, illustrates floodplain quality scores as they relate to the watershed's stream and lake segments.

iii. Forested Riparian Corridor Assessment

A formal assessment of the watershed's riparian corridors has not been performed. Williamson's thesis examined and characterized the riparian corridor of the watershed, including the lakeside properties. Results indicated the average condition of the riparian width ranged from poor to moderate. According to the thesis (1999, p.43), the range is attributed to agricultural practices in the southern portion of the watershed, while urban sprawl is responsible for the rating in the northern end. Two areas identified with excellent riparian ratings are the Poland Forest and Yellow Creek Park, both identified as preserved lands and located in the northern end of the watershed. The thesis also ranked the riparian surrounding the lakes within the watershed from worst to best conditions in the following order: Evans Lake, Pine Lake, Lake Hamilton and Beaver Lake. The ranking was indicative of the level of development surrounding each lake with Evans Lake having the most land development surrounding its waters. *Figure 43* and *Figure 44*, from Williamson's thesis, illustrate the riparian width score as they relate to the watershed's stream and lake segments and the sum of both the floodplain quality and riparian width for the watershed's stream and lake segments (respectively).

Figure 42: Floodplain Quality Score Results (Williamson, 1999)

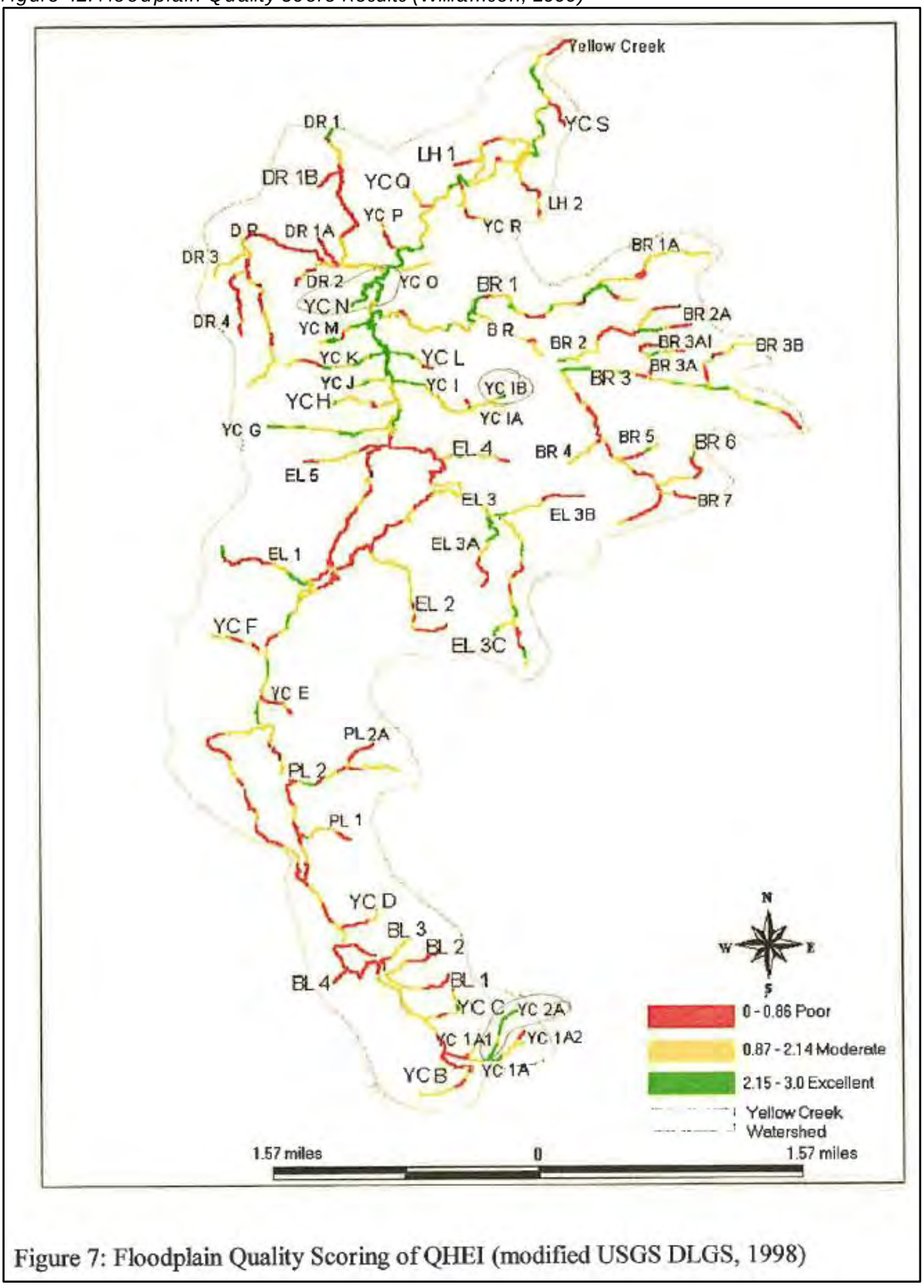


Figure 7: Floodplain Quality Scoring of QHEI (modified USGS DLGS, 1998)

Figure 43: Riparian Width Score Results (Williamson, 1999)

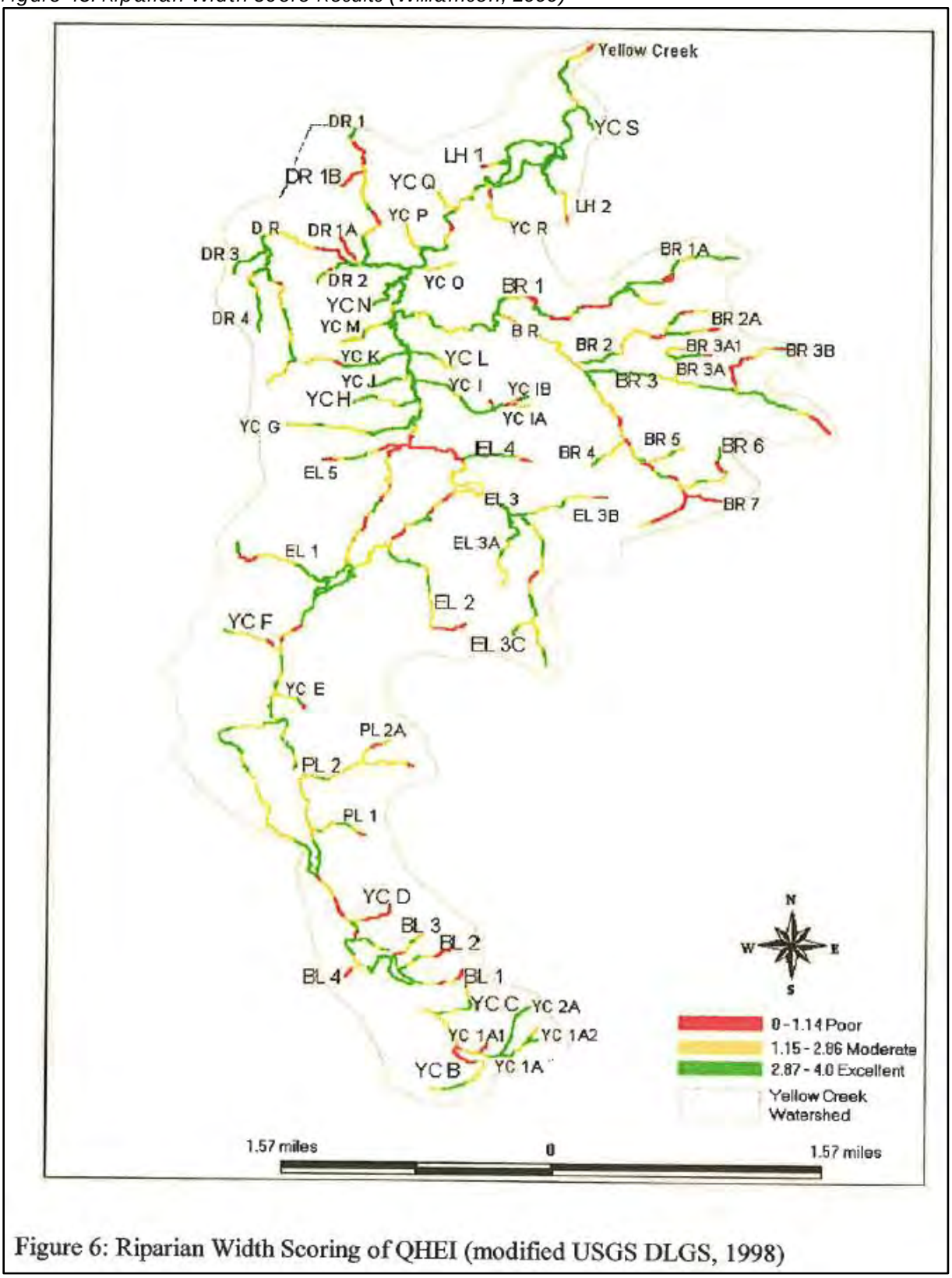


Figure 6: Riparian Width Scoring of QHEI (modified USGS DLGS, 1998)

Figure 44: Sum of Floodplain Quality and Riparian Scores (Williamson, 1999)

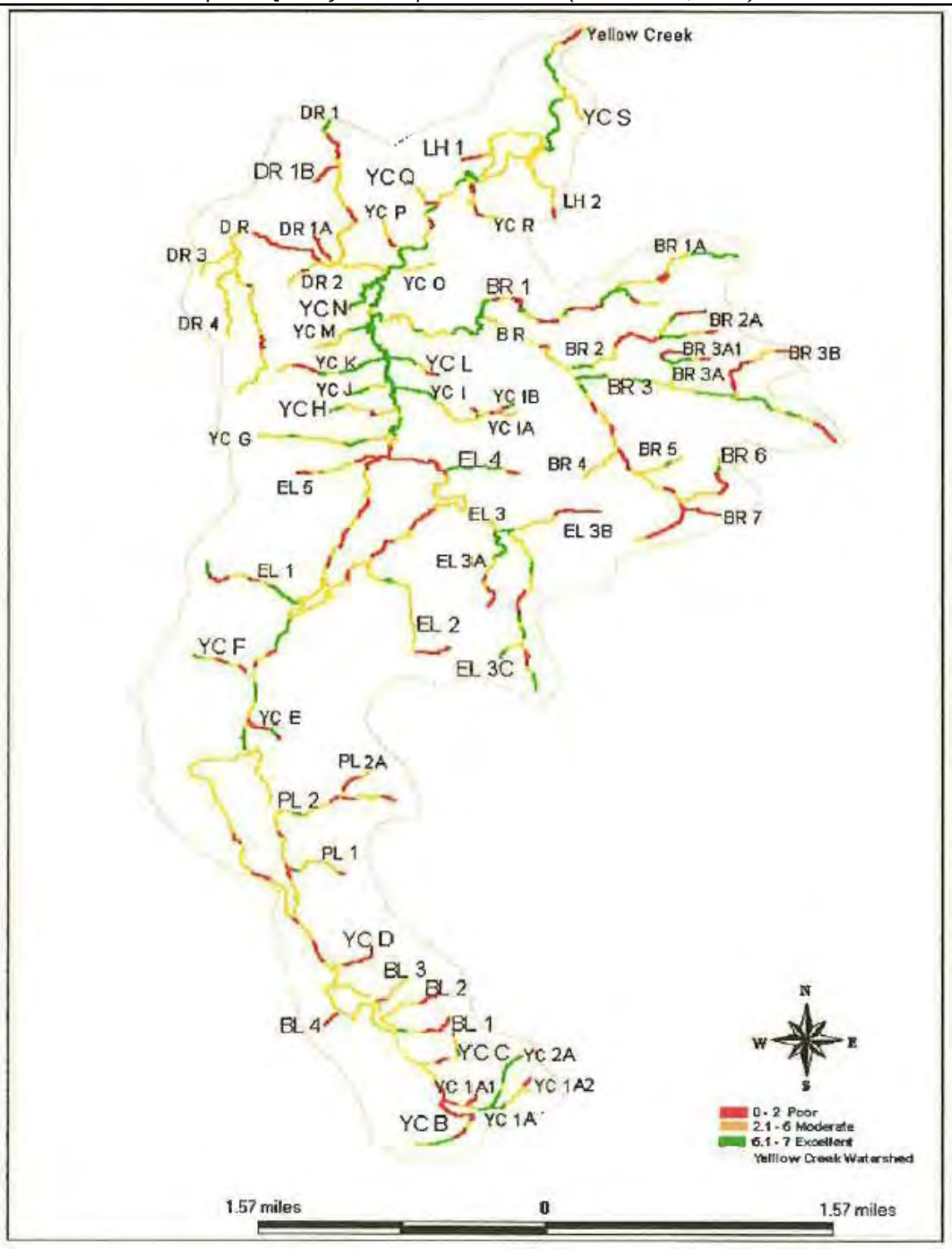
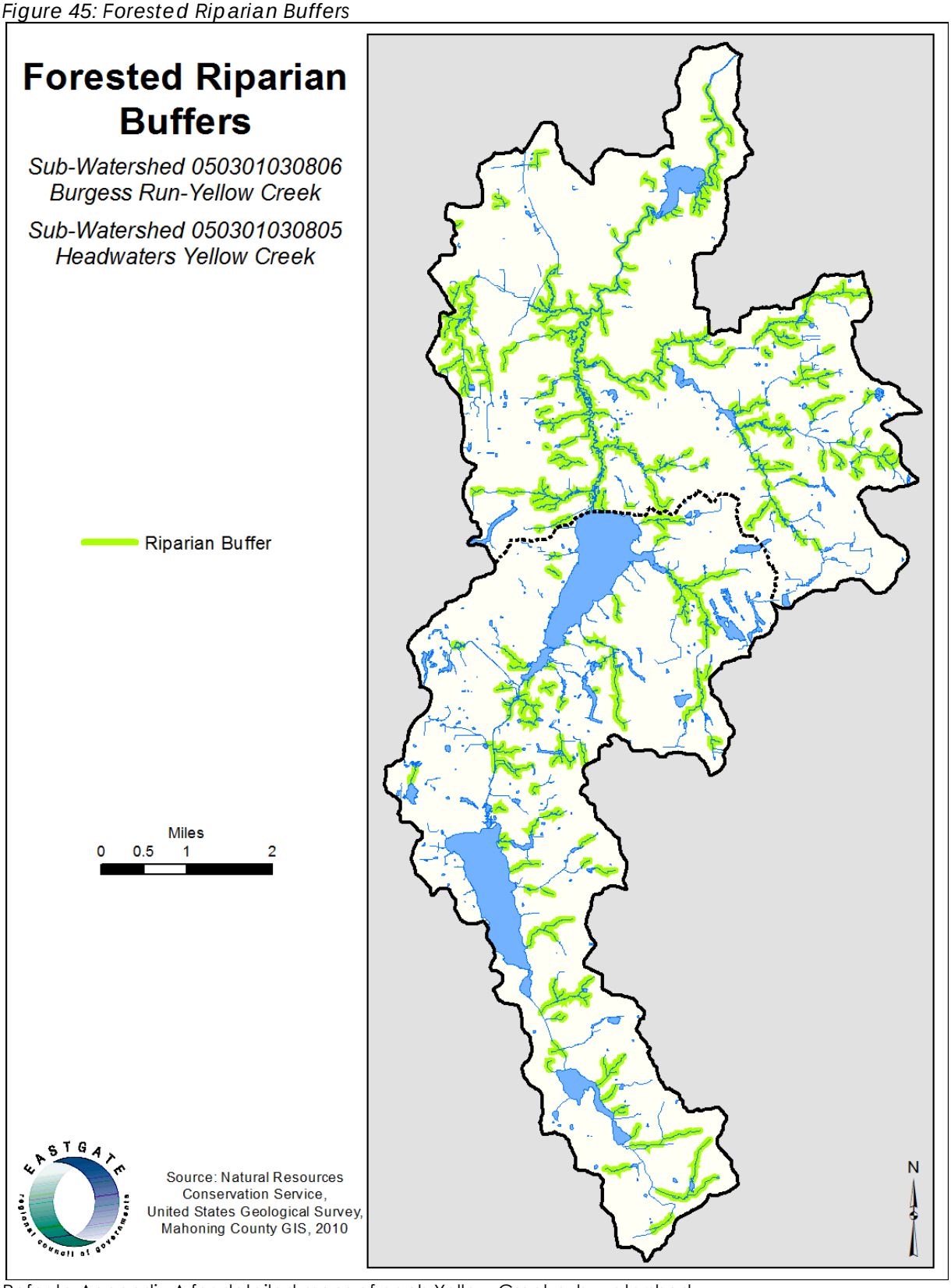


Figure 8: Sum of Floodplain and Riparian Sections of QHEI Riparian Metric (modified USGS DGLS, 1998)

iv. Forested Natural Riparian Buffers

The watershed contains 72.99 miles of streams with forested riparian buffers. *Figure 45* illustrates the buffered streams within the watershed and developed using aerial interpretation

Figure 45: Forested Riparian Buffers



Refer to Appendix A for detailed maps of each Yellow Creek sub-watershed

v. Miles with Permanent Protection

The Clean Ohio Fund program has made it possible to preserve 711.05 acres of land within the watershed. A total of 13.39 stream miles within those preserved lands are in permanent protection.

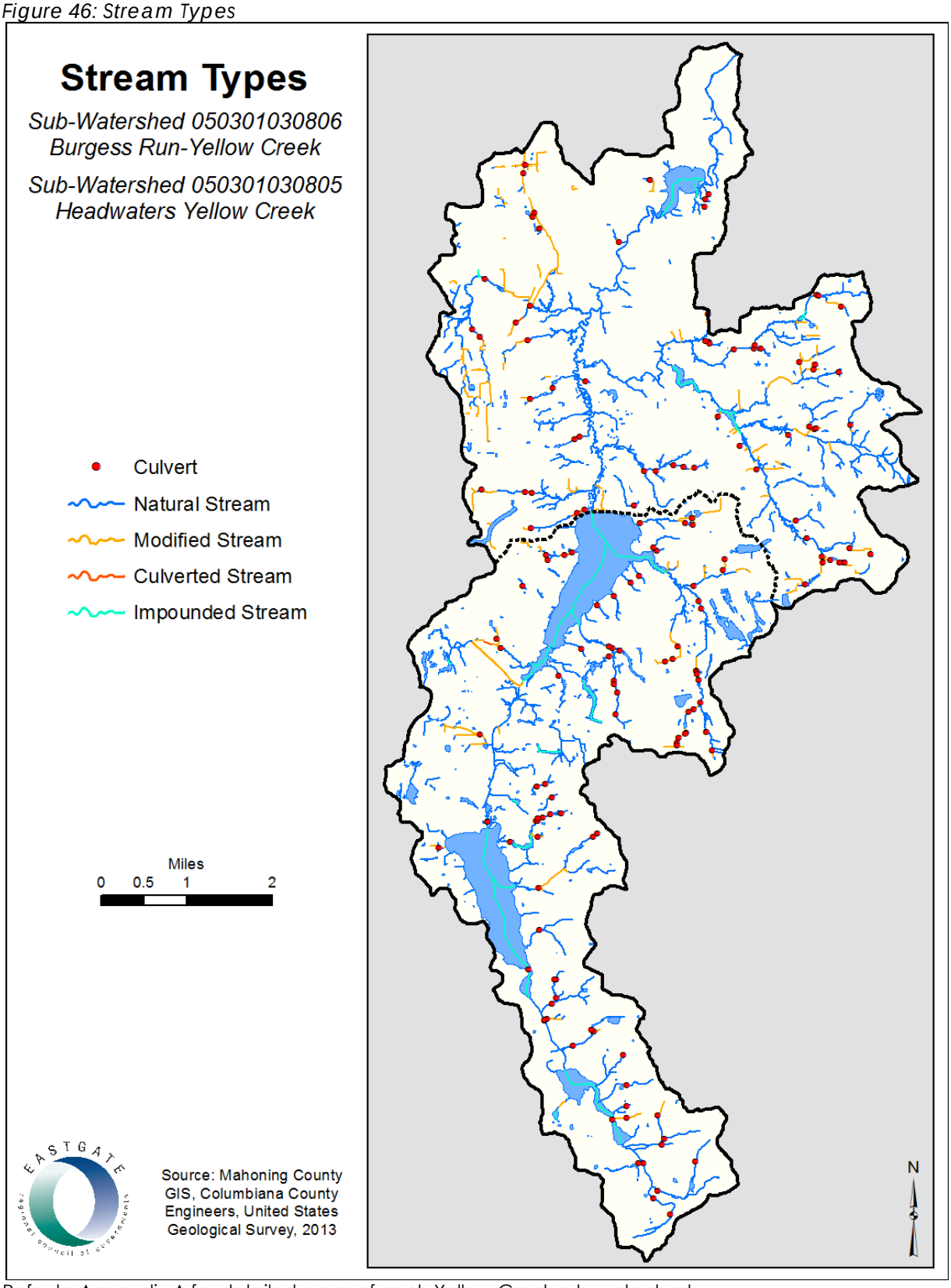
vi. Miles of Natural Channel (Never Modified or Fully Recovered)

Currently there is no data available for locations, levels, or amount of natural channel. However, a subjective review of aerial photography and GIS maps of the watershed show 111.88 miles of streams exist within in the watershed that could be classified as never modified or fully recovered due to their sinuous nature. *Figure 46* identifies natural channel locations.

vii. Miles and Location of Modified Channel

There is no data available for locations, levels, or amounts of modified channel within the watershed. The QHEI's metric 3, Channel Morphology, classifies stream segments as never been channelized, recovered (from channelization), recovering(from channelization), or recent or no recovery. According to the Ohio EPA's QHEI metric 3 score, assessments indicated three of the six survey sites on the mainstem of Yellow Creek were recently channelized and/or in the stages of recovering from channelization: Yellow Creek at Heck Road (RM 14.03), Yellow Creek at SR 165 (RM 11.40) and Yellow Creek at E. Western Reserve Road (RM 7.75). A review of aerial photography and GIS maps of the watershed show 23.17 miles of streams exist within in the watershed that could be classified as modified due to their low or lack of sinuous nature. *Figure 46* identifies modified channel locations.

Figure 46: Stream Types



Refer to Appendix A for detailed maps of each Yellow Creek sub-watershed

viii. Dams

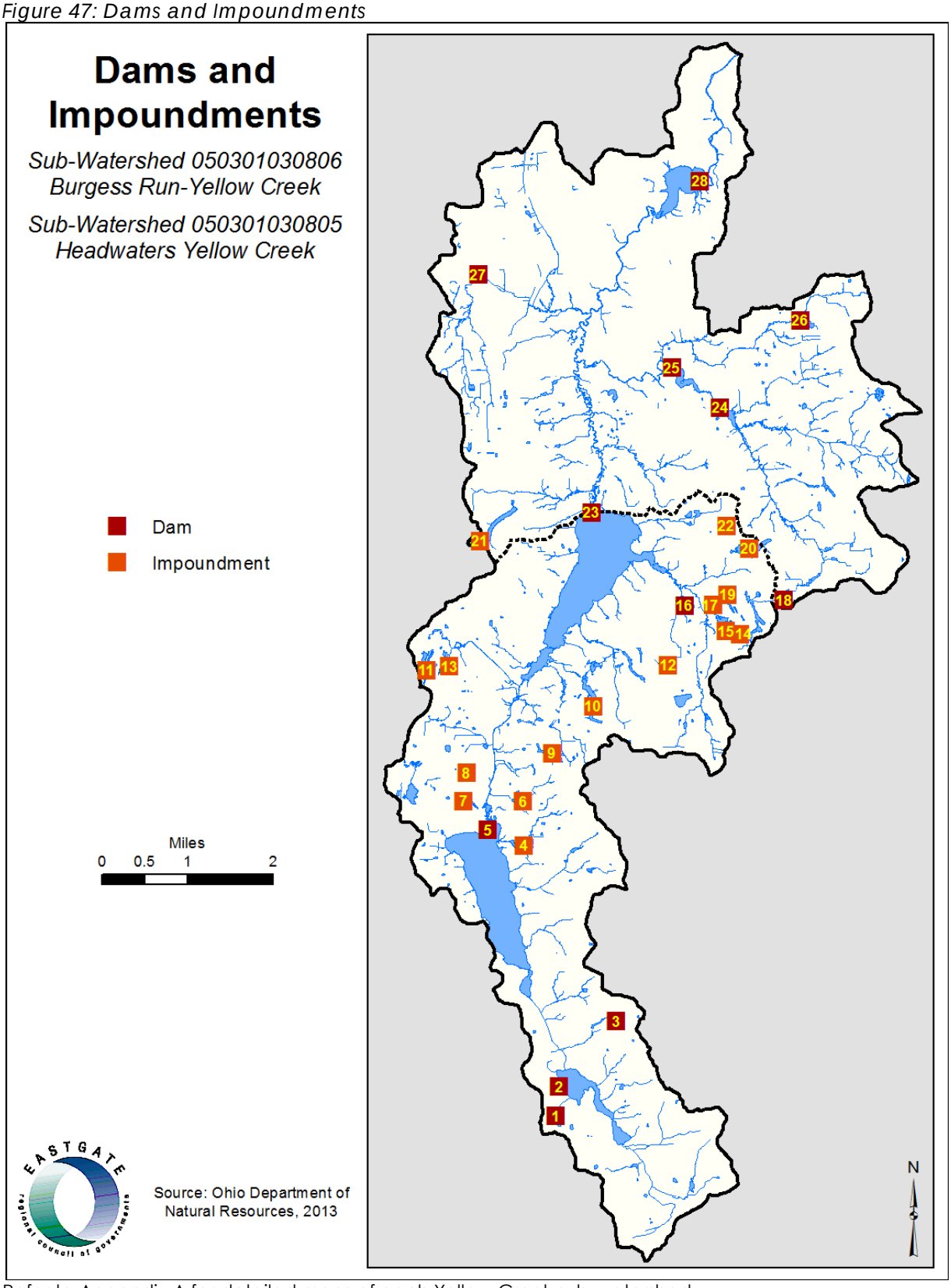
Numerous dams can be found within the watershed. Five major dams are present along the mainstem of Yellow Creek and form Beaver Lake, Pine Lake, Evans Lake, Lake Hamilton; a sixth major dam sits outside the mainstem, but along one of Yellow Creek's major tributaries forming Burgess Lake. According to Aqua Ohio's SWAP the construction of the earthen dam at Beaver Lake is unknown. Two earthen dams form Pine Lake, were constructed in 1912 and are located at the northern and southern embankment, respectively. The earthen dam forming Evans Lake was built in 1948. The dam at Lake Hamilton was constructed in 1905 and is comprised of cut stone and a concrete main structure. Though not located on the mainstem of Yellow Creek, the dam at Burgess Lake was built in 1915. Numerous small dams exist within the watershed, many located on unnamed tributaries to Yellow Creek and Burgess Run. A list of dams within the watershed was compiled from ODNR and can be seen in *Table 35*, *Figure 47* shows the locations of all dams and impoundments in the watershed.

Evans Lake Spillway (Source: Eastgate)

Table 35: Dams and Impoundments

ID	Name	Owner	Owner Type	Stream	Purpose	Type	Structure Type	Max Height
1	Keating Lake Dam		Private	Tributary to Yellow Creek	Recreation, Private	Dam and Spillway		10.0
2	Beaver Lake Dam	Meadowbrooke Development, Llc	Private	Bull Creek	Recreation, Private	Dam and Spillway	Earthfill	17.7
3	Moore Lake Dam	Robert R. & Laura Mehocic Moore	Private	Tributary to Yellow Creek	Recreation, Private	Dam and Spillway	Earthfill	9.2
4	Strip Mine Impoundment		Unknown		Surface Mining	Dugout		
5	Pine Lake Dam	Aqua Ohio, Inc.	Utility	Yellow Creek	Water Supply, Industrial; Recreation, Public	Dam and Spillway	Earthfill	16.0
6	Strip Mine Impoundment		Unknown		Surface Mining	Dugout		
7	Strip Mine Impoundment		Unknown		Surface Mining	Dugout		
8	Strip Mine Impoundment		Unknown		Surface Mining	Dugout		
9	Strip Mine Impoundment		Unknown		Surface Mining	Dugout		
10	Strip Mine Impoundment		Unknown		Surface Mining	Dugout		
11	Strip Mine Impoundment	D & R Elser	Private		Surface Mining	Dugout		
12	Strip Mine Impoundment		Unknown		Surface Mining	Dugout		
13	Strip Mine Impoundment	Ray Heindel	Private		Surface Mining	Dugout		
14	Strip Mine Impoundment		Unknown		Surface Mining	Dugout		
15	Strip Mine Impoundment		Unknown		Surface Mining	Dugout		
16	Unknown			Tributary to Yellow Creek (Evans Lake)		Dam and Spillway	Earthfill	18.0
17	Strip Mine Impoundment		Unknown		Surface Mining	Dugout		
18	Unknown			Burgess Run		Dam and Spillway	Earthfill	10.0
19	Strip Mine Impoundment		Unknown		Surface Mining	Dugout		
20	Strip Mine Impoundment		Unknown		Surface Mining	Dugout		
21	Strip Mine Impoundment		Unknown		Surface Mining	Dugout		
22	Strip Mine Impoundment		Unknown		Surface Mining	Dugout		
23	Evans Lake Dam	Aqua Ohio, Inc.	Utility	Yellow Creek	Water Supply, Industrial; Recreation, Public	Dam and Spillway	Earthfill	49.0
24	Mike Lake Dam	M Charlotte Mike.	Private	Burgess Run	Recreation, Private	Dam and Spillway	Earthfill	11.3
25	Burgess Lake Dam	Aqua Ohio, Inc.	Utility	Burgess Run	Water Supply, Industrial	Dam and Spillway	Earthfill	26.5
26	Roybuck Lake Dam	D.H. Roybuck	Private	Tributary to Burgess Run	Recreation, Private	Dam and Spillway	Earthfill	10.0
27	Boardman Park Detention Basin Dam	Boardman Township		Unnamed Tributary to Yellow Creek				
28	Lake Hamilton Dam	Aqua Ohio, Inc.	Utility	Yellow Creek	Recreation, Public; Water Supply, Industrial	Dam and Spillway	Concrete; Masonry	70.1

Figure 47: Dams and Impoundments



Refer to Appendix A for detailed maps of each Yellow Creek sub-watershed

ix. Channelization

According to Ohio EPA's QHEI assessments, three sites on the mainstem of Yellow Creek were found to be recently channelized and/or in the stages of recovering from channelization: Yellow Creek at Heck Road (RM 14.03), Yellow Creek at SR 165 (RM 11.40) and Yellow Creek at E. Western Reserve Road (RM 7.75). Currently there is no data available for additional locations, levels, or amounts of channelization; for stream channelization information refer to pg.91.

x. Streams with Unrestricted Livestock Access

Agricultural land makes up 40.87% of the total land use in the watershed, with most of the agricultural lands located within the Headwaters-Yellow Creek subwatershed. Although there is no record of livestock entering encroaching upon the streams, physical evidence can be seen along the mainstem of Yellow Creek, downstream of Evans Lake, as well as along various eastern tributaries leading into Evans Lake.

xi. Eroding Banks

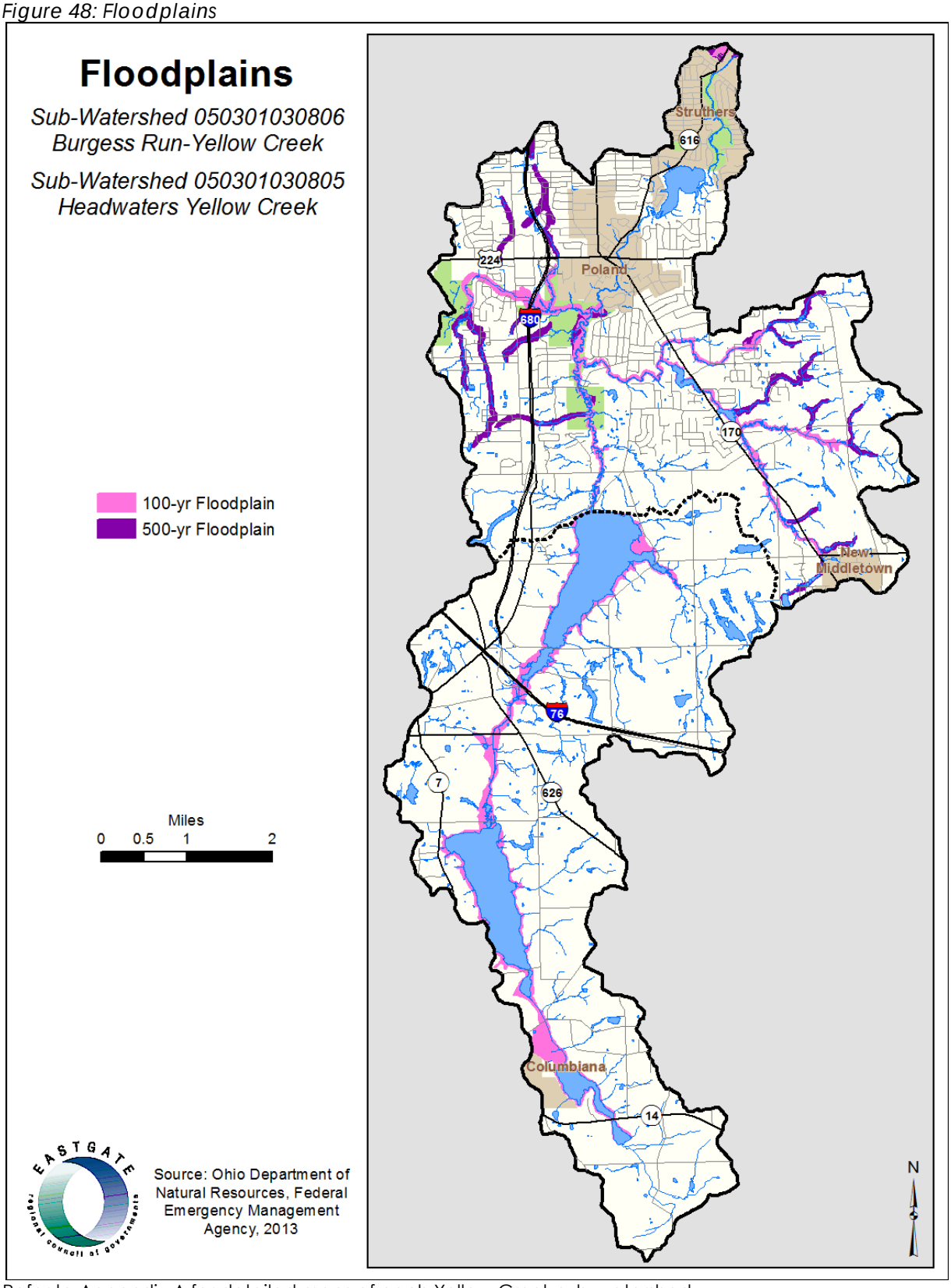
Ohio EPA's QHEI assessments performed within the watershed indicated that none/little to moderate bank erosion is currently experienced at the assessment sites. Currently there is no data available for other locations, levels, or amount of eroding banks because a formal inventory of eroding stream banks within the watershed has not been performed. However, the level of development occurring within the Burgess Run subwatershed could indicate otherwise. *Figure 45* and *Figure 46* identify general areas where stream banks are possibly eroding. These maps could be the base for identifying areas for future evaluation.

Drakes Run, a tributary to Yellow Creek and located in the Burgess Run-Yellow Creek subwatershed, was identified in 2003 with extremely unstable banks. Drakes Run drains the State Route 224 and South Avenue commercial corridor. The stream retains its natural sinuous state at its headwaters, in Boardman Park, and regains that state when it reaches Poland Woods. However, the section of Drakes Run between the two park systems is where it is straightened and culverted. During heavy rain events, the section of Drakes Run leading into Poland Woods becomes an expressway for stormwater, leading to flooding, bank erosion, and silt deposition. The pictures below illustrate the aftermath of erosion of Drakes Run after a storm event. Both pictures were taken in Poland Woods in October of 2013 after a weekend rain event.

xii. Floodplain Connectivity

Currently there is no data available for locations, levels, or amount of floodplain connectivity. *Figure 42* illustrates the floodplain quality as determined by Williamson's calculation methods. The areas in yellow represent those with poor floodplain quality. *Figure 48*, along with the information provided in the thesis, provides a base for identifying future evaluation areas.

Figure 48: Floodplains



Refer to Appendix A for detailed maps of each Yellow Creek sub-watershed

xiii. Riparian Levees

Currently there is no data available for locations, levels, or amount of riparian levees in the watershed.

xiv. Entrenched Miles

An entrenched stream is one with deep stream walls, where its water is confined to its stream walls, and has little to no floodplain. Streams become entrenched due to changes within the watershed or riparian vegetation. Currently there is no data available for locations, levels, or amount of entrenched stream miles. A formal analysis of entrenched portions of the watershed has not been attempted. Ad hoc committee notes from 2003 planning efforts state the banks of Yellow Creek's mainstem are raw, eroding, and entrenched to one degree or another from Western Reserve Road to State Route 170. Drakes Run is the second stream in the watershed listed as having severely unstable banks and being deeply entrenched.

xv. Status and Trends

1. Expected Residential/Commercial Development

Development is a serious factor in the watershed, particularly the Burgess Run subwatershed. According to Eastgate's historical aerials, in 1938 the watershed's residential areas were the City of Struthers and the Village of Poland. Since the late 50's and early 60's, residents began to expand out and develop within the surrounding townships. The townships seeing the highest increase in development are also those that have seen the dramatic change in land use since the early 1900's. Poland and Boardman Townships in Mahoning County experienced the greatest increase in growth both residentially and commercially from 1950 to the present day. Since the late 1950s, State Route 224, South Avenue, and Western Reserve Roads have been the fastest growing commercial corridors of the watershed. In the 1972 aerial, Interstate 680 (I-680) began its trek through the subwatershed, and further changed the landscape of Boardman and Poland Townships.

Urban sprawl continues on a southern path and into Beaver and Springfield Townships, Mahoning County, and Fairfield Township, Columbiana County. Lake front property is a popular draw for new residential developments, as seen by the development around Beaver, Pine, and Evans Lake. According to the Mahoning County Planning Commission, future development is projected to infill existing phases and/or follow where utilities are in place.

Beaver Township in Mahoning County created a comprehensive land use plan, adopted in 2003 by the township's trustees. The plan identifies the northeastern portion of the township as the primary corridor for residential development. In 2008, Boardman Township launched the Boardman Plan 2010 to identify the priorities and objectives of the township, such as investigating the possibilities of a land bank.

Commercial development is limited to the Burgess Run-Yellow Creek HUC of the watershed, specifically Boardman Township. Boardman Township has experienced commercial growth over the past ten years within the confines of South Avenue, Western Reserve Road, and State Route 224. This western quadrant of the watershed is attractive to commercial and small businesses due to easy interstate access and state route traffic. Due to the fact residential developments exist immediately outside the commercial corridor, additional commercial development will continue within that quadrant of the watershed.

Burgess Run-Yellow Creek commercial corridor. (Source: Mark Bergman)

Located within the City of Struthers and at Yellow Creek's confluence with the Mahoning River is the CASTLO Community Improvement Corporation (CASTLO) and ASTRO Shapes, an aluminum extrusion company. CASTLO is located on 120 plus acres of former steel mill property. Several areas of the park are former steel mill properties that have undergone Environmental Phase II remediation due to their relation to steel mill operations. However, the portion of the park within the watershed houses several buildings that are either occupied by tenants or are vacant. Direct access to rail and interstate highway systems makes this industrial park attractive to prospective tenants and/or redevelopment.

CASTLO Industrial Park, Struthers, Ohio. (Source: Mark Bergman)

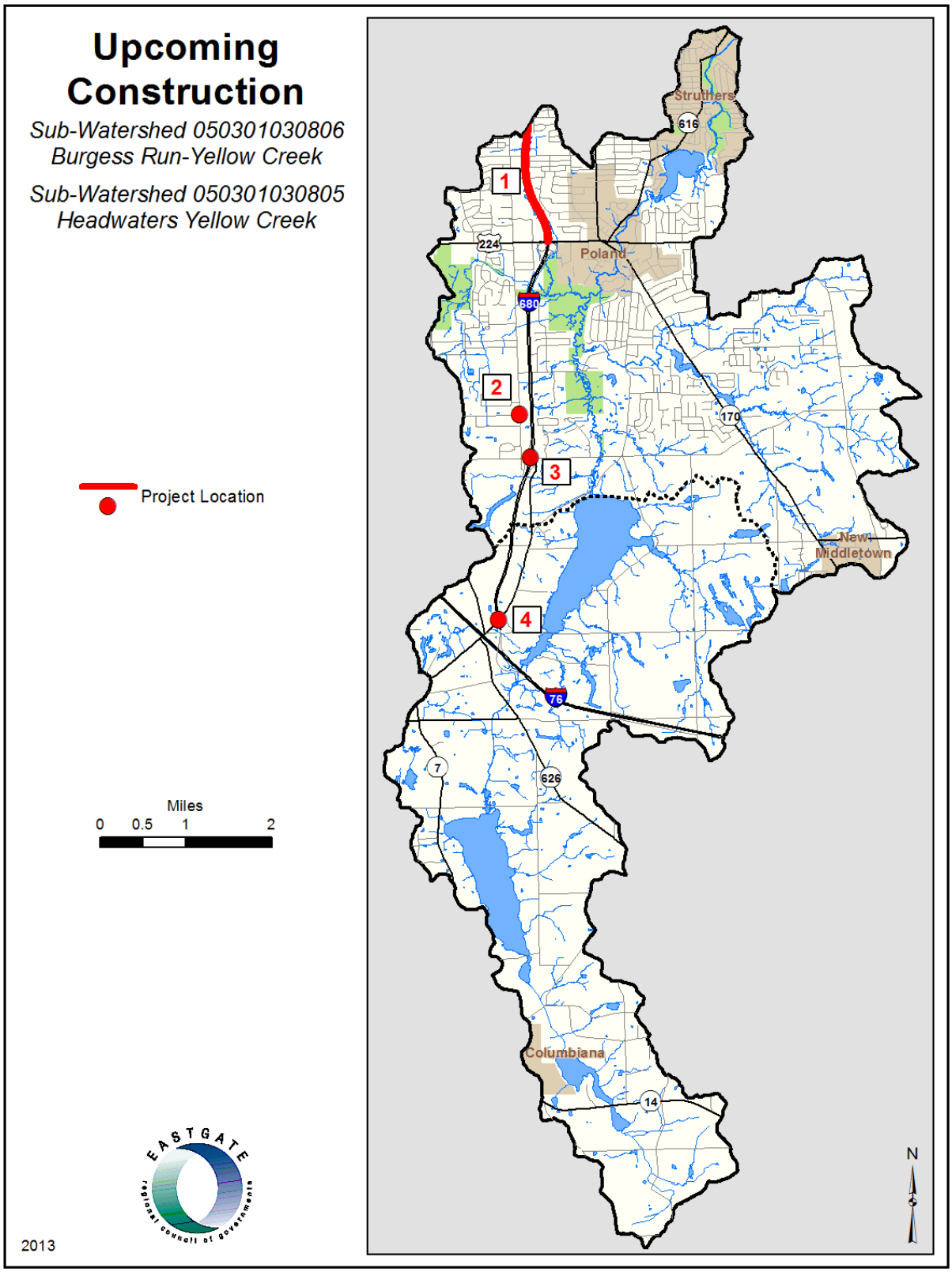
2. Expected Road, Highway and Bridge Construction

Eastgate maintains a Transportation Improvement Program (TIP) which provides a comprehensive list of transportation improvements within the planning area that use federal and state funds over a period of four years. The focus of the TIP is to provide a list of all highway, bridge, and transit system projects. The improvements are developed to promote and safeguard the environment, and overall public health and safety by maintaining clean air standards and providing transportation improvements and enhancements geared to improve the quality of life throughout our area. The current TIP reflects those projects for FY2014-FY2017. The expected construction occurring in the watershed is outlined in *Table 36* and illustrated on *Figure 49*.

Table 36: Upcoming Construction

Map ID	Location	Year	Description	Sponsor	Sale Date
1	IR 680	2014	Resurfacing and bridge work	ODOT	10/1/2016
2	South Ave / McClurg Rd	2015	Construction of signalized intersection	Mahoning Co Engineer	TBD
3	SR 164	2014	Rehabilitation of Western Reserve Rd bridge over IR 680	ODOT	10/10/2013
4	IR 680 / SR 164	2017	Interchange construction and widening of State Route 164	ODOT	7/1/2016

Figure 49: Upcoming Construction



Refer to Appendix A for detailed maps of each Yellow Creek sub-watershed

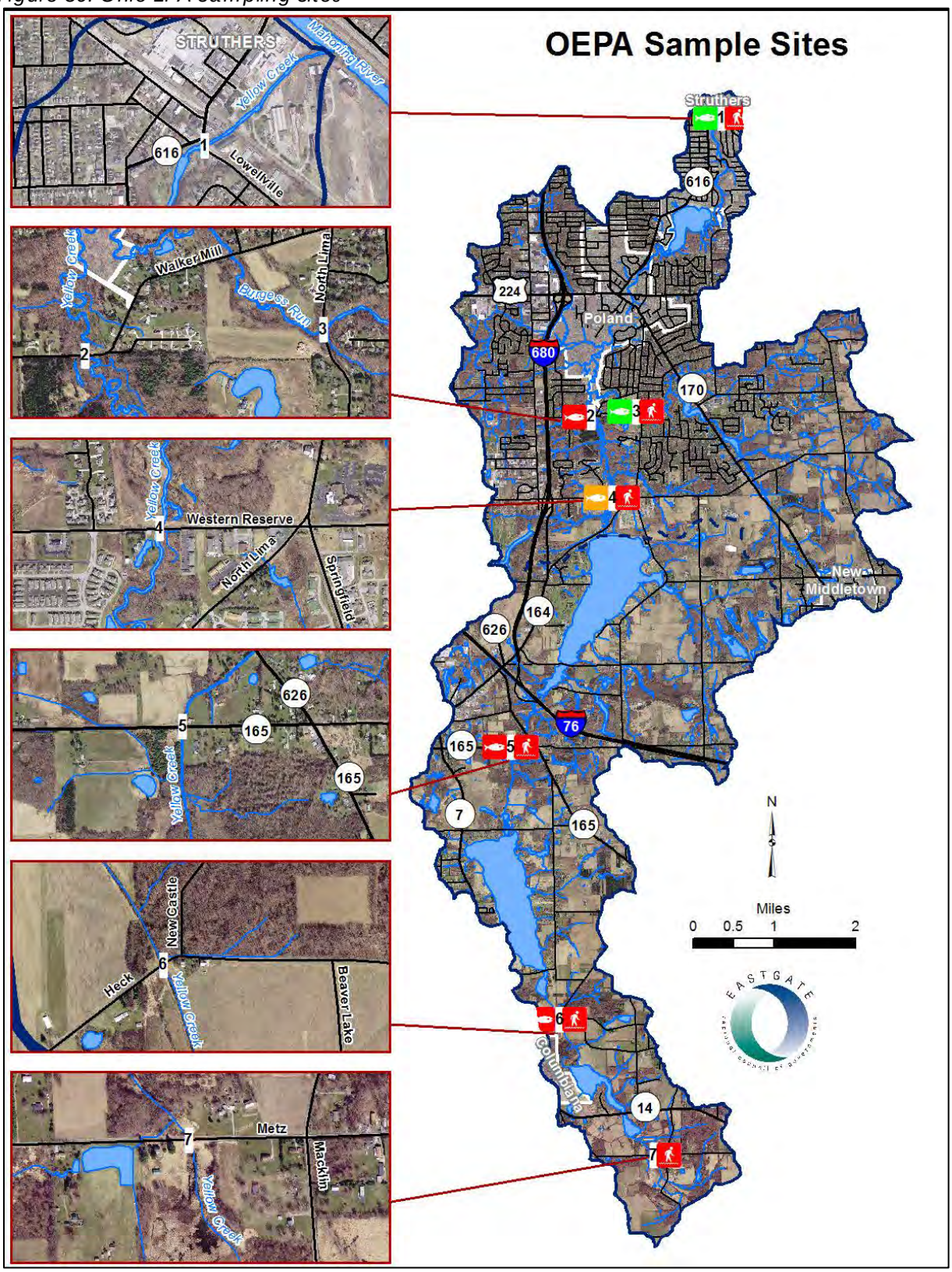
D. Water Resource Quality

The Ohio EPA surveyed six stream sites in Yellow Creek during their 2011 monitoring season. All six sites were sampled for chemistry and bacteria; five out of the six sites additionally sampled for bugs, fish; and two were sampled additionally for sediment. Due to an impoundment located at RM 7.75 (Yellow Creek at E. Western Reserve Road) and the probability of it affecting the outcome of the bug and fish sampling at RM 7.75, bugs and fish were analyzed at a downstream location, Yellow Creek at Walker Mill Road (RM 6.3). Due to the headwater status of Yellow Creek at Metz Road and at Heck Road (drainage area < 1 square mile), only chemistry and bacteria samples were taken. *Table 37* lists the sampled sites, while *Figure 50* illustrates the sampling location.

Table 37: 2011 Yellow Creek Stream Monitoring Sites

HUC 050301030805 – Headwaters to Yellow Creek/Evans Lake	**River Mile**	***Sample Type***
Yellow Creek @ Metz Road	16.2	Chemistry, Bacteria
Yellow Creek @ Heck Road	14.03	Bugs, Fish, Chemistry, Bacteria
Yellow Creek @ State Rt.165	11.4	Bugs, Fish, Chemistry, Bacteria, Sediment
HUC 050301030806 – Burgess Run – Yellow Creek	**River Mile**	***Sample Type***
Yellow Creek @ E. Western Reserve Road	7.75	Bugs, Fish, Chemistry, Bacteria
Yellow Creek UST Lowellville Road	0.36	Bugs, Fish, Chemistry, Bacteria, Sediment
Burgess Run @ North Lima Road	1.05	Bugs, Fish, Chemistry, Bacteria
*Yellow Creek @ Walker Mill Rd.	6.3	Bugs, Fish

Figure 50: Ohio EPA Sampling Sites



i. Locationally-Referenced Use Designations/Use Attainment

The Ohio Administrative Code (OAC) 3745-1-25 provides use designations for water bodies within the Mahoning River drainage basin. Section 2(d) of the plan discusses those water bodies surveyed by the Ohio EPA and reported within the OAC.

The Ohio EPA performed a Biological and Water Quality Study of the watershed in 2011. Five locations were evaluated for aquatic life and six locations were evaluated for recreational use potential. The six locations in Yellow Creek evaluated for aquatic and recreational use potential in 2011 are shown in *Table 38* and illustrated in *Figure 50* and *Figure 51*. Significant findings include the following:

- Yellow Creek is currently assigned the WWH aquatic life use. In spite of its failure to consistently achieve WWH biocriteria due to some natural limitations (i.e. low gradient), and some anthroprogenic reason, the WWH aquatic life use is currently the most appropriate aquatic life use for this stream and therefore should be retained. In 2011 the downstream station (RM 0.6) improved into the "good" range (ICI=40) from 1994 (ICI=32), likely due to improvements to habitat.

- Yellow Creek is designated as a Public Water Supply (PWS) at RM 2.0 for the City of Campbell. It is also a PWS at RM 8.4 for the City of Struthers.

- One stream is listed in the Ohio WQS that has an unverified WWH aquatic life use. Burgess Run is listed as a WWH stream based on 1978 water quality standards. In 2011 biological sampling (both macroinvertebrate and fish) conducted on Burgess Run verified that the WWH aquatic life use designation is appropriate for this stream. It is therefore recommend that the use designation be retained.

- Burgess Run is designated as a PWS at RM 2.0 for the City of Struthers.

Table 38: Ohio EPA Water Body Use Designations, Yellow Creek Watershed

Water Body Segment	Use Designations													Comments
		Aquatic Life Habitat						Water Supply			Recreation			
	SRW	WWH	EWH	MWH	SSH	CWH	LRW	PWS	AWS	IWS	BW	PCR	SCR	
Yellow Creek – at RMs 2.0 and 8.4		+						o	+	+		+		PWS intakes – Campbell (RM 2.0) and Struthers (RM 8.4)
All other segments		+							+	+		+		
Burgess Run – at RM 2.0		*						o	*	*		*		PWS intake - Struthers

All locations within Yellow Creek and Burgess Run in this study should retain the Primary Contact Recreation Class B use, along with the Agricultural Water Supply, Industrial Water Supply and Public Water Supply uses.

1. Number of Waterbodies/Miles in Full Attainment

Results from the 2011 stream monitoring session identified Yellow Creek upstream Lowellville Road (RM 0.36), and Burgess Run at North Lima Rd. (RM 1.05) in full attainment of Ohio EPA's water quality standards.

2. Number of Threatened Miles

Results from 2011 stream monitoring did not identify any stream segments threatened by definition of the Ohio EPA's water quality standards.

3. Number of Waterbodies/Miles in Partial Attainment

Results from the 2011 stream monitoring session identified Yellow Creek at E. Western Reserve Road (RM 7.75) in partial attainment of Ohio EPA water quality standards.

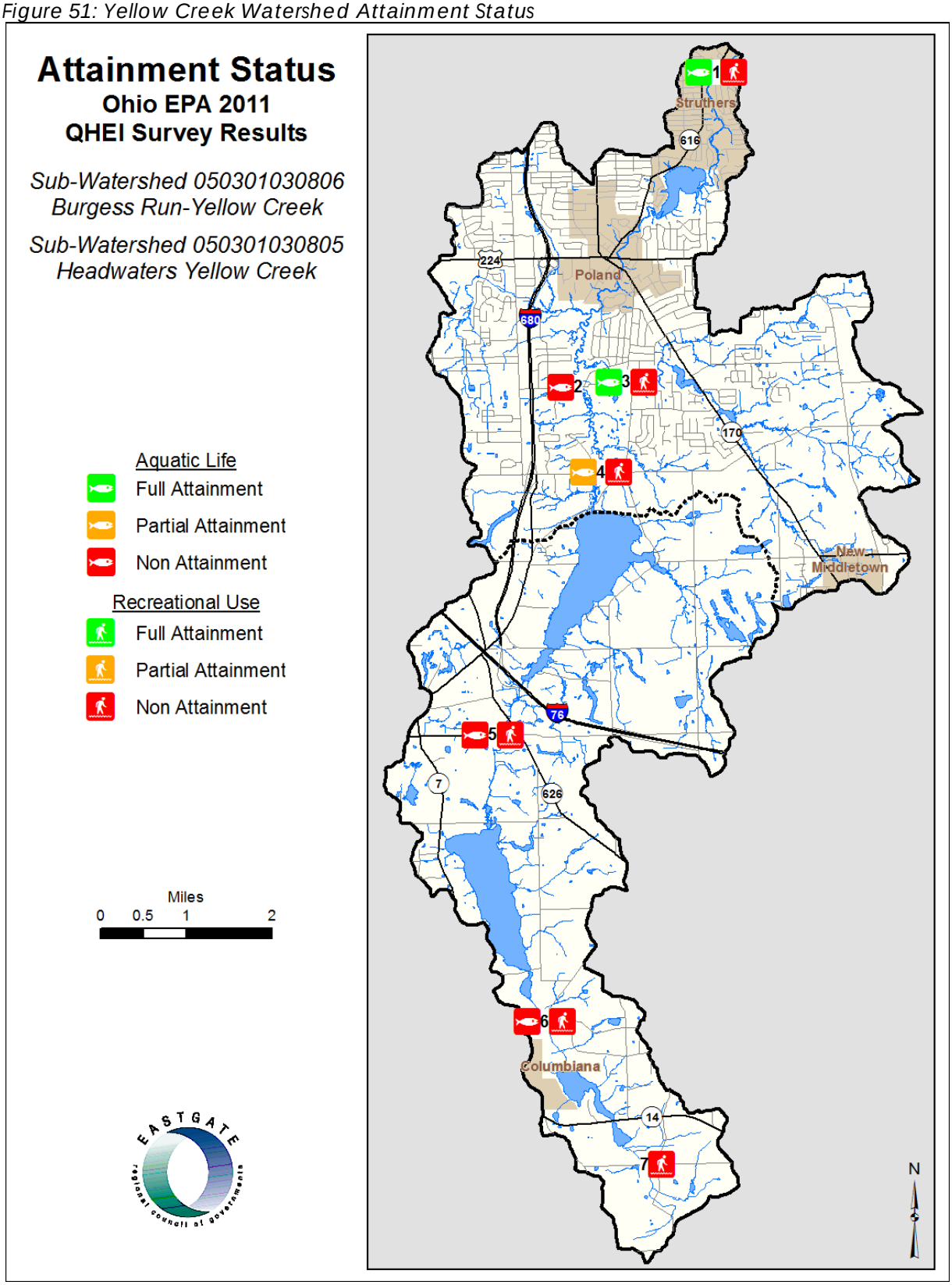
4. Number of Segments/Miles in Non-Attainment

Results from the 2011 stream monitoring session identified Yellow Creek at Heck Road (RM 14.03), Yellow Creek at State Rt. 165 (RM 11.4) and Yellow Creek at Walker Mill Road (RM 6.3) in non attainment of Ohio EPA water quality standards.

5. Number of Streams Designated but not Monitored

Currently there is no data available for the number of streams designated but not monitored in the Yellow Creek Watershed.

Figure 51: Yellow Creek Watershed Attainment Status



6. Lakes/Quality

Water quality monitoring data for the lakes within the watershed is limited to information provided within the SWAP created by Burgess and Niple, for Aqua Ohio. Because Aqua Ohio owns most of the lakes within the watershed, the SWAP describes the water quality of Beaver Lake, Pine Lake, Evans Lake, Burgess Lake, and Lake Hamilton. In summary, the SWAP states Beaver and Pine Lake have relatively good, high water quality. However, the water quality of Evans Lake, Burgess Lake and Lake Hamilton is described as being hard due to the previous mining activities within the watershed below Pine Lake.

The Ohio EPA surveyed the intakes for Evans Lake and Lake Hamilton in 2013. Parameters covered include monitoring for select nutrients (ammonia, phosphorus, nitrates) and inorganic parameters (i.e. aluminum, chloride, iron). Results from the survey indicated the Lakes were not exceeding the water quality parameters for nutrients; and the only inorganic parameters showing exceedences were chloride, copper and sodium for both lakes.

7. Wetlands/Quality

Wetlands are nature's sponge tasked with absorbing and filtering floodwaters prior to their entrance into waterways. According to the NWI and the OWI, 1,119.61 acres of wetlands have been identified within the Yellow Creek Watershed. Currently there is no data available stating the exact number of wetlands or the water quality of wetlands within the Yellow Creek Watershed. However, the Ohio EPA performed several field wetland assessments with relation to proposed development or current violations and in summary, several Ohio Rapid Assessment Method (ORAM) scores for various sites indicate wetlands within the watershed scored within the moderate to high Category 2 and Category 3 range.

A wetland mitigation plan was developed by Dr. Scott Martin, Ph.D, P.E., Scott Airato, and Susheel Kowalkar of the YSU's Civil and Environmental Engineering Program. The plan, "*Wetland Mitigation Plan for Mill Creek, Yellow Creek, and Meander Creek Watersheds*" was developed to fulfill an objective identified by AWARE for inclusion in the original watershed action plan. The mitigation plan identified large wetland areas within the Yellow Creek Watershed, and according to the plan, these areas lie within four locations:

- Land Surrounding Beaver Lake, Columbiana County- includes a mixture of forested, scrub/shrub, and emergent wetlands;
- North of Pine Lake, along Yellow Creek, Mahoning County- includes a mixture of forested, scrub/shrub, and emergent wetlands;
- South of the Village of Poland, along Yellow Creek, Mahoning County- mostly forested wetlands (majority located within the Poland Forest); and
- At the intersection of Clingan and Dobbins Roads, Poland Township, Mahoning County- majority forested wetlands.

However, the plan did not identify areas suitable for wetland mitigation (Airato, Kowalkar, & Martin, 2000, p. 32). This conclusion was drawn based on the residential and commercial development, hilly topography, and lack of hydric soils (confirmed by ***Figure 13)***.

In general, the acreage of wetlands in Yellow Creek is found along waterway riparian areas (pg. 73). In addition, past strip mining operations throughout the southern portion of the watershed have left numerous, isolated open water areas.

8. Groundwater/Quality

Ohio does not have statewide ground water quality standards. Summary information and data may be found in the Ohio 2010 Integrated Report, Section M: An Overview of Ground Water Quality in Ohio, http://epa.ohio.gov/portals/35/tmdl/2012IntReport/IR12SectionMfinal.pdf.

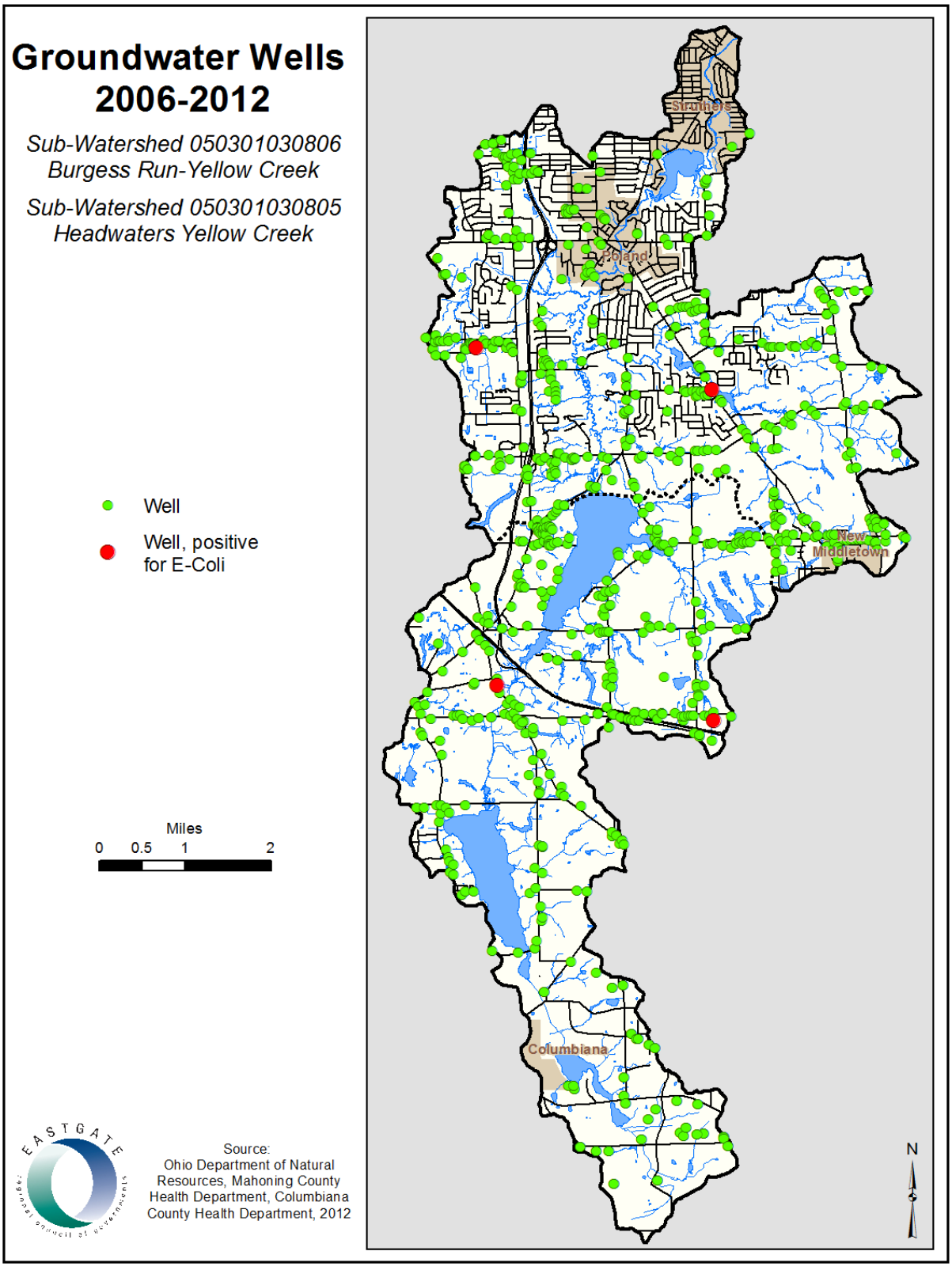
Groundwater Sensitivity, discussed on pg. 62, describes the areas sensitive to ground water pollution. Based on the information, the majority of the watershed falls within the low or low-moderate level of vulnerability to contamination. These areas are located along the whole length of Yellow Creek's mainstem (refer to ***Figure 33***). Other vulnerable areas include Burgess Run and its tributaries.

The Mahoning County District Board of Health and the Columbiana County Health Department both test ground water wells on the following basis:

- Real estate point of sale transfer/property transfer;
- New well/alteration to existing wells;
- Complaints;
- Daycare/Foster Care operations
- Restaurant/Business;
- Manufactured Home Parks; and
- Campgrounds.

Both health departments test water wells for bacteria (total coliform) and nitrates. Total coliform is used as an indicator that other, potentially harmful bacteria may be present within the water. When a well tests positive for total coliform, a second test is performed to determine whether or not Fecal coliform or E. coli is present. These two bacteria may be the result of human or animal waste. Based on information provided by both health departments, 727 groundwater wells exist within the watershed and only three tested positive for E. coli. ***Figure 52*** illustrates the location of groundwater wells within the watershed.

Figure 52: Groundwater Wells



ii. Causes and Sources of Impairment for 305(b) 303 (d) Listed Streams

The Ohio EPA's Division of Surface Water (DSW) completed the Ohio 2012 Integrated Water Quality Monitoring and Assessment Report. The report indicates the general condition of Ohio's waters and identifies those waters not meeting water quality standards. Prepared in accordance with federal guidance, the report satisfies the Clean Water Act for both Section 305(b) water quality reports and Section 303(d) lists of impaired waters. According to the Ohio EPA Division of Surface Water's Watershed Assessment Unit Summary, streams within the Yellow Creek Watershed have not been sampled since 1994. However, for the purpose of developing this watershed action plan, the Ohio EPA added six sites within the Yellow Creek watershed to their 2011 sampling schedule.

The monitoring identified exceedances of Ohio's Water Quality Standards criteria (OAC 3745-1) for chemical and physical (bugs, fish, habitat) parameters at five assessment locations. *Table 39* identifies the sampling sites and lists causes and sources of impairments. *Table 40*, lists the aquatic life use status for sampling sites in Yellow Creek where the Index of Biotic Integrity (IBI) and Modified Index of well being (MIwb) measure the fish community and its diversity, while the Invertebrate Community Index (ICI) measures the health of the macroinvertebrate community.

Table 39: Causes and Sources of Impairments

HUC 050301030805 – Headwaters to Yellow Creek/Evans Lake	**River Mile**	**Causes of Impairment**	**Sources of Impairment**
Yellow Creek @ Heck Road	11.4	Low dissolved oxygen, Sedimentation/Siltation, Nutrient/organic enrichment, Metals, direct habitat alterations	Channelization, acid mine drainage, agricultural runoff, agricultural tile, failing septic systems
Yellow Creek @ State Rt. 165	14.03	Low dissolved oxygen, Sedimentation/Siltation, Nutrient/organic enrichment, direct habitat alterations	Channelization, agricultural runoff, loss of riparian habitat
HUC 050301030806 – Burgess Run – Yellow Creek	**River Mile**	**Causes of Impairment**	**Sources of Impairment**
Yellow Creek UST Lowellville Road	0.36	None	None
Yellow Creek @ E. Western Reserve Road	7.75	Nutrient/organic enrichment, sedimentation/siltation, Total dissolved Solids (TDS). Fish passage barrier	Dam/impoundment, failing septic systems, agricultural runoff, livestock, urban runoff
Burgess Run @ North Lima Road	1.05	Nutrients, sedimentation/siltation	Failing package plant, failing septic systems, urban runoff, channelization

Table 40: Aquatic Life Use Status

Location	STORET (RM)	DRAIN. (MI²)^	IBI	MIwb [a]	ICI [b]	QHEI[c]	Status[d]	Causes	Sources
Yellow Creek (18-007) WWH Existing									
Yellow Creek @ Heck Road	301466 (14.03)	3.7[H]	34*	--	P*	44.0	**NON**	Low dissolved oxygen Sedimentation/siltation Nutrient/organic enrichment Metals Direct habitat alterations	Channelization Acid mine drainage Agricultural runoff Agriculture tile On-site treatment systems
Yellow Creek @ State Rt. 165	301407 (11.4)	10.11[H]	32*	--	F*	40.5	**NON**	Low dissolved oxygen Sedimentation/siltation Nutrient/organic enrichment Direct habitat alterations	Channelization Agricultural runoff Loss of riparian habitat
Burgess Run – Yellow Creek (18-008) WWH Existing									
Yellow Creek @ E. Western Reserve Road	301468 (7.75)	20.52[W]	36[ns]	6.28	28	49.0	**PARTIAL**	Nutrient/organic enrichment Sedimentation/siltation TDS Fish passage barrier	Dam/impoundment On-site treatment systems Agricultural runoff Livestock Urban runoff
Yellow Creek @ Walker Mill Road	301739 (6.3)	23.2[W]	32	7.08	--	77.0	**NON**	Nutrients Sedimentation/siltation	Failing package plant On-site treatment system Urban runoff Channelization
Yellow Creek UST Lowellville Road	N03S18 (0.36)	39.03[W]	42	8.57	40	85.5	**FULL**	*****	

^ - H= Headwater; W= Wading

a- MIwb is not applicable to headwater streams with drainage areas < 20 mi2.

b- A narrative evaluation of the qualitative sample based on attributes such as EPT taxa richness, number of sensitive taxa, and community composition was used when quantitative data was not available or considered unreliable. VP=Very Poor, P=Poor, LF=Low Fair, F=Fair, MG=Marginally Good, G=Good, VG=Very Good, E=Exceptional

c - Narrative habitat evaluations are based on QHEI scores for wading sites (Excellent >75, Good: 60-74, Fair: 45-59, Poor: 30-44, Very Poor <30) and headwater sites (Excellent >70, Good: 55-69, Fair: 43-54, Poor: 30-42, Very Poor <30).

d- Attainment is given for the proposed status when a change is recommended.

ns- Nonsignificant departure from biocriteria (<4 IBI or ICI units, or <0.5 MIwb units).

*- Indicates significant departure from applicable biocriteria (>4 IBI or ICI units, or >0.5 MIwb units). Underlined scores are in the Poor or Very Poor range.

According to the results from the 2011 study, the greatest threats to Yellow Creek's water quality is nutrient enrichment, low dissolved oxygen, bacteria, stormwater runoff, acid mine drainage (AMD), and sedimentation.

iii. Point Sources (by Subwatershed or Stream Segment)

Point source pollution is a direct discharge into a river, stream, lake or wetland from a known source such as a wastewater treatment plant or industrial facility. Any such direct discharge into a water body is required, by the laws set forth in the Clean Water Act, to obtain an NPDES permit. The NPDES permit creates a means of operating, monitoring, reporting, and sets numerical limitations on the amount of specified pollutants authorized for discharge. There are currently four package plants and two facilities discharging treated effluent into Yellow Creek and are located along Evans Lake. A Package Plant is a prefabricated, discharging treatment facility typically treating wastewater volumes less than 100,000 gpd. Besides the package plants, the Ohio EPA lists three (3) additional NPDES permit holders within the Yellow Creek Watershed. ***Figure 53*** illustrates the location of each permit holder. A brief description of the significant NPDES facility discharges is included in the following paragraphs listed by 12-digit subwatershed provided for Ohio EPA permits. Visit the Ohio EPA's Division of Surface Water Individual NPDES Permits for more information on Ohio's Individual NPDES permits, http://www.epa.ohio.gov/dsw/permits/individuals.

1. Permitted Discharges

HUC050301030805,Headwaters-YellowCreek

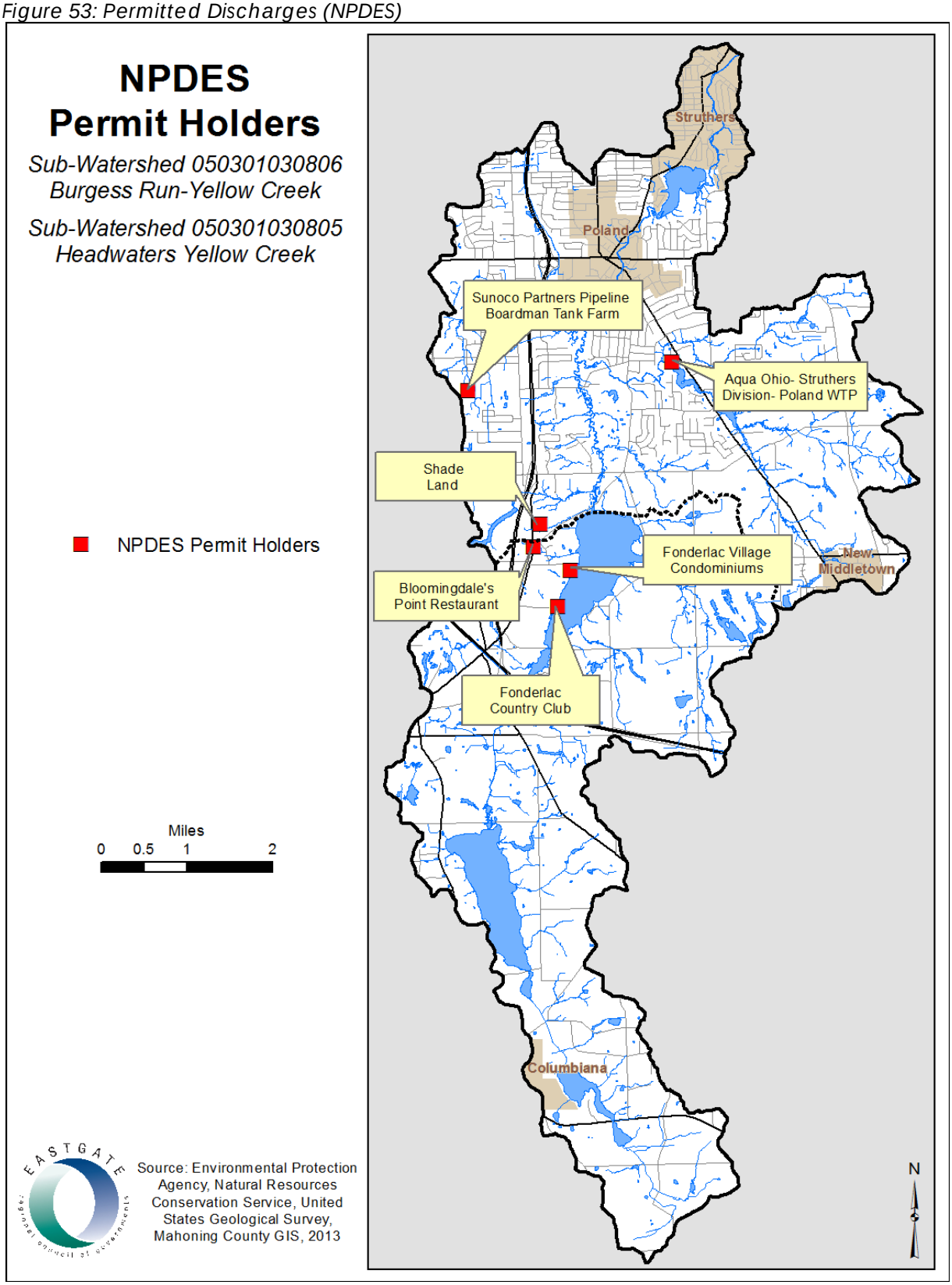
- The Lake Club- NPDES#3PR00219 (http://wwwapp.epa.ohio.gov/dsw/permits/doc/3PR00219.pdf)
- Fonderlac Village Condominiums – NPDES#3PW00025 (http://wwwapp.epa.ohio.gov/dsw/permits/doc/3PW00025.pdf)
- Bloomingdales- NPDES#3PR00298 (http://wwwapp.epa.ohio.gov/dsw/permits/doc/3PR00298.pdf)

HUC050301030806,Burgess Run-Yellow Creek

- Shadeland Apartments, LLP- NPDES#3PR00546*AD (http://wwwapp.epa.ohio.gov/dsw/permits/doc/3PR00546.pdf)
- Aqua Ohio- Struthers Division, Poland Water Treatment Plant- NPDES#3IW00082(http://wwwapp.epa.ohio.gov/dsw/permits/doc/3IW00082.pdf)
- Sunoco Partners Pipeline, Boardman Tank Farm- NPDES #3IG00015 (http://wwwapp.epa.ohio.gov/dsw/permits/doc/3IG00015.pdf)

Too numerous to mention are the HSTS off lot discharges covered under Ohio House Bill (HB)110. House Bill 110 provides an NPDES permit for off lot discharging HSTS systems that fall under the jurisdiction of local health departments. Adding another level of permitting, Ohio HB 231 requires the Ohio EPA to create a general permit for all residential systems discharging to Waters of the State. On February 17, 2006, the Ohio EPA introduced a draft General NPDES Permit (No. OHK000001)to issue for new and replacement discharging sewage treatment systems. The general permit received final approval in December of 2006. On January 1, 2007 the Ohio EPA adopted the general permit, authorizing wastewater discharges for selected new and replacement HSTS's under the NPDES program. Both county health departments signed memorandums of understanding (MOU) with the Ohio EPA to administer the General NPDES permit program. According to the Ohio EPA, the general permit is issued to those dischargers that will have a minimal impact on the environment and covers a one, two, or three family or residential dwelling. In order to ensure compliance with the discharge standards of each permit and proper system operation, the Ohio EPA is requiring each permit holder annual sampling and testing of discharge from the system. The sampling results are to be submitted to the jurisdictional local health department and made available at the request of the Ohio EPA. A second General NPDES permit, OHL000001 was created to cover existing discharging HSTSs in counties that have not signed an MOU with the Ohio EPA and therefore, would be under the Ohio EPA's HSTS program. Due to the number of NPDES permits for such systems, a list was not created.

Figure 53: Permitted Discharges (NPDES)



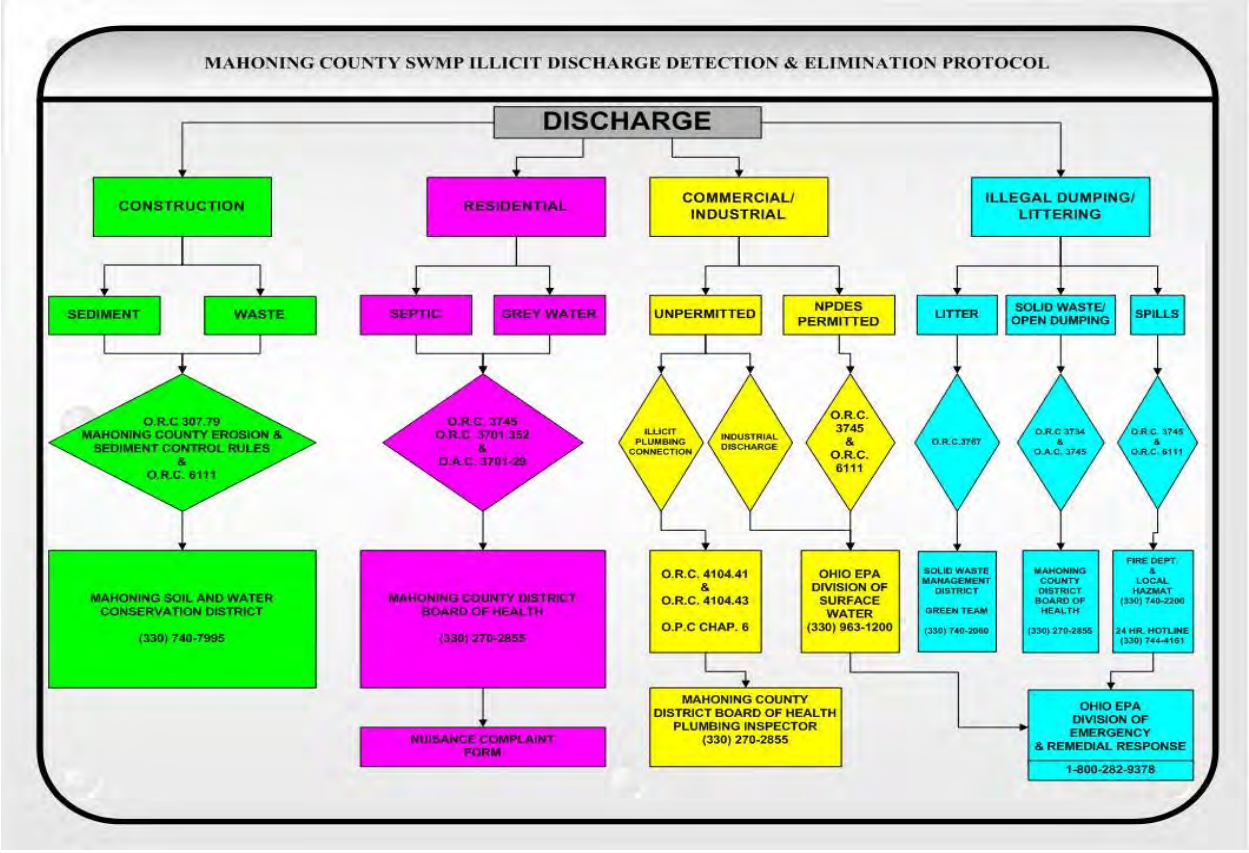
2. Spills and Illicit Discharges

Research of the Ohio EPA's Emergency Response (ER) Spills database did not produce any records of spills occurring within the watershed.

The Mahoning County Engineers office worked with their Phase II Stormwater communities to identify and locate illicit discharges within their areas. Under the first permitting period, the engineers' office identified 408 outfalls within the watershed. The first Phase II permitting term required communities to observe, during dry weather conditions, each outfall 72 hours after a rainfall event and once during the permitting term. Under the engineer's second Phase II permitting period, January 2009 to January 2014, the engineer's office mapped each Phase II community's outfall's conveyance system. According to the engineer's office, the watershed has a total of 3,200 catch basins, and 3,133 catch basins leading into an into outfalls.

The Mahoning County Engineers Office developed a flow chart, shown as *Figure 54*, depicting the protocol for reporting stormwater illicit discharges. The chart provides contact information of the regulating authority based on the type of discharge present.

Figure 54: SWMP Illicit Discharge Flow Chart



iv. Non Point Sources

1. Inventory of Home Sewage Treatment Systems/Projected Number of Failing Systems.

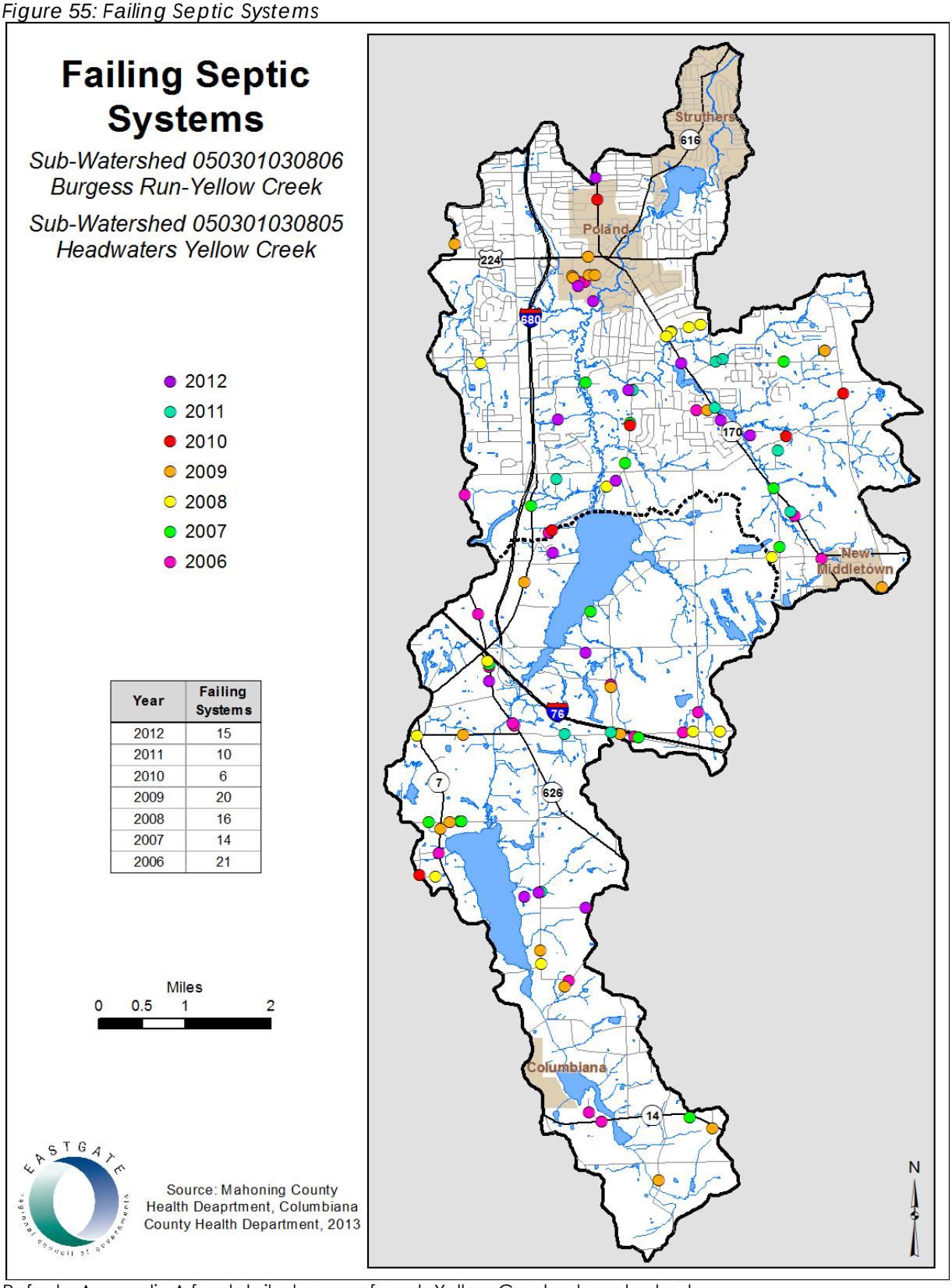
Regardless of age, numerous problems and failures with individual HSTS systems have been documented across Ohio. Specifically, in the Yellow Creek Watershed soil suitability, the age of the system, and the establishment of subdivision and environmental regulations are leading causes of system failure.

Soil suitability is a prevalent failure factor in watershed. If effluent cannot percolate efficiently, then it remains in the leachfield and can cause a system backup or discharge. Effluent percolates faster in soil composed of sand and gravel than in clay-like soil. The elevation of a site's water table will also have a direct affect on the percolation of effluent. Other factors that can prohibit the proper HSTS function include:

- Shallow depth to bedrock;
- Slope that shall not exceed 15 percent in both county regulations;
- Frequency of flooding- both counties state that an HSTS shall not be placed in a one hundred (100) year flood plain (delineated using FEMA maps);
- Improper installation and lack of maintenance (i.e. switching leachfield distribution baffle);
- Excessive water use in the home;
- Change in property drainage i.e. position of down spouts or rain gutters, or the installation of paved areas that drain to excess water to yard area of the septic system; and
- Failure to pump the septic tank.

Failing septic systems were identified as one of many sources causing nonattainment status for all but one sampling site within the watershed. According to Mahoning County District Board of Health (Board of Health), septic system inspections occur either prior to the sale of a house, land re-plats, home additions, owner repair request, or if a nuisance report was filed. According to the Board of Health, systems with minor problems are allowed to function under the condition the problem is fixed through maintenance, servicing, or alternative system permit. Systems brought back into compliance require documentation of such to be submitted to the appropriate board of health. *Figure 55* shows how many septic systems in the watershed had complaints issued or were designated as failing, unsafe, or malfunctioning in each year, through the end of 2012.

Figure 55: Failing Septic Systems



Refer to Appendix A for detailed maps of each Yellow Creek sub-watershed

2. Number of New Homes Being Built

New housing start information was requested from the Mahoning County Building Inspection Department and the Columbiana County Auditor's office for the period of time from 2008 until 2012. According to the Columbiana County Auditor's Office, the county does not have a building permit system like Mahoning County. Instead, the county keeps record of new construction by tabulating the total dollars spent on construction, which includes garages, porches, additions, and buildings. Therefore, information provided could not be separated out to indicate new housing starts and was not included in the discussion.

During the mid 2000's, the housing market took a tumble and as a result, new residential starts began to decline. Although Beaver, Poland, and Springfield Townships experienced a modest decline in new housing starts, they still remain the target areas within the watershed for new residential development.

According to the Mahoning County Planning Commission, the availability of utilities has been a good indicator of where development may occur. Additionally, the commission believes that rather than expanding into untouched areas of the watershed, new residential starts are expected to fill in existing phases of developments. *Table 41* summarizes the residential development within the watershed from 2008-2012.

Development along the northeastern shoreline of Evans Lake, Springfield Township, Ohio. (Source: Mark Bergman)

Table 41: Development Permits Issued within the Yellow Creek Watershed, Mahoning County

Year	Township	Single Family Dwelling Permits
2008	City of Struthers	0
	Boardman Twp.	6
	Beaver Twp.	13
	Poland Twp.	20
	Poland Village	0
	Village of New Middletown	0
	Springfield Twp.	9
	Unity Twp.	-
	Fairfield Twp.	-
2009	City of Struthers	2
	Boardman Twp.	5
	Beaver Twp.	6
	Poland Twp.	9
	Poland Village	0
	Village of New Middletown	0
	Springfield Twp.	7
	Unity Twp.	-
	Fairfield Twp.	-
2010	City of Struthers	0
	Boardman Twp.	2
	Beaver Twp.	1
	Poland Twp.	8
	Poland Village	0
	Village of New Middletown	0
	Springfield Twp.	4
	Unity Twp.	-
	Fairfield Twp.	-
2011	City of Struthers	0
	Boardman Twp.	0
	Beaver Twp.	1
	Poland Twp.	7
	Poland Village	0
	Village of New Middletown	1
	Springfield Twp.	7
	Unity Twp.	-
	Fairfield Twp.	-
2012	City of Struthers	0
	Boardman Twp.	3
	Beaver Twp.	2
	Poland Twp.	3
	Poland Village	0
	Village of New Middletown	0
	Springfield Twp.	7
	Unity Twp.	-
	Fairfield Twp.	-

3. Surface Mines

Unreclaimed surface and/or underground mines pose a threat to water quality as metals, sulfates, dissolved solids are introduced to waters as well as the remnants of the mining activity increase the hardness and acidity and/or alkalinity of water. Surface mines make up 2,966 acres of land within the watershed. The greatest concentration of mines (2,455 acres) are located within the Headwaters subwatershed, between Pine Lake and Evans Lake.

In 2001, AWARE formed a Mine Drainage Task Force to evaluate existing data on mine drainage in the Yellow Creek and Mill Creek Watersheds. The group reviewed water quality data, mining permits, well logs, and drilling reports and created a report summarizing their findings. Results from the group's research found the collected information to be old and incomplete in several areas. However, the data was sufficient enough to characterize the water quality of the watershed's streams. The report, *Mine Drainage Task Force Report*, describes probable extent of mine drainage in the watershed and provides recommendations for water quality improvements. According to the report (pg. 3) 62% of the hardness in Evans Lake originates from tributaries draining lands that include a surface mine, with active mines making up 15% of the total. The Source Water Assessment Plan, described on pg. 58 of this plan, confirms that hardness has affected water quality in Evans Lake, Burgess Lake, and Lake Hamilton. A total of 67 stream miles were sampled within the watershed and 10 miles were found impaired by mine drainage.

Inspectors at the Northern District office of ODNR's Division of Mineral Resources Management reviewed the watershed for mining activities. According to ODNR, one active, permitted coal mine exists within the watershed and is located northwest of Pine Lake in Beaver Township. ODNR reports that no known Acid Mine Drainage (AMD) or water quality issues have been associated with this site. A search for current Industrial Mineral permits indicated no industrial mining operations currently exist within the watershed.

In 2014, ODNR's Division of Mineral Resource Management (DMRM) awarded a 2015 Acid Mine Land grant to reclamate a dangerous highwall, associated hazardous water body and a gob pile at a pre-law abandoned mine site within the watershed. According to DMRM officials, work at the site will include clearing, access, dewatering, earthwork, installation of sediment control devices, and site revegetation. These activities will eliminate the dangerous highwall and provide positive drainage at the completion of the project.

The Ohio EPA's 2011 survey of Yellow Creek identified lead and iron violations within the headwaters, likely a result of AMD. In their technical support document, the Ohio EPA recommends an AMD study to determine if restoration work is needed.

4. Number and Size of Animal Feeding Operations.

Based on Ohio EPA's map "Permitted Livestock Facilities, Ohio, USA", no permitted Concentrated Animal Feeding Operations exist in the Yellow Creek Watershed, http://www.epa.ohio.gov/portals/35/cafo/FacilityLocations_8x14_061308a.pdf. Smaller animal feeding operations, those not needing an NPDES permit, exist within the watershed. A rough estimate of the number of animals at the feeding operations was provided by the watershed's SWCDs and can be found in the *Livestock Inventory* on pg. 79 . These figures stated by the SWCDs are approximations based on aerial review of the agricultural land in the watershed and their knowledge stemming from relationships with the watershed's farmers.

5. Acres of Highly Erodible Land and Potential Soil Loss.

A map of the watershed's erosion potential for bare soil was created utilizing ODNR's soil data. *Table 42* and *Figure 56* illustrate the erosion potential of bare soil for the watershed. The potential for erosion by wind and water was also evaluated. *Table 43* and *Figure 57* show the general potential for erosion by wind and water. Figure 58 estimates the effect of erosion on agricultural land employing a crop rotation of corn, corn, oats, wheat, meadow, meadow and spring residue plowing.

Table 42: Erosion Potential of Bare Soil

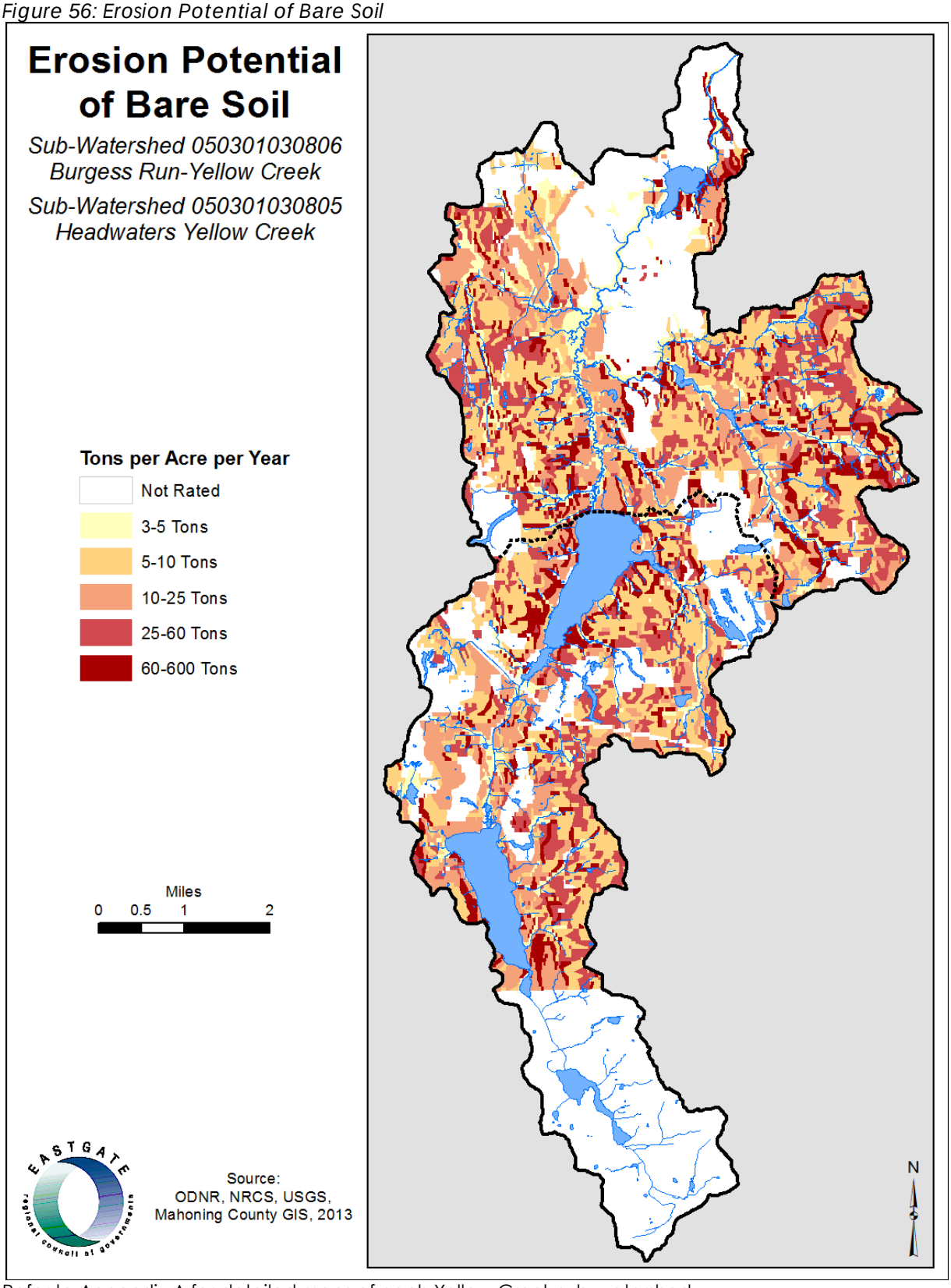
Erosion potential of bare soil (tons per acre per year)	Acres
Not Rated	9,248.68
3-5 Tons	1,701.43
5-10 Tons	5,454.07
10-25 Tons	3,638.07
25-60 Tons	3,092.98
60-600 Tons	2,160.40
Total	**25,295.63**

Table 43: Potential for Erosion by Wind and Water

Potential for erosion by wind and water	Acres
Highly Erodible	626.07
Potentially Highly Erodible	14,246.74
Not Highly Erodible	3,410.76
Not Rated	7,012.06
Total	**25,295.63**

Soil Erosion into Evans Lake (after a rain event), Springfield Township, Ohio. (Source: Mark Bergman)

Figure 56: Erosion Potential of Bare Soil



Refer to Appendix A for detailed maps of each Yellow Creek sub-watershed

Figure 57: Highly Erodible Lands

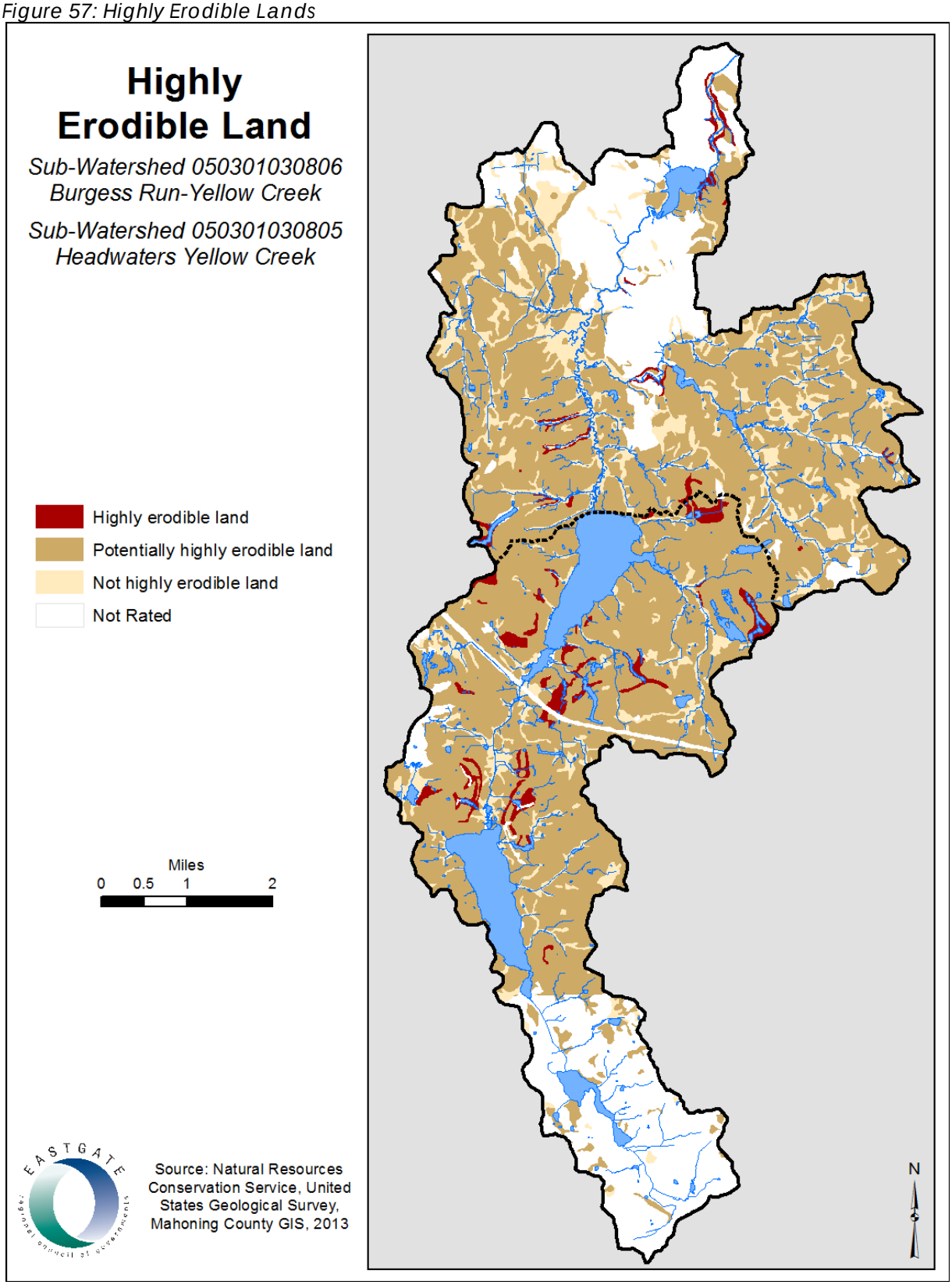
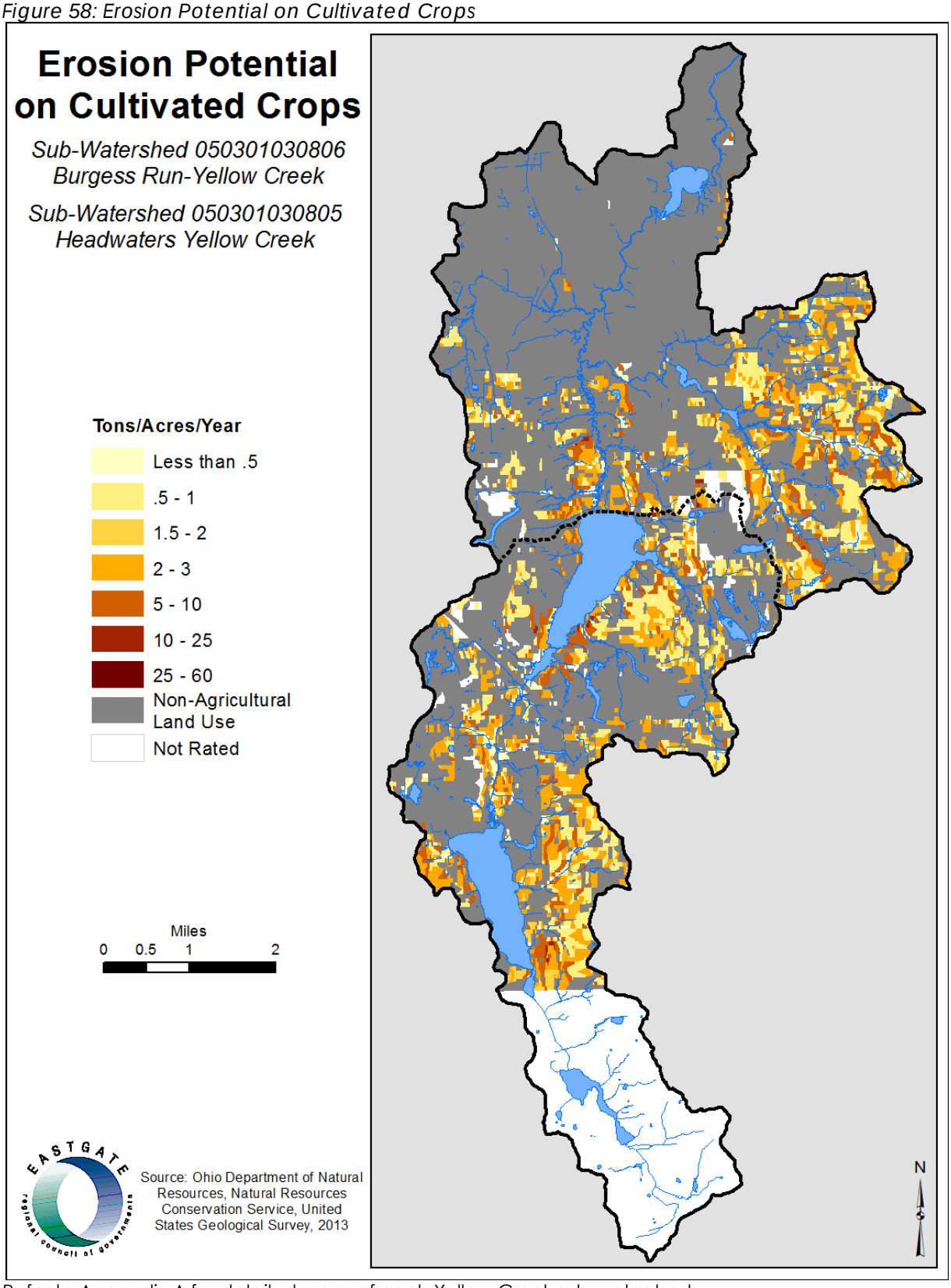


Figure 58: Erosion Potential on Cultivated Crops



Refer to Appendix A for detailed maps of each Yellow Creek sub-watershed

6. Culverted Stream Segments.
Approximately 3.09 miles of stream (16,342.84 ft) is culverted within the watershed. *Figure 46* identifies culvert locations in the watershed. There are 157 identified culverts in the watershed. The average culvert length is 104 feet.

7. Channelized Stream Segments.
According to 2003 Yellow Creek Watershed Ad Hoc Committee notes, the sections known to have been channelized with severely limited in-stream habitat are Beaver Lake to Pine Lake, located in the Headwaters Yellow Creek subwatershed(HUC050301030805). Ohio EPA's QHEI scores for the watershed identified 3 channelized areas of Yellow Creek: Yellow Creek at Heck Road (RM 14.03), Yellow Creek at SR 165 (RM) 11.40, and Yellow Creek at E. Western Reserve Road (RM 7.75). Please refer to pg. 93 for additional discussion regarding channelized streams within the watershed.

8. Levied Stream Segments.
A localized levee was constructed along Yellow Creek, within the Burgess Run-Yellow Creek subwatershed (HUC050301030806), just north of state route 170 and adjacent to the Poland Library. The levee was built following damage the library experienced during flooding events in May and September of 2004.

9. Areas Exhibiting Little Human Impact
Currently there is no data for the locations, levels or areas exhibiting little human impact. The watershed contains 111.88 miles of unmodified or natural streams. *Figure 46*, Stream Types in the Yellow Creek Watershed, illustrates those streams that may be considered natural due to their sinuous characteristic.

10. Effluent Volume
The Design Average Daily Flow is the average of daily volume recorded at a wastewater treatment plant over a 12 month period of time. However, peak hourly flows can exceed or fall short of the Design Average Daily Flow for short periods of time due to seasonal variations of rain fall or snow melt. A sanitary wastewater treatment plant's daily flow is based on the number of customers, tributary to the treatment plant, and an expected per capita flow of wastewater.

Effluent volumes, *Table 44*, for NPDES permitted package plants within the Headwaters Yellow Creek subwatershed were provided by John Kwolek, Ohio EPA (NEDO). According to Joe Trocchio, Ohio EPA (NEDO), there are no effluent volumes to report for Columbiana County's portion of the watershed.

Table 44: Effluent Volumes

NPDES Permit Entity	County	Design Average Daily Flow-million gallons per day (mgd)
The Lake Club	Mahoning	0.020
Fonderlac Condominiums	Mahoning	0.020
Bloomingdales	Mahoning	0.0015
Shadeland Apartments, LLP	Mahoning	0.009

11. Dammed

As discussed on pg. 93 various dams are located within the watershed. Consequently, 11.35 stream miles are impounded by the dams. *Figure 46* identifies impounded locations.

12. Officially Classified and/or Unofficially Maintained as Petition Ditches

According to the Mahoning County Engineers Office, there are no petition ditches within the Yellow Creek Watershed.

13. Biosolids

Biosolids are the nutrient-rich organic materials resulting from the treatment of sewage sludge. Biosolids are recycled and applied as fertilizer to improve and maintain productive soils and stimulate plant growth. There are different classes of biosolids which determine regulation levels.

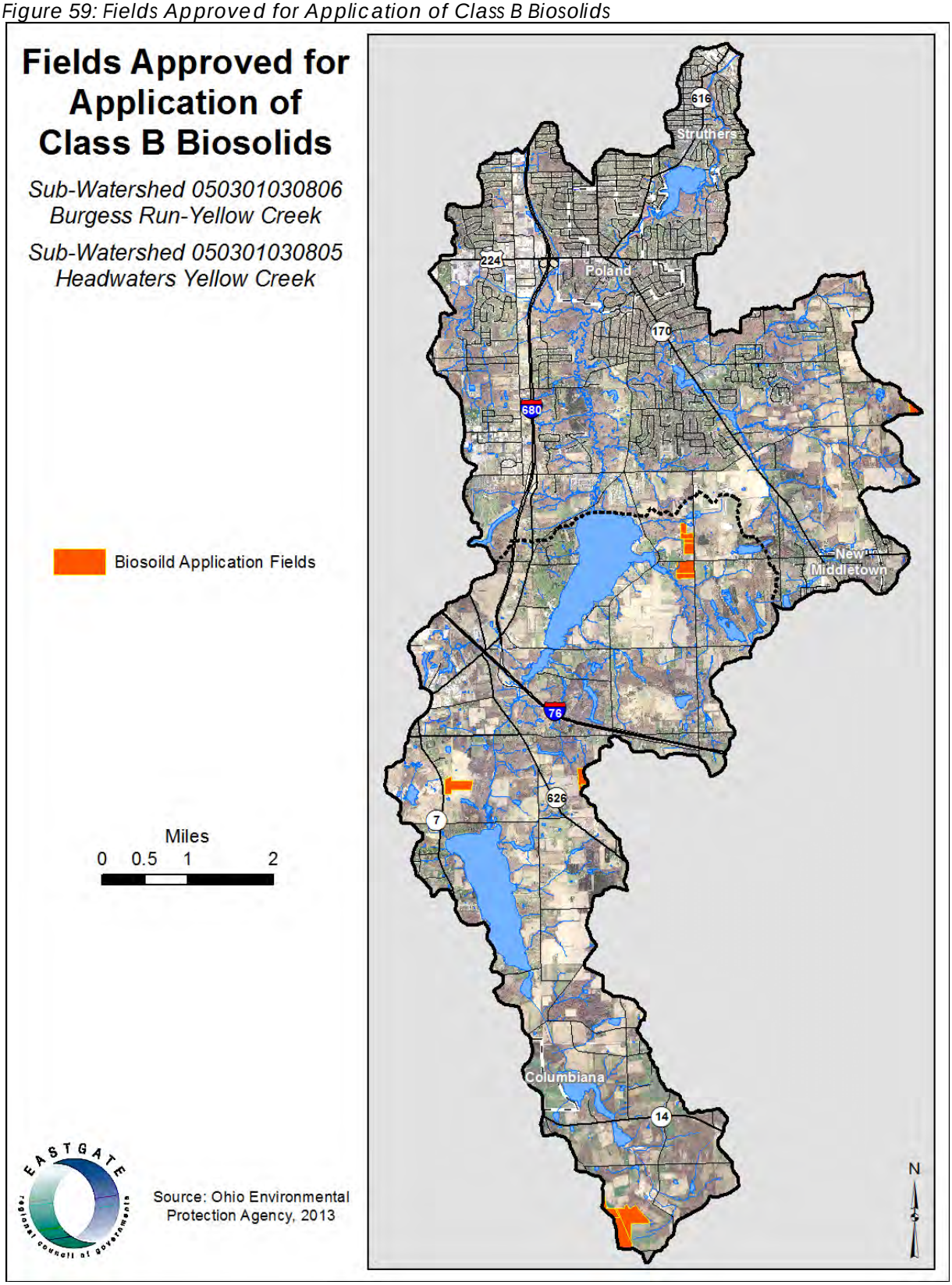
Class A biosolids contain no detectible levels of pathogens and do not need Ohio EPA authorization to be land applied. Information on where Class A biosolids are used is not available because use is not monitored.

Class B biosolids are treated but still contain detectible levels of pathogens. There are buffer requirements, public access, and crop harvesting restrictions for virtually all forms of Class B biosolids. Fields which have authorization to land apply Class B biosolids are shown in *Table 45* and *Figure 59*. Because a fields is approved for the application of Class B biosolids does not mean biosolids have ever been applied to the field.

Table 45: Fields approved for application of Class B Biosolids

Sub-Watershed	Acres within Watershed	OEPA Site #	NPDES #	Biosolids Generator	Owner
Burgess Run-Yellow Creek	1.01	50-00058	3PD00026*JD	Struthers WWTP	Stacey Hugh
Burgess Run-Yellow Creek	8.88	50-00054	3PD00026*JD	Struthers WWTP	Stacey Hugh
Burgess Run-Yellow Creek	1.6	50-00059	3PD00026*JD	Struthers WWTP	Stacey Hugh
Headwaters Yellow Creek	8.96	50-00101	3PD00026*JD	Struthers WWTP	Kohler
Headwaters Yellow Creek	3.02	50-00104	3PD00026*JD	Struthers WWTP	Kohler
Headwaters Yellow Creek	18.06	50-00100	3PD00026*JD	Struthers WWTP	Kohler
Headwaters Yellow Creek	5.09	50-00102	3PD00026*JD	Struthers WWTP	Kohler
Headwaters Yellow Creek	6.64	50-00103	3PD00026*JD	Struthers WWTP	Kohler
Headwaters Yellow Creek	9.84	50-00105	3PD00026*JD	Struthers WWTP	Kohler
Headwaters Yellow Creek	2.81	15-00158	3PD00027*ID	Salem STP	Kenneth Robb
Headwaters Yellow Creek	7.47	15-00159	3PD00027*ID	Salem STP	Kenneth Robb
Headwaters Yellow Creek	40.54	15-00160	3PD00027*ID	Salem STP	Kenneth Robb
Headwaters Yellow Creek	30.74	15-00161	3PD00027*ID	Salem STP	Kenneth Robb
Headwaters Yellow Creek	26.38	50-00106	3PD00027*ID	Salem STP	Ronald Rapp
Headwaters Yellow Creek	1.05	50-00116	3PD00041*FD	Columbiana WWTP	David Bair
Headwaters Yellow Creek	12.01	50-00115	3PD00041*FD	Columbiana WWTP	Glacier Hills Corp-Raymond Wiery

Figure 59: Fields Approved for Application of Class B Biosolids



Refer to Appendix A for detailed maps of each Yellow Creek sub-watershed

IV. STATUS AND TRENDS

Two of the six sampling sites within the Yellow Creek Watershed were in full attainment of their aquatic life uses status (pg. 113): Burgess Run at North Lima Rd. and Yellow Creek upstream Lowellville Rd., both within Burgess Run-Yellow Creek subwatershed. Yellow Creek upstream Lowellville Rd. is located within Yellow Creek Park, where the stream is protected by a healthy riparian, is preserved as a park, and maintained by Mill Creek MetroParks. The city of Struthers implemented a stormwater management program throughout the city. However, untreated stormwater runoff from upland residential neighborhoods and commercial areas can still pose a threat to water quality.

Burgess Run at North Lima Rd. is located at a lower elevation than its surrounding land uses. However, some of the residences properties slope down toward the stream, while others remain detached from the stream's banks. Residential education is greatly needed to continue to protect the wooded riparian and water quality within this stretch of Burgess Run.

A. Critical Areas

Eastgate's 208 Water Quality Management Plan defines critical areas as those which are identified on a regional basis by understanding the recognized values of the planning region's communities. The watershed stakeholders identified the following areas of value for the Yellow Creek WAP:

- Drinking water source protection
- Septic care and maintenance
- Stormwater management
- Natural and green spaces
- Recreation
- Yellow Creek Park

At the same time, watershed stakeholders identified the following concerns threatening the health of their watershed community:

- Non point source pollution
- Flooding
- Over application of residential yard chemicals
- Under-planned development
- Lack of detention/retention pond maintenance
- Erosion
- Loss of riparian
- High nutrient levels
- Inadequate stormwater collection systems to handle excess stormwater
- Failing septic systems

This section identifies the critical areas within the watershed in need of protection, restoration, and/or improvement based on water quality data, land use information, and stakeholder values and concerns. In order to provide a better description for the critical areas, the plan identifies and discusses the critical areas based on the watershed's named tributary drainage basins (see ***Figure 28***).

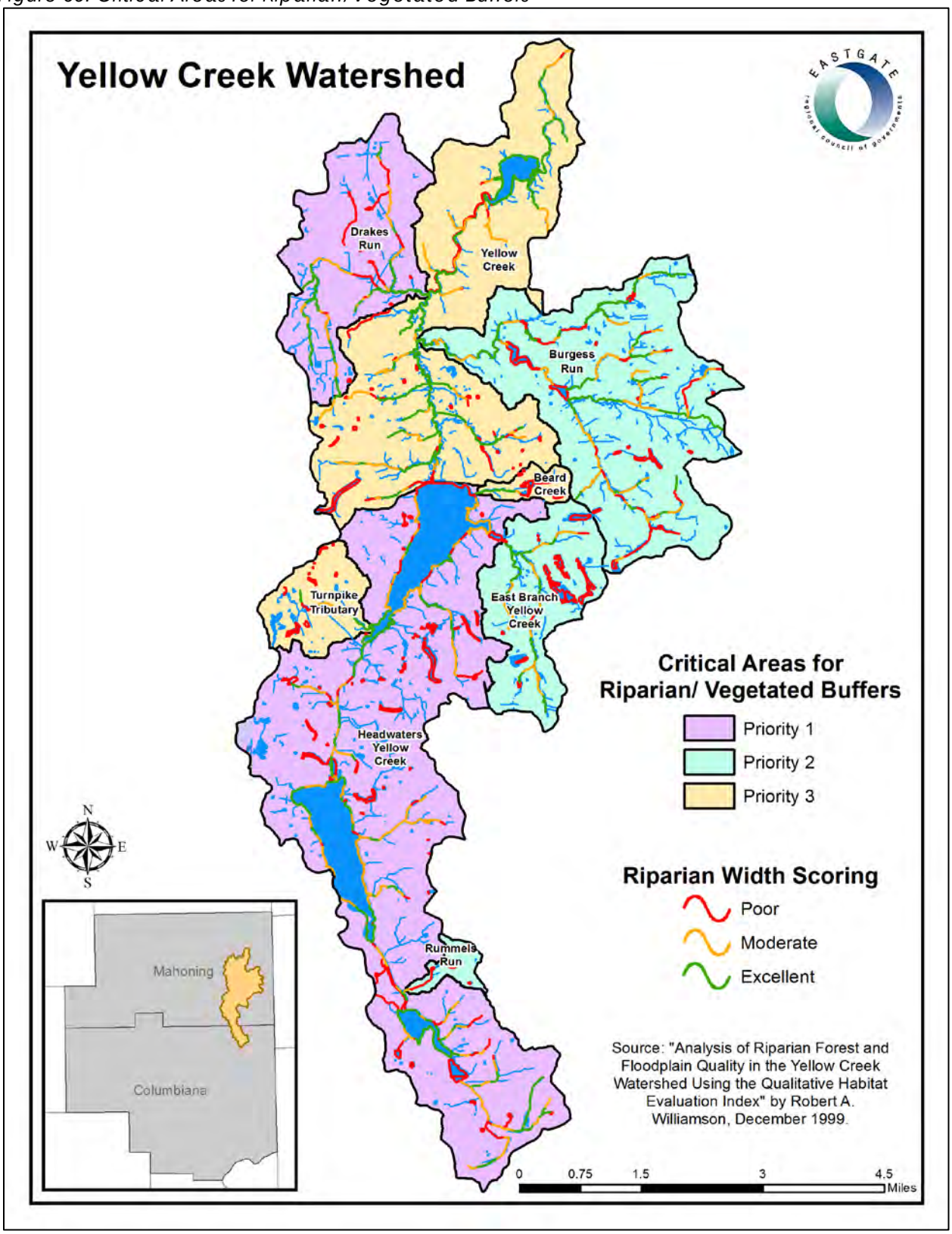
Loss of Riparian/ Vegetated Buffer Areas of Concern

The watershed steering committee identified the following concerns: flooding, erosion, and loss of riparian (areas). Without vegetated riparian buffers, streams and, in the case of this watershed, surface drinking water source integrity suffers as pollutants (i.e. chemical fertilizers, herbicides, pesticides, oil, road salt) and sediment are washed straight into streams and the lakes during rain events. Bank erosion occurs more frequently when there is a void of rooted vegetation to reinforce a stream bank and hold sediment in place.

A review of aerial photographs and Williamson's thesis, "Analysis of Riparian Forest and Floodplain Quality in the Yellow Creek Watershed Using the Qualitative Habitat Evaluation Index" (refer to pg.85 for thesis discussion), revealed many non-buffered stream and lake side segments located in the Headwaters Yellow Creek and the Burgess Run drainage basins (see also ***Figure 45***). Agricultural production and development along the watershed's streams and lakes have denuded riparian areas in order to maximize their investment.

Figure 43 illustrates the locations of stream and lake shore segments with poor and moderate riparian widths. It should be noted without a formal riparian inventory and based on the methodology used to analyze stream and lake side buffers buffer, it is difficult to determine the actual stream miles in need of buffers at this time. ***Figure 60*** incorporates information from ***Figure 43*** and provides a starting point for riparian/vegetated buffer restoration.

Figure 60: Critical Areas for Riparian/Vegetated Buffers



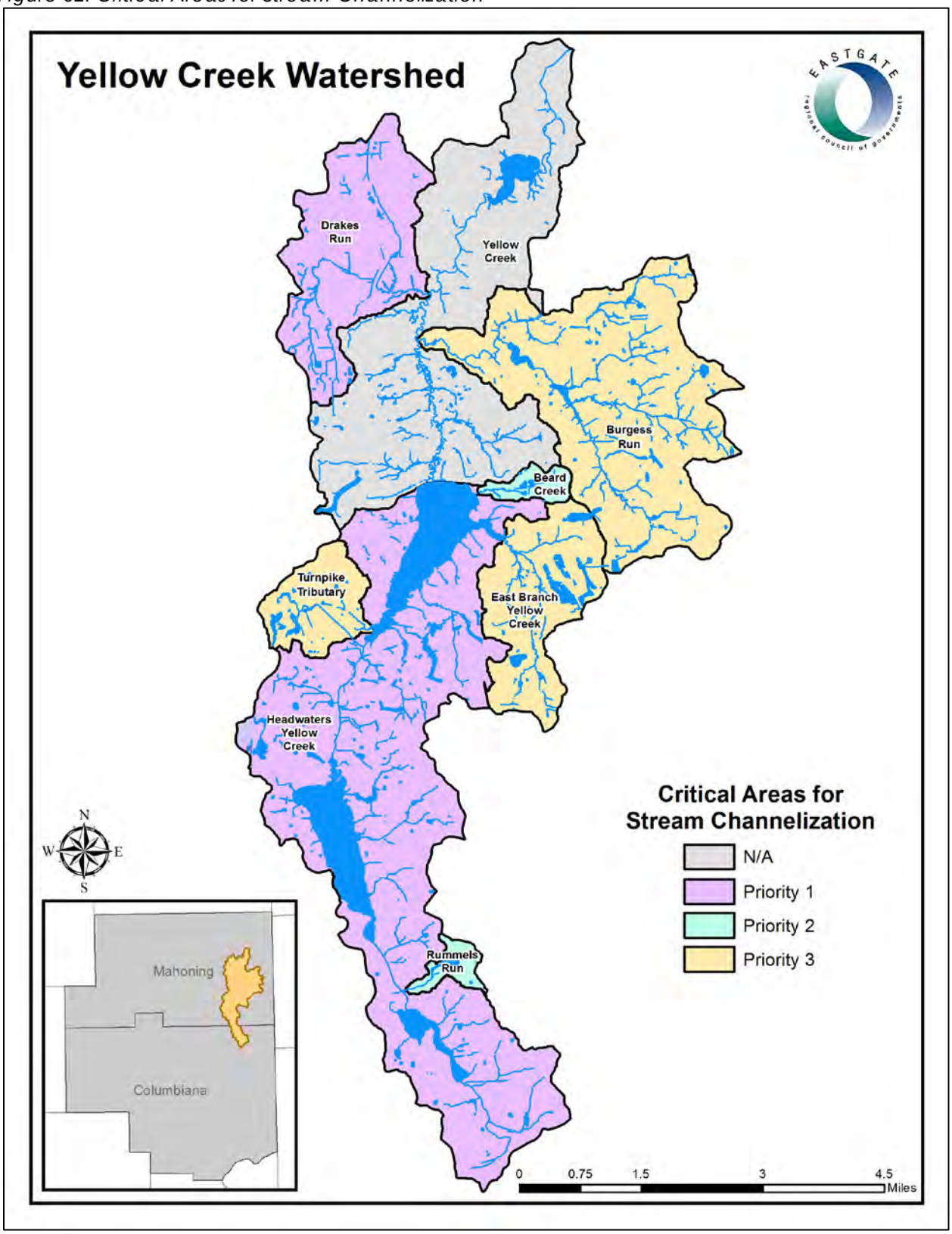
Stream Channelization Areas of Concern

Streams have been historically channelized or modified to suit human needs. In the end, stream channelization has become more costly to humans and the ecosystem than costs associated with the channelizing/modification process. When streams are channelized, the velocity at which water flows downstream is increased and drainage time is reduced. An increase in velocity forces streams become deeper as large and coarse materials are carried away rather than scoured; stream banks become more steep, unstable and erodible as fast moving water cuts into the banks; and increased flooding events occur in downstream areas where the stream channel may be more natural and sinuous.

The negative effects of channelization can be felt in both rural and urban communities. For crop producers, channelization causes soil erosion of fertile soil. If a channelized stream is not maintained and vegetated, the stream bank can become unstable and widen. In urban settings channelized streams are detrimental to infrastructure (roads and bridges) as the sheer volume and force of water can be harmful to public investments. Development located within close proximity of a channelized stream may see an increase in floodwater velocity and a rise in flooding events.

Stream channelization occurred in the watershed in headwater streams and within streams traversing through urbanized areas. For whatever reason, channelization as a result of commercial/residential development or agriculture production, the headwater streams and/or stream segments were straightened. *Figure 46* was developed using aerial photographs of the watershed and identified natural, modified, culverted, and impounded stream segments. *Figure 61* illustrates the watershed's individual drainage basin and where stream restoration efforts should be focused.

Figure 61: Critical Areas for Stream Channelization



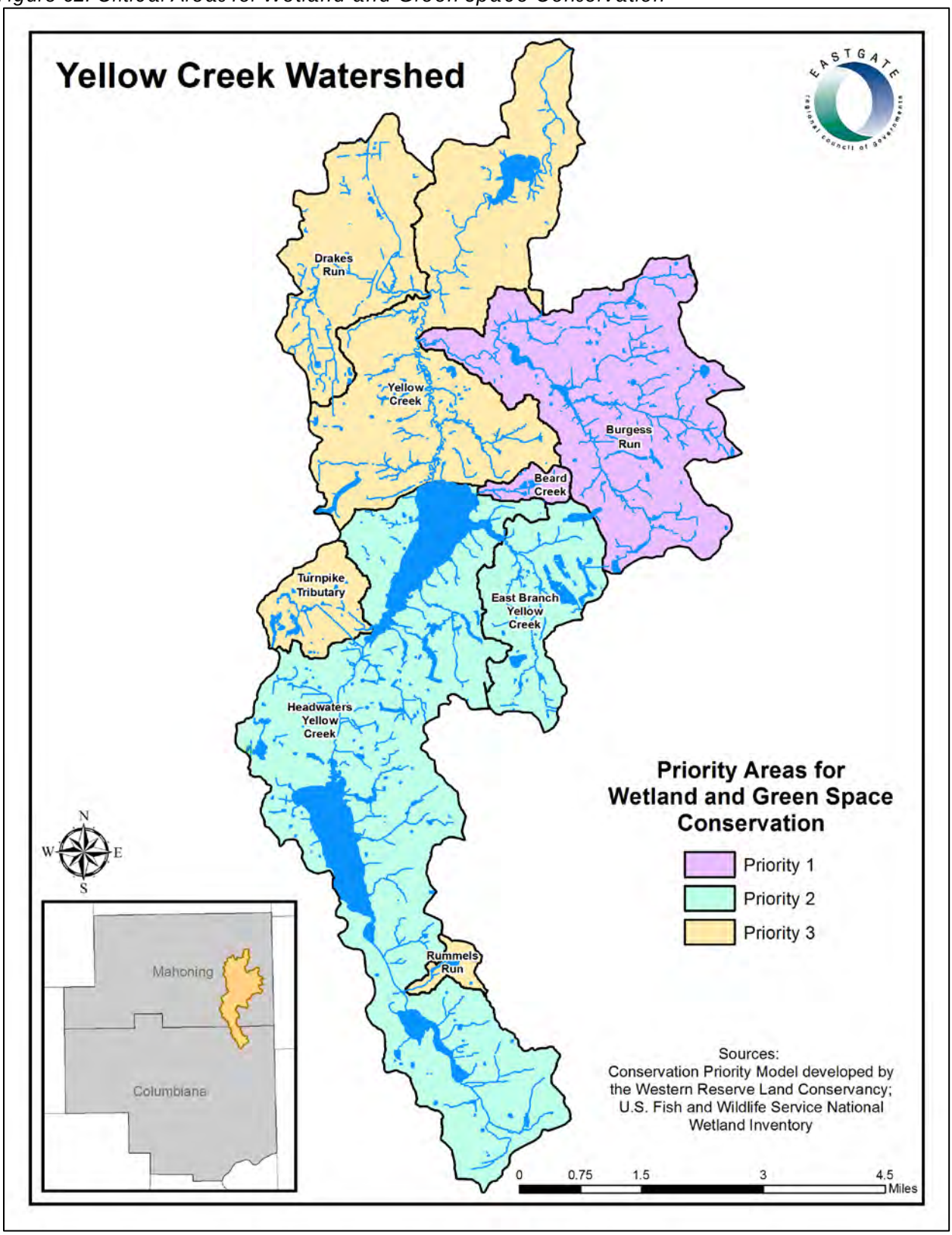
Wetland and Green Space Preservation Areas of Concern

Wetlands are nature's sponge tasked with absorbing and filtering floodwaters prior to their entrance into waterways. Areas of open/green space, left untouched allow additional absorption and filtration of pollutants from stormwater prior to entering a waterway. To date, the Yellow Creek Watershed has 1,119.61 acres of wetlands and 711 acres of protected green space.

The Burgess Run-Yellow Creek is the urbanized portion of the watershed and includes the 711 acres of preserved green space. This preserved green space represents lands located throughout the Drakes Run and Yellow Creek drainage basin of the Burgess Run-Yellow Creek subwatershed already protected by a conservation easement, a park system, and/or a private land preservation agreement. These two drainage basins do not contain additional opportunities for wetland and/or green space preservation due to their urbanized and developed status. However, the Burgess Run and Beard Creek drainage basins present just the opposite. Areas are still undeveloped and contain wetlands. Although under development pressure, green space and wetlands within Burgess Run, Beard Creek, and Headwaters-Yellow Creek drainage basins should be preserved.

The wetland mitigation plan referenced on page 113, in conjunction with conservation priority data provided by Western Reserve Land Conservancy, identify preservation priority areas. The conservancy's data was stakeholder driven. *Figure 62* was developed using the data from the conservancy as well as the NWI.

Figure 62: Critical Areas for Wetland and Green Space Conservation



Bacteria Areas of Concern:
Beard Creek, sub-watersheds south of Evans Lake, and the eastern-southeastern portion of Burgess Run is rural in nature with residences utilizing home sewage treatment systems for wastewater treatment. Bacteria samples at each of the six sites had some level of bacteria exceedence. Field reconnaisance indicated bacteria exceedences may be more agricultural and/or natural related than caused by failing septic systems. A review of local health records did not indicate any failing HSTSs during the sampling year and/or within the vicinity of the sampling sites. However, it is important to note HSTS inspections occur either prior to the sale of a house, land re-plats, home additions, owner repair request, or if a nuisance report is filed. Therefore, the possibility of a failing HSTS exists. At the time of sampling, the Shadeland Apartments' package plant, located upstream of sampling site RM 7.75, was not functional and waste from its service area discharged directly into a tributary. Bacteria exceedence for RM 7.75 reflects this discharge. Since the first submission of this plan (June 2014), the owners of the package plant have upgraded the plant, received an NPDES permit (NPDES#3PR00546*AD), and waste is now being properly treated. For the purpose of this plan, most of the bacteria exceedences will be addressed in the agricultural critical area of concern discussions to follow. *E. coil*, as it relates to failing HSTS's, will be addressed in Section VII as education and outreach opportunities and in terms of septic maintenance, repair, and/or elimination, and cost assistance for homeowners.

Agricultural (Rural) Areas of Concern
Many streams traversing through agricultural fields are lack of vegetated buffer and/or are channelized in order to maximize the number of acreage for crops or grazing. The lack of streamside vegetated buffers and presence of channelized stream segments, in combination with manure and/or chemical (fertilizer/herbicide/pesticide) application, can add to water quality impairments. Without adequate buffers, nutrients from chemical or manure application can flow straight into streams.

The Headwaters Yellow Creek basin is more rural in nature, but the eastern perimeter of the Burgess Run contains some agricultural lands too. Although the steering committee did not identify any concerns related to agricultural practices, a review of aerials and local knowledge of the agricultural operations identified the following topics of concern:

- Livestock having direct access to streams;
- Lack of grassed waterways;
- Streams within agricultural fields do not have adequate buffers; and
- Proper manure/nutrient management strategies
- Nutrient management plans.

The livestock inventory on pg. 76 indicates the number of cattle and horses (head count) are not indicative of large operations. However, the fact remains animals have unrestricted access to streams, especially those directly tributary to the watershed's drinking water lakes. ***Figure 63*** and ***Figure 64*** illustrate the priority areas for agriculture areas of concern regarding crop production runoff and livestock operation runoff (respectively).

Figure 63: Critical Areas for Crop Production Runoff

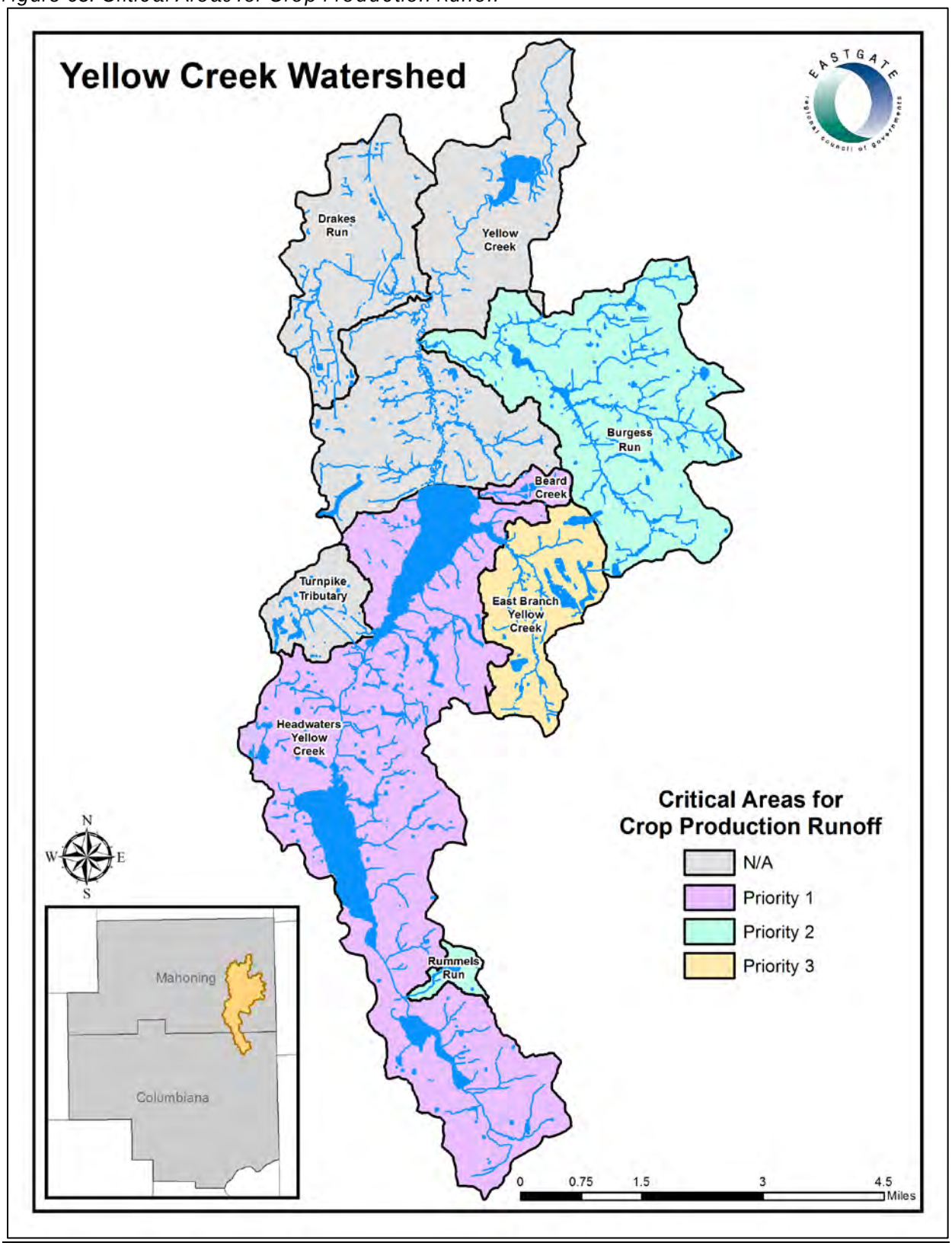
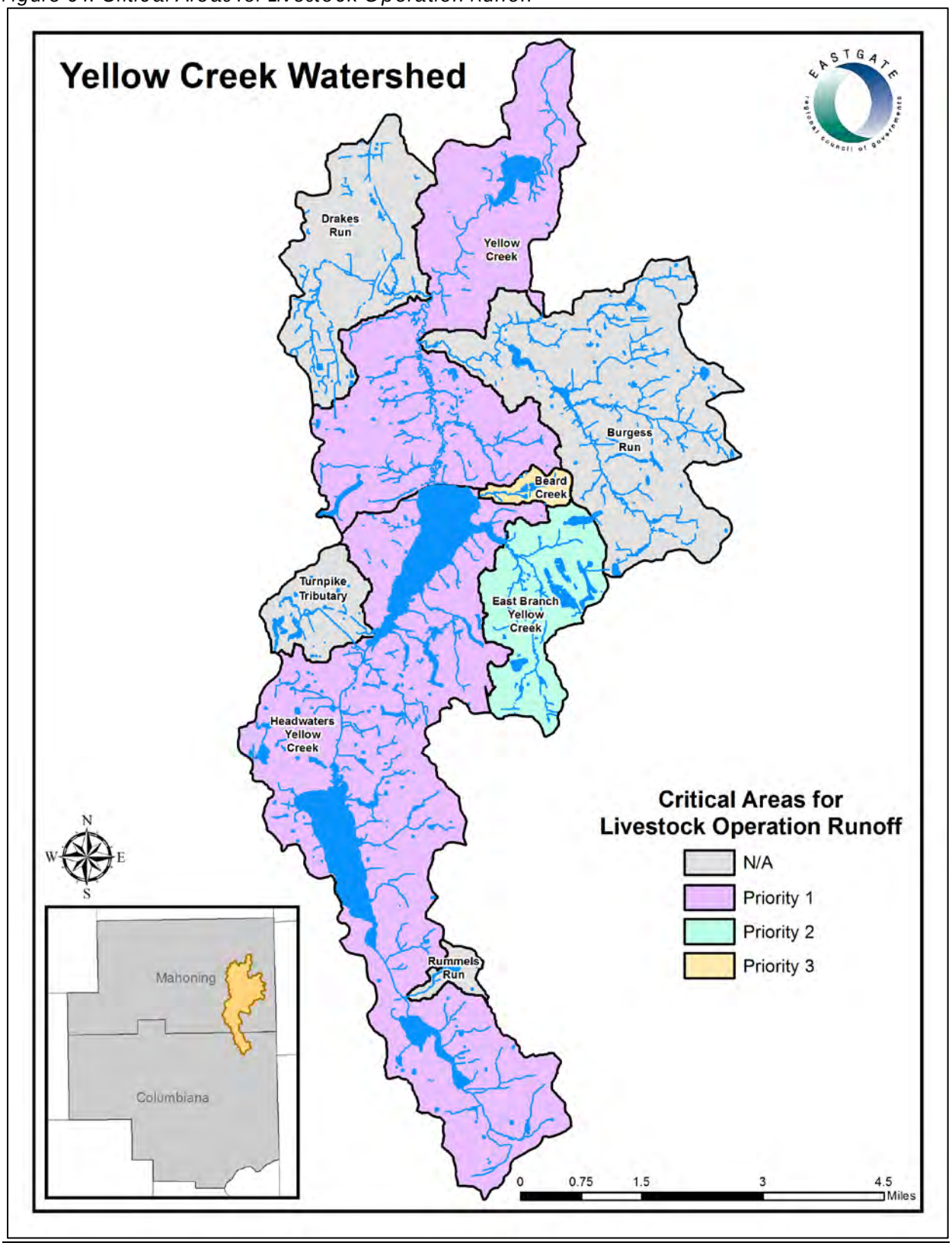


Figure 64: Critical Areas for Livestock Operation Runoff



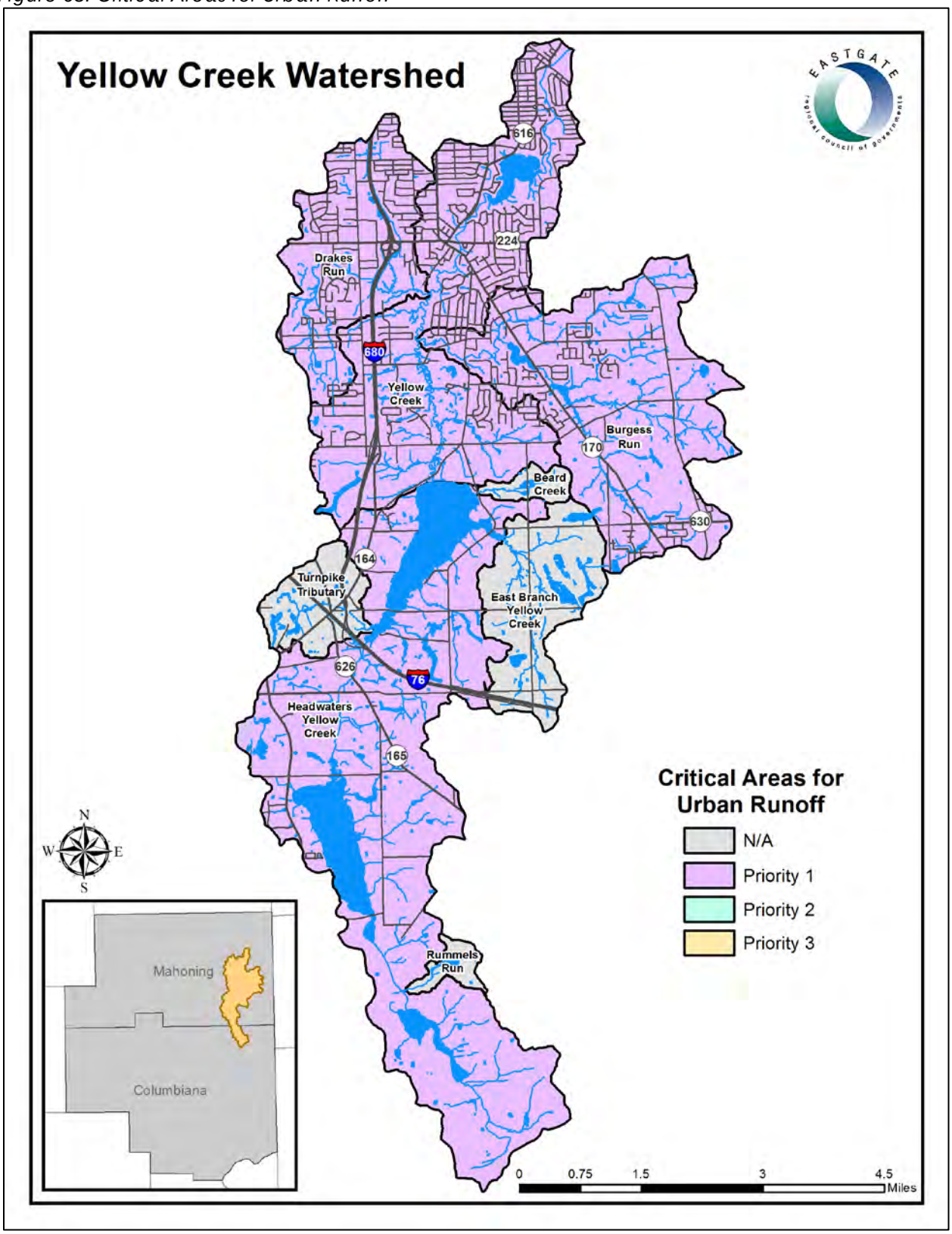
Urban Pollutant Source Areas of Concern

Urban pollutants are different than those found in the rural community and are more compounded due to the quantity of impervious surfaces (rooftops, roadways, driveways, parking lots). Fertilizer from urban residential and commercial lawns and golf courses are often applied in excess of manufactures' directions and what grass types typically require. Fertilizers, when applied at the wrong time and/or in excess, are more likely to runoff during heavy and flashy rain events. Stormwater commonly carries runoff of sediment from construction sites and oil, gas, and road salts. Wildlife and pet waste left on lawns or streets can make its way into open waters via storm sewer systems, increasing *E. coli* and nutrient levels.

The Burgess Run-Yellow Creek subwatershed is the more urban subwatershed in Yellow Creek. In 2010, at the Public and Official Stakeholders meetings, the following urban concerns were identified:

- Sewer/wastewater treatment plant discharge into surface drinking water sources;
- Sewage draining into stormsewers;
- Non point source pollutants;
- Flooding;
- Source Water Protection;
- Over application of residential yard chemicals;
- Under planned development;
- Excess stormwater flow into natural areas;
- Erosion, sedimentation, and loss of Riparian due to development and/or poor commercial/residential lawn maintenance practices; and
- Lack of maintenance with development retention ponds.

Figure 65: Critical Areas for Urban Runoff



Critical Area Summary

Ohio EPA water quality data and the STEPL load reduction model indicated every sub-watershed within the watershed is a significant contributor to water quality issues within Yellow Creek. However, the landscape of Yellow Creek Watershed is very different as it transitions from the headwaters into the Burgess Run subwatershed. As noted pg.66 of this plan, the Headwaters subwatershed is very rural in nature with some pockets of residential development, while the Burgess Run subwatershed is urbanized with a small eastern section of agricultural activity. Recognizing the difference, prioritizing the critical areas for each concern was broken down further into the tributary drainage basin level.

Riparian/Vegetated Buffers (*Figure 60*):

- Priority Area 1- Headwaters Yellow Creek and Drakes Run;
- Priority Area 2- Rummels Run, East Branch Yellow Creek, and Burgess Run; and
- Priority Area 3- Turnpike Tributary, Beard Creek, and Yellow Creek.

Stream Channelization (*Figure 61*):

- Priority Area 1- Headwaters Yellow Creek and Drakes Run. *Prioritized areas identified in the Headwaters subwatershed appears large in scope, but this large area may only have small headwater streams within agricultural areas in need of restoration;*
- Priority Area 2- Rummels Run and Beard Creek; and
- Priority Area 3- Turnpike Tributary, East Branch Yellow Creek, and Burgess Run.

Agricultural (crop production) runoff (*Figure 63*):

Prioritized areas identified are generalizations and appear large in scope. However, operations within the drainage areas were identified by the watershed's respective county SWCD and NRCS personnel. Therefore, the identity of site specific operations will default back to the aforementioned stakeholders;

- Priority Area 1- Headwaters Yellow Creek and Beard Creek;
- Priority Area 2- Burgess Run; and
- Priority Area 3- East Branch Yellow Creek.

Agricultural (livestock operation) Runoff (*Figure 64*):

Prioritized areas identified are generalizations and appear large in scope. However, small operations within the drainage areas were identified by the watershed's respective county SWCD and NRCS personnel. Therefore, the identity of site specific operations defaults back to the aforementioned stakeholders;

- Priority Area 1- Headwaters Yellow Creek and Yellow Creek.
- Priority Area 2- East Branch Yellow Creek; and
- Priority Area 3- Beard Creek.

Urban runoff (*Figure 65*):

All drainage basins, with the exception of Rummels Run, were identified as a priority due to their associated township, city, or village Phase II status.

- BMP control surface flow and volume of polluted stormwater, riparian buffers in residential and commercial areas
- All urbanized portions of the watershed, especially Phase II communities, are critical for increase education and outreach measures
- Increase stormwater BMPs to decrease urban nonpoint source pollutants (i.e. nutrients, sediment, road salts *E.coli*) from entering open surface waters, especially drinking water sources.

V. WATERSHED IMPAIRMENTS

A. Pollutant Loading

The Yellow Creek Watershed does not have a TMDL. The Ohio EPA projects it will perform a TMDL study of the Lower Mahoning River Watershed in 2016, which will include the Yellow Creek watershed. In the absence of a TMDL and current water quality data, the Ohio EPA performed a limited Biological and Chemical Water Quality Study of the watershed in 2011 and again in 2013 as part of the Lower Mahoning River Biological and Chemical Quality Study. Prior to 2011, the Ohio EPA last surveyed the watershed in 1994, again as part of a Biological and Chemical Water Quality Study of the Lower Mahoning River. The following is a review of the causes and sources of impairment or threats identified in the 2013 Yellow Creek Technical Support Document (TSD):

The Ohio EPA 2013 Yellow Creek TSD listed the following causes of impairment:

- Low dissolved oxygen
- Sedimentation/siltation
- Nutrient/organic enrichment
- Metals
- Direct habitat alterations
- Total dissolved solids (TDS)
- Fish passage barrier

The sources of impairment were determined as:

- Channelization
- Acid mine drainage (AMD)
- Agriculture runoff
- Livestock
- On-site home sewage treatment system
- Failing package plant
- Loss of riparian habitat
- Dam/impoundment
- Urban runoff

In 1994, the Ohio EPA listed the following causes of Impairment:

- Low dissolved oxygen
- Unknown
- Nutrient/organic enrichment
- Metals
- Direct habitat alterations
- Siltation
- Unionized ammonia
- Fish passage barrier

The sources of impairment were determined as:

- Channelization
- Combined sewer overflows
- Dam construction
- Major municipal point source
- Natural
- Non-irrigated crop production
- Unknown
- Urban runoff
- Storm sewers

Habitat Conditions

Streams in the Yellow Creek Watershed are naturally low gradient streams and as such do not possess adequate energy to form and maintain flow velocity and complex channel features. Low gradient streams also lack coarse substrate materials beneficial to the WWH biological community. Problems with habitat conditions are also a result of increased human activities. The goal of this watershed action plan is to protect and/or restore stream habitat wherever possible and promote developing natural stormwater management practices where streams have already been altered and water quality impaired.

Modeling

Modeling programs exist to provide estimates for nutrient and sediment loads for a watershed. The US EPA's Spreadsheet Tool for Estimating Pollutant Load (STEPL) and the US EPA Region 5 model were used to determine the loadings for nitrogen, phosphorus, and sediment from different land uses for this watershed plan. According to the U.S. EPA's STEPL website, the model "employs simple algorithms to calculate nutrient and sediment loads from different land uses and the load reductions that would result from the implementation of various best management practices (BMPs). It computes watershed surface runoff; nutrient loads, including nitrogen, phosphorus, and 5-day biological oxygen demand (BOD5); and sediment delivery based on various land uses and management practices. For each watershed, the annual nutrient loading is calculated based on the runoff volume and the pollutant concentrations in the runoff water as influenced by factors such as the land use distribution and management practices. The annual sediment load (sheet and rill erosion only) is calculated based on the Universal Soil Loss Equation (USLE) and the sediment delivery ratio. The sediment and pollutant load reductions that result from the implementation of BMPs are computed using the known BMP efficiencies".

The US EPA Region 5 model was used to estimate the pollution loadings for agricultural nonpoint sources. According to the US EPA's website, this model "is an Excel workbook that provides a gross estimate of sediment and nutrient load reductions from the implementation of agricultural and urban BMPs. The algorithms for non-urban BMPs are based on the "Pollutants controlled: Calculation and documentation for Section 319 watersheds training manual" (Michigan Department of Environmental Quality, June 1999). The algorithms for urban BMPs are based on the data and calculations developed by Illinois EPA. Region 5 Model does not estimate pollutant load reductions for dissolved constituents".

An attempt by the Ohio EPA's NEDO to determine the watershed's pollutant loads and load reductions for *E. coli* was made, but loading results were deemed not accurate. However, using the STEPL model, general reductions were made. The watershed action plan addresses bacteria exceedences through the development of comprehensive nutrient management plans, livestock exclusion, and residential HSTS education and outreach, system maintenance, and repair and elimination cost assistance.

VI. WATERSHED RESTORATION AND PROTECTION GOALS

Goal: Reduce Nitrogen Loading

The Yellow Creek subwatershed is impaired by 45,473 pounds of excess nitrogen from urban stormwater runoff, agricultural cropland, pastureland, and failing onsite sewage treatment systems. Therefore, the WAP recommends a load reduction of 45,473 lbs of the current nitrogen loading. Because of their chemical nature and origin, many of the management measures indicated for nitrogen loading will be mimicked to reduce phosphorus loading in the watershed.

Goal Statement 1- NITROGEN:
A goal of this watershed plan is to see the watershed's nitrogen levels reduced in order for streams to reach attainment of their WWH designation. According to the STEPL model those reduction levels would require:

- 27,242 lbs/yr nitrogen load reduction from urban stormwater;
- *4,957 lbs/year* nitrogen load reduction *from failing wastewater treatment systems;*
- *255 lbs/yr by restoring modified streams;*
- *50% of farmers (1,971 acres of farmland)incorporating agricultural BMPs and/or grassed waterways; and*
- *50% of pasture farmers (1,402 acres of pastureland) incorporating pasture BMPs in order to reduce nitrogen loading from pastureland by 11,623 lbs/year.*

Goal Indicator
Water quality and programmatic indicators will be used to measure the progress toward meeting the goal for nitrogen levels in the Yellow Creek Watershed.

Water Quality Indicator
Nitrogen levels will be measured on a monthly schedule throughout the sampling season at or near the original six Ohio EPA sampling sites. Water quality monitoring will begin immediately after funding is secured to purchase the proper monitoring equipment. To determine if the STEPL load reduction levels specified for nitrogen are being met, it is expected to see water quality samples show a reduction in nitrogen each year after urban and/or agricultural BMP implementation.

Programmatic Indicator
The load reductions, as a result of urban BMPs installed in the watershed and as determined by the STEPL model, will be monitored to determine if the installed BMPs are working adequately to assist in reducing overall nitrogen loads.

Programmatic Indicator
The number of agricultural BMPs installed and management strategies implemented for nitrogen load reduction will be monitored.

Programmatic Indicator
The number of comprehensive nutrient management plans developed will be recorded and implementation measures monitored to determine if the plans aid in reducing nitrogen loads.

Programmatic Indicator
The number of crop producers and/or livestock operators that test their soil's nitrogen levels every three years will be monitored.

Programmatic Indicator
The number home sewage treatment system tank pumping reports will be monitored.

Programmatic Indicator
The number of failing home sewage treatment system upgrades/repairs will be monitored and recorded.

Goal: Reduce Phosphorus Loading

The Yellow Creek watershed is impaired due to 8,312 pounds of excess phosphorus from urban stormwater runoff, agricultural cropland, pastureland, and failing onsite sewage treatment systems. Therefore, the WAP recommends a load reduction of 8,312 lbs of phosphorus.

Goal Statement 2- PHOSPHORUS:
A goal of this plan is see phosphorus levels in the watershed reduced in order for streams to reach attainment of their WWH designation. According to the STEPL model those reduction levels would require:

- *5,983 lbs/year* phosphorus load reduction from urban stormwater;
- *1,817 lbs/year* phosphorus load reduction *from failing wastewater treatment systems;*
- *510 lbs/yr* phosphorus load reduction *by restoring* 4,000 LF *modified streams;*
- *50% of farmers (1,971 acres of farmland) incorporating agricultural BMPs and/or grassed waterways; and*
- *50% of pasture farmers (1,402 acres of pastureland) in order to reduce phosphorus loading from pastureland by 802 lbs/year.*

Goal Indicator
Water quality and programmatic indicators will be used to measure the progress toward meeting the goal for phosphorus levels in the Yellow Creek Watershed.

Water Quality Indicator
Phosphorus levels will be measured at a minimum monthly throughout the sampling season at or near the original six Ohio EPA sampling sites. Water quality monitoring will begin immediately after funding is secured to purchase the proper monitoring equipment. To determine if the load STEPL reduction levels specified for phosphorus are being met, it is expected to see water quality samples show a reduction in phosphorus each year after urban and/or agricultural BMP implementation.

Programmatic Indicator
The load reductions, as a result of urban BMPs installed in the watershed and as determined by the STEPL model, will be monitored to determine if the installed BMPs are working adequately to assist in reducing overall phosphorus loads.

Programmatic Indicator
The number of agricultural BMPs installed and management strategies implemented for phosphorus load reduction will be monitored.

Programmatic Indicator
The number of comprehensive nutrient management plans developed will be recorded and implementation measures monitored to determine if the plans aid in reducing phosphorus loads.

Programmatic Indicator
The number of crop producers and/or livestock operators that test their soil's phosphorus levels every three years will be monitored.

Programmatic Indicator
The number home sewage treatment system tank pumping reports will be monitored.

Programmatic Indicator
The number of failing home sewage treatment system upgrades/repairs will be monitored and recorded.

Goal: Reduce Sediment Loading

The Yellow Creek watershed is impaired due to 4,143 tons of excess sediment from cropland, urban runoff, and pastureland. Therefore, the WAP recommends a load reduction of 4,143 tons of sediment.

Goal Statement 3- SEDIMENT:
A goal of this plan is see sediment loads in the watershed reduced in order for streams to reach attainment of their WWH designation. According to the STEPL model those reduction loads would require:

- *1,008 ton load reduction of sediment from urban runoff;*
- *Achieve 50% of farmers (1,971 acres of farmland) within the watershed to incorporate agricultural BMPs and/or grassed waterways in order to reduce the annual load of sediment from cropland by 4,500 tons/yr.*
- *50% of pasture farmers (1,402 acres of pastureland) in order to reduce sediment loads from pastureland by 402 tons/yr.*

Indicator
Water quality and programmatic indicators will be used to show the progress toward meeting the goal for sediment levels in the watershed. An administrative indicator will also be used to measure the progress toward meeting the goal for sediment levels.

Water Quality Indicator
Turbidity and TDS levels will be measured at a minimum monthly throughout the sampling season at or near the original six Ohio EPA sampling sites. Water quality monitoring will begin immediately after funding is secured to purchase the proper monitoring equipment. To determine if the load STEPL reduction levels specified for sediment is being met, it is expected to see water quality samples show a load reduction each year after urban and/or agricultural BMP implementation.

Programmatic Indicator
The load reductions as a result of best management practices that are installed in the watershed, as determined by the load reduction models, will be monitored to determine if the BMPs installed are adequately working to reduce overall sediment loading.

Programmatic Indicator
The number of best management practices that can reduce sediment levels installed in the watershed will be monitored and recorded.

Goal: Reduce Bacteria(E.coli) Loading

The mean for *E.coli* (Class B Primary Contact Recreation waters) is 161 cfu/100 ml. Six sites were evaluated for E. coli. The Yellow Creek Watershed is non attainment of its recreational use due to an excess of 3,417 colony forming units (cfu) per 100 ml. of water, a combined cfu total for all six sites. Field reconnaisance indicated bacteria exceedences may be more agricultural and/or natural related than caused by failing septic systems. A review of local health records did not indicate any failing HSTSs during the sampling year and/or within the vicinity of the sampling sites. However, it is important to HSTS inspections occur either prior to the sale of a house, land re-plats, home additions, owner repair request, or if a nuisance report was filed. Therefore, the possibility of a failing HSTS exists. *E. coil*, as it relates to failing HSTS's, will be addressed in Secton VII as education and outreach opportunities and in terms of septic maintenance, and repair and/or elimination cost assistance for homeowners. At the time of sampling, the Shadeland Apartments' package plant, located upstream of sampling site RM 7.75, was not functional and waste from its service area directly discharged into a tributary. The STEPL model's reduction may be appropriate for this discharge.

Goal Statement 4- BACTERIA (E.coli):
A goal of this plan is for the watershed's bacteria loads to meet the mean E.coli water quality criteria for its designated Class B Primary Contact Recreation designation. According to the STEPL model it would require a reduction of:

- *1,700 cfu/100ml from failing HSTS and/or package plants;*
- *685 cfu/100ml from agricultural runoff; and*
- *1,032 cfu/100ml from livestock.*

Indicator
Programmatic indicators will be used to show the progress toward meeting the goal for *E. coli* levels in the Yellow Creek watershed.

Programmatic Indicator
The upgrading progress of the Shadeland Apartments' package plant facility will be monitored by keeping in contact with the Ohio EPA. Bacteria measurements, as per their NPDES permit, will be monitored.

Programmatic Indicator
The number of HSTS pumping reminders sent out to watershed residents by the local health departments will be monitored.

Programmatic Indicator
The number of residents reporting to the local health departments regarding HSTS maintenance pumping will be monitored.

Programmatic Indicator
The number of best management practices that can reduce *E. coli* levels that are installed in the watershed will be monitored.

Programmatic Indicator
The load reductions as a result of best management practices that are installed in the watershed, as determined by the load reduction models, will be monitored to determine if the agricultural BMPs being installed are working adequately to reduce overall loading of *E.coli* to reach the determined cfu/100ml reduction for agricultural and livestock.

Programmatic Indicator

The number of comprehensive nutrient management plans developed will be recorded and implementation measures monitored to determine if the plans aid in reducing bacteria loads.

Goal: Protect Surface Drinking Water Sources

Development has occurred and continues to occur along the boundaries of Beaver, Pine Lake, Evans Lake and Lake Hamilton. Most of the protective buffers once surrounding the lakes no longer exist, and if they do they are narrow. The lack of vegetated buffers allows stormwater runoff to flow quickly and directly into the lakes without naturally filtering out pollutants. Many residents and business owners may not be aware of the potential risks to surface water resulting from their property maintenance routines and/or land use practices. Commercial fertilizers, pesticides, failing septic systems, and sediment pose threats to the water quality of Evans Lake and Lake Hamilton and the tributaries leading directly into the lakes.

Goal Statement 5- SOURCE WATER PROTECTION:

The Yellow Creek Watershed has two assets in need of additional protection, Evans Lake and Lake Hamilton. Both Evans Lake and Lake Hamilton are surface drinking water sources that do not have adequate protection from pollutants. Additionally, many small tributaries begin and flow through agricultural production lands prior to their confluence with Evans Lake. Those tributaries serve as express ways for nutrients, chemicals, and sediments to enter into the lake. Though not to minimize the importance of the other lakes in the watershed, the following measures are suggested for implementation in the watershed and can be applied across the board:

- *Reduce the impacts of residential land management practices on Beaver, Pine, and Evans Lake and Lake Hamilton;*
- *Promote Evans Lake and Lake Hamilton as a valuable and critical resource in the watershed;*
- *Reduce surface water impacts of golf course activity on Beaver Lake and Evans Lake;*
- *Promote and encourage agricultural BMP programs to limit the amount of nutrients and sediment entering Evans Lake;*
- *Promote and encourage riparian buffers for 50% of lake and stream side landowners in order to limit the amount of nutrients entering Evans Lake and Lake Hamilton.*

Goal Statement

It is the goal of this project to have at least 25% of landowners adjacent to Lake Hamilton and Evans Lake and its tributaries to have a minimum 20 foot riparian buffer by 2020, and 75% of parcels with a minimum 20 foot buffer by 2040.

Indicator

Social and programmatic indicators will be used to show the progress toward meeting the goal for surface drinking water protection.

Social Indicator

A survey will be developed to determine watershed residents and business owner perception of the value of clean drinking water. An education and outreach program will be developed based on the initial survey's findings. After a time period of 2-3 years after the initial survey, a second survey will be developed to re-evaluate the perception.

Programmatic Indicator
The number of landowners who install a minimum of a 20 foot riparian buffer will be measured. It is expected that the installation of riparian buffers will increase annually to meet the goal set by this project.

Programmatic Indicator
The total acreage draining into a 20 foot riparian buffer and the percentage of forested riparian buffer that is installed each year will be measured.

Programmatic Indicator
A GIS riparian buffer inventory will be conducted within the first five years of implementation, to determine if the project is nearing the goal of 50% of parcels adjacent to a headwater streams having a minimum of a 20 foot riparian buffer

Goal: Determine Impact of acid mine drainage on the watershed
According to ***Figure 33***, surface mines exist within the Yellow Creek Watershed, many of them located in the Headwaters-Yellow Creek subwatershed. Page 123 contains a dialogue about the surface mining activity within the watershed. Based on the initial discussion and the watershed's mining history, it would be beneficial to determine what, if any, impact mining has had on water quality.

Goal Statement 6- Acid Mine Drainage
The Ohio EPA's 2011 survey of Yellow Creek identified lead and iron violations within the headwaters, likely a result of AMD. In their technical support document, the Ohio EPA recommends an AMD study to determine if restoration work is needed.

Goal Statement
It is the goal of this plan to initiate an ODNR Division of Mineral Resource Acid Mine Drainage Abatement and Treatment (AMDAT) Plan in place for the Yellow Creek Watershed.

Indicator
Programmatic indicators will be used to show the progress towards meeting the goal of receiving an AMDAT plan for the watershed.

Programmatic Indicator
Stakeholders may petition ODNR to perform a watershed assessment to determine is AMD is present within the watershed and to what extent it is impairing water quality.

Programmatic Indicator
If AMD is present within the watershed, and based on the severity, stakeholders may petition ODNR to develop an AMDAT plan.

Goal: Educate Stakeholders and Watershed Residents

Many homeowners are unaware of the potential risks to surface and ground water, and their property if the system is not properly maintained. Leaking, failing, or straight pipe septic systems pose a threat to water quality by increasing nutrient, sediment and bacteria levels in the water.

Goal Statement 7- WATERSHED WIDE EDUCATION

Obtaining attainment for Ohio's water quality standards will require a strong and proactive education and outreach program for watershed residents and business owners. The educational programs developed through the watershed action plan in conjunction with active agency and community leader involvement will help bring changes in philosophy and practices of watershed users both at a community leader and resident level.

Goal Statement
It is the goal of this project to hire a watershed coordinator who will take the lead or partner with organizations or agencies to educate watershed residents, school districts, and business owners about the watershed's current state and ways to improve water quality and promote stewardship.

Indicator
Programmatic indicators will be used to show the progress toward meeting the goal for watershed education.

Programmatic Indicator
A watershed coordinator will be hired within the first five years after plan endorsement.

Programmatic Indicator
The number and diversity of programs developed by the watershed coordinator will be monitored.

Programmatic Indicator
The number of schools involved in educational programs relating to this plan will be monitored.

Programmatic Indicator
The number of outreach events and people who attend outreach events developed by the coordinator for the watershed will be monitored.

Programmatic Indicator
An educational brochure regarding living adjacent to streams and the water quality be produced and distributed by 2020.

VII. IMPLEMENTATION

In order to address the concerns of the watershed's critical areas, best management practices and conservation measures will need to be taken. In this section several practices and measures are presented. The following list is not all inclusive and other practices and management measures may be added to the list in the future.

The objectives and action items for nitrogen and phosphorus are synonymous with one another and therefore, are represented in the following tables as such. However, due to the differences in land use for the Yellow Creek watershed, the plan separates the implementation items into a table for the Headwaters-Yellow Creek subwatershed, Burgess Run-Yellow Creek subwatershed, and a Yellow Creek Watershed Wide table. The following tables contain the plan's implementation actions and priorities are listed in the following tables.

Partners (P) and those providing Technical Assistance (TA) include, but not limited to: Columbiana and Mahoning SWCD, Ohio State University Extension Offices (P, TA), Farm Bureaus (P); Regional NRCS Office (P, TA); Alliance for Watershed Action and Resource Education (P), Eastgate (P, TA), Unity, Fairfield, Springfield, Beaver, Boardman, and Poland townships (P); Villages of New Middletown and Poland; City of Struthers; Aqua Ohio (P);

Priority Area*	Objective	Target Audience	Implementation Timeframe	Action	Milestone	Quantity	Load Reduction			Est. Cost
							Nitrogen (lbs)	Phosphorus (lbs)	Sediment (ton)	
Headwaters-Yellow Creek; Beard Creek	Implement 20' vegetated buffer installation	Yellow Creek watershed landowners adjacent to headwater streams	Within 20 years after WAP approval	Re-vegetate Stream Buffer using native plantings on both Left bank and Right bank	900LF/year for 30 years	27,000 LF	140.1	25.5	6.4	$100-$750/LF per project
Headwaters-Yellow Creek; Rummels Run, East Branch Yellow Creek; Burgess Run, Beard Creek	Implement Agricultural programs to reduce Nitrogen , Phosphorus & Sediment to target load reductions	Yellow Creek watershed crop producers and livestock operators	Within 30 years after WAP approval	Crop Cover	140 new acres/year for 10 years	1,402 acres	8,692	351	130	$55-$100/acre and up to $160/acre for organic farms
				Livestock Exclusion Strategies	2-4 BMPs/year	10 BMPs	510	255	255	$1,800-$3,500/ BMP
				Grassed waterways	1 waterway per year for 10 years	10 grassed waterways	3 per acre treated	3 per acre treated	3 per acre treated	$4,200/acre installed
				Stream bank Stabilization	1 project every 5 years	3 projects-1000 LF on each side	108	54	54	$7.00-$50.00/LF**
				Comprehensive Nutrient Mgmt. Plan	4 plans every year for 5 years	20 Plans	N/A	N/A	N/A	$0.00
				Nutrient Mgmt. Strategies	140 new BMPs applied/ year	100 BMPs	N/A	N/A	N/A	$16- $70/acre for crop nutrient mgmt. $8,500-$125,000/ manure mgmt. structure
			After WAP approval then ongoing	Soil Testing	Every Year: 3 different producers perform 6 soils tests each.	18 soil tests per year; 54 total for each three year period	N/A	N/A	N/A	$10.00 per test***

*Refer to Critical Area discussion, Section V, for map of priorities.

**Dependent upon the stabilization method chosen.

*** Test covers approx. 20-30 acres of field.

Partners (P) and those providing Technical Assistance (TA) include, but not limited to: Columbiana and Mahoning SWCD, Ohio State University Extension Office (P, TA); Alliance for Watershed Action and Resource Education (P), Eastgate (P, TA),Unity, Fairfield, Springfield, Beaver, Boardman, and Poland townships (P); Villages of New Middletown and Poland; City of Struthers; Aqua Ohio (P);

Priority Area*	Objective	Target Audience	Implementation Timeframe	Action	Milestone	Quantity	Load Reduction			Est. Cost
							Nitrogen (lbs)	Phosphorus (lbs)	Sediment (ton)	
Headwaters Yellow Creek; Drakes Run	Implement Riparian buffer restoration	Yellow Creek watershed landowners adjacent to streams	Within 20 years after WAP approval	Riparian buffer using native plantings on both left bank and right bank	500 LF/year for 30 years	15,000 LF	77.8	14.1	3.5	$100-$750/LF per project
Headwaters Yellow Creek	Implement 20' buffer along Beaver, Pine, Evans Lakes	Yellow Creek residential and commercial stakeholders	Within 5 years after WAP approval and ongoing	20' native vegetated buffer	2 landowners every year for 10 years	20 land owners with a 20' vegetated lake buffer	20.7	3.7	0.94	$50-$20,000/ lot**
Headwaters Yellow Creek; Yellow Creek; Drakes Run; Burgess Run;	Implement Urban stormwater practices to reduce Nitrogen, Phosphorus, & Sediment to target load reductions	Yellow Creek watershed residential and commercial stakeholders	Within 5 years after WAP approval then ongoing	Rain Gardens (Residential)	Install 5 rain gardens/year for 15 years	75 rain gardens	55	18.8	-	$100 - $1,500/ rain garden***
				Rain Barrels (Residential)	Install 5 rain barrels/year	150 rain barrels	2.59	0.47	117.9 (lbs)	$100/rain barrel
				Rain Gardens (Commercial)	Install 1 garden/year for 15 years	15 rain gardens	4.4 per acre treated	0.56 per acre treated	-	$6,000-$15,000/ rain garden***
				Curb Cuts (in combination with other LID practices)	2 projects every 10 years	2 projects	-	-	-	$10,000/project
				Pervious Pavement	1 project every 10 years	1 project, 5-10 acres each	179 per project	8 per project	5.31 per project	$3.00-$30.00/ sq. ft.****

*Refer to Critical Area discussion, Section V, for map of priorities.

**Dependent upon cost of method to re-establish vegetation, native plating selected, and length of lake frontage.

***Dependent upon design, size, installation labor (individual vs. professional) cost, and cost native plants selected.

****Dependent upon type of permeable pavement chosen and square footage. Price may be higher due to associated design and labor costs.

Hire Watershed Coordinator and Acquire Necessary Funding					
Objective	**Target Audience**	**Implementation Timeframe**	**Milestone**	**Estimated Cost**	**Partners (P) / Technical Assistance (TA)**
Implement the Yellow Creek Watershed Action Plan	Yellow Creek Watershed Stakeholders	Within the First five Years after WAP Approval then ongoing	Hire watershed coordinator to implement the WAP (6 months)	$55,000/ year	Columbiana and Mahoning SWCD and NRCS offices (P, TA), Columbiana and Mahoning OSU Extension office, ODNR, OEPA (P and TA)
			Secure Funding to Implement the WAP (6 months)	$1,500	
			Secure funding to promote education and outreach programs (6 months)	-	
			Secure Funding to Begin Water Quality Sampling Efforts (3 years)	-	

Provide Education and Outreach in Critical Areas					
Objective	**Target Audience**	**Implementation Timeframe**	**Milestone**	**Estimated Cost**	**Partners (P) / Technical Assistance (TA)**
Develop and Implement an Agriculture Education and Outreach Program Specific to Crop Producers	Yellow Creek Watershed Crop Producers	Within the first 12 Months after WAP Approval then every 5 years	Compile a Education/Outreach Plan for crop producers (6 months)	-	Columbiana and Mahoning County SWCD and NRCS offices (P, TA) Mahoning County OSU Extension (P, TA), Columbiana and Mahoning County Farm Bureau (P), Eastern Ohio Grazing Council (P), Ohio Corn and Soybean Council (P)
			Develop and Disseminate an Ag. Education Brochure (8 months)	$2,000	
			Hold annual Ag. BMP Workshop/Field Day (12 months)	$1,500/year	

Provide Education and Outreach in Critical Areas					
Objective	**Target Audience**	**Implementation Timeframe**	**Milestone**	**Estimated Cost**	**Partners (P) / Technical Assistance (TA)**
Develop and Implement a Livestock Education and Outreach Program Specific to Livestock Operators	Yellow Creek Watershed Livestock Operators	Within the first 12 Months after WAP Approval then every 5 years	Compile a Education/Outreach Plan for livestock operators (6 months)	-	Columbiana and Mahoning County SWCD and NRCS offices (P, TA) Eastern Ohio Grazing Council (P), Ohio Livestock Coalition (P,TA)
			Develop and Disseminate a livestock Education Brochure (8 months)	$2,000	
			Hold monthly pasture walks (12 months)	$500/year	
			Partner with local SWCD and/or NRCS to cost share the installation of a livestock BMP in the Yellow Creek Watershed (24 months)	$1,000-$12,000*	

* Dependent upon BMP chosen.

Provide Education and Outreach in Critical Areas					
Objective	**Target Audience**	**Implementation Timeframe**	**Milestone**	**Estimated Cost**	**Partners (P) / Technical Assistance (TA)**
Develop and Implement a Manure/Nutrient Management Education and Outreach Program for Crop Producers and Livestock Operators	Yellow Creek Watershed Crop Producers and Livestock Operators	Within the first 12 Months after WAP Approval then every 5 years	Compile a nutrient management Education/Outreach Plan for crop producers and livestock operators (6 months)	-	Columbiana and Mahoning County SWCD and NRCS offices (P, TA) Columbiana and Mahoning County OSU Extension (P, TA), Columbiana and Mahoning County Farm Bureau (P), Eastern Ohio Grazing Council (P), Ohio Corn and Soybean Council (P), Ohio Livestock Coalition (P,TA)
			Develop and disseminate nutrient management Education Brochure (8 months)	$2,000	
			Partner with local SWCD and/or NRCS to hold nutrient management workshop for crop producers and livestock operators (12 months)	$500/year	

Provide Education and Outreach in Critical Areas					
Objective	**Target Audience**	**Implementation Timeframe**	**Milestone**	**Estimated Cost**	**Partners (P) / Technical Assistance (TA)**
Develop and Implement an Urban Education and Outreach Program	Burgess Run-Yellow Creek Subwatershed Stakeholders in Critical Areas (MS4 Phase II communities)	Within one year after WAP approval then ongoing	Compile an urban education and outreach plan (6 months)	-	County Engineers (P); AWARE (P); Eastgate (P); MS4 Coordinators and Decision Makers (P); SWCDs (P); Springfield twp., Boardman twp., Poland twp., Village of Poland, City of Struthers (P); Zoning officials (P)
			Develop and disseminate an urban education fact sheet (6 months)	$2,000	
			Hold an urban BMP Workshop (18 months)	$1,000/year	
			Install a Demonstration Urban BMP in the Watershed (24 months)	$1,000/year	

Provide Education and Outreach in Critical Areas					
Objective	**Target Audience**	**Implementation Timeframe**	**Milestone**	**Estimated Cost**	**Partners (P) / Technical Assistance (TA)**
Develop watershed and stream signage awareness program	Yellow Creek Watershed stakeholders	Within first 5 years after WAP approval then ongoing	Make contact with Aqua Ohio, ODOT, and Mahoning County engineer to discuss locations for stream crossing signs	-	County Engineers (P); AWARE (P); Eastgate (P); MS4 Coordinators and Decision Makers (P); SWCDs (P); Springfield twp., Boardman twp., Poland twp., Village of Poland, City of Struthers (P); Zoning officials (P)
			Work with ODOT and county engineer to seek support and right of way permission for placement of signs	-	
			Partner with Aqua Ohio and/or watershed stakeholder to cost share the purchase of stream crossing signs (use AWARE's signage as template).	$200.00/sign (incl. cost of U-bar)	

Provide Education and Outreach in Critical Areas					
Objective	**Target Audience**	**Implementation Timeframe**	**Milestone**	**Estimated Cost**	**Partners (P) / Technical Assistance (TA)**
Develop and Implement a Septic System Educational Program	Yellow Creek Watershed Stakeholders who Utilize Septic Systems	Within 5 years after WAP approval then ongoing	Develop and/or disseminate a Septic System Maintenance Brochure (18 months)	$2,000	Columbiana Health Department and SWCD (P); Mahoning County District Board of Health and Mahoning SWCD (P); Columbiana and Mahoning County Sanitary Engineers (P)
			Hold a Septic System Workshop for homeowners and for on-site waste disposal installers (18 months)	$1,000/ year	
Develop Septic Pumping reminder and record keeping program	Yellow Creek Watershed Stakeholders who Utilize Septic Systems	Within 5 years after WAP approval for off-lot discharging systems then ongoing	100 homeowners complying with original O&M affidavit	$8,000/year	Columbiana Health Department and SWCD (P); Mahoning County District Board of Health and Mahoning SWCD (P); Columbiana and Mahoning County Sanitary Engineers (P)
		Within 10 years* after WAP approval for on-lot discharging systems then ongoing	25% initial compliance rate for homeowners during the first year of implementation; increasing to 50% compliance within 2 years of implementation;75% compliance within 4 years of implementation; and 100% within 10 years of implementation		

*Time frame reflects the default time frame specified in the Ohio Department of Health's new septic regulations.

Provide Education and Outreach in Critical Areas					
Objective	**Target Audience**	**Implementation Timeframe**	**Milestone**	**Estimated Cost**	**Partners (P) / Technical Assistance (TA)**
Partner with Aqua Ohio to assist with Education and Outreach or Cost Assistance for Surface Drinking Water Source Protection	Yellow Creek watershed stakeholders, business owners, and residents in Unity, Fairfield, and Springfield Twp.,	Within 5 years after WAP approval then ongoing	Re-establish a 20 ft. minimum "no mow" zone along lake boundaries. (36 months)	-	Aqua Ohio, AWARE, Columbiana and Mahoning County SWCD
			Work with city, township, and county officials to encourage good housekeeping measures for residential lawns. (18 months)	-	
			Establish working relationship with golf course owners in order to provide educational and technical support for source drinking water protection measures. (24 months)	-	
			Partner with organizations that currently provide urban education and outreach regarding homeowner BMPs (12 months)	-	
Partner watershed stakeholders to hold a watershed festival	Yellow Creek watershed stakeholders, business owners, and watershed residents	Within two years after WAP approval then ongoing	Partner with communities and organizations, to host watershed festival (12 months)	-	AWARE (P), Aqua Ohio (P), Eastgate (P), Columbiana and Mahoning County SWCD (P)
			Partner with organizations that currently provide urban education and outreach regarding homeowner BMPs (12 months)	-	
Partner watershed stakeholders to develop volunteer stream monitoring activities	Yellow Creek watershed stakeholders, school districts, civic groups, and watershed residents	Within two years after WAP approval then ongoing	Partner with agencies and organizations to develop a volunteer stream monitoring program (12 months)	-	AWARE (P), Eastgate(P), Mahoning County Green Team (P), Columbiana and Mahoning County SWCD (P), Sierra Club Water Sentinel(P, TA)
			Develop and distribute a fact sheet about the benefits of volunteer stream monitoring (6 months)	$2,000	
			Hold stream monitoring training workshop (12 months)	$5,000	

Milestones for Indicators of Reaching Goals (not covered elsewhere)					
Objective	**Target Audience**	**Implementation Timeframe**	**Milestone**	**Estimated Cost**	**Partners (P) / Technical Assistance (TA)**
Water Quality Sampling	Yellow Creek Watershed Stakeholders	Within 10 Years after WAP Approval	Water Quality Sampling Begins with those Sites identified by the Ohio EPA for Turbidity, TDS, TSS, Nitrate+Nitrite, TP, DRP, and E. coli at a minimum	$21,000/ year*	Columbiana and Mahoning County SWCDs (P), AWARE (P), Eastgate (P), volunteer groups (P), Ohio EPA (TA), Sierra Club Water Sentinel (P,TA)
Conduct a Desktop Survey of Riparian Buffers	Yellow Creek Watershed Stakeholders	Within 5 Years of WAP Approval and then resurveyed every 5-10 years	Desktop Survey of Riparian Buffers within the Yellow Creek Watershed Completed (5 years)	$6,000	Eastgate (P, TA), Mahoning County Engineer (P, TA), Mahoning GIS (P, TA)
Remove/breach impoundment within Yellow Creek at E. Western Reserve Rd.	Impoundment owner	Within 10 years of WAP approval then ongoing	Establish working relationship with the owner of the impoundment in order to determine the impoundment's purpose and functionality. (24 months)	-	Ohio EPA (P), ODNR (P), AWARE (P), Eastgate(P)
			Provide education regarding the water quality impairments enhanced by the presence of the impoundment.	-	
			Work with impoundment owner to seek funding for the removal or breaching of the impoundment in order to restore Yellow Creek to free flowing conditions.	-	
Conduct AMD study on the watershed	Yellow Creek Watershed Stakeholders	Within 10 years of WAP approval	Evaluate the impact extent of Acid Mine Drainage on water quality. (24 months)	-	ODNR (P), Ohio EPA (P), AWARE (P), Eastgate(P)

*Cost includes the purchase of monitoring equipment and related equipment maintenance.

Milestones for Indicators of Reaching Goals (not covered elsewhere)					
Objective	**Target Audience**	**Implementation Timeframe**	**Milestone**	**Estimated Cost**	**Partners (P) / Technical Assistance (TA)**
Increase the amount of wetlands and green space preserved	Landowners and Stakeholders within Priority Area 1 and 2	Within the first 10 years after WAP Approval then ongoing	Partner with local preservation experts to compile a list of parcels within the identified priority areas (12 months)	-	Mill Creek MetroParks (P., TA), Western Reserve Land Conservancy (P, TA), Eastgate(P, TA), Columbiana and Mahoning SWCD, Unity, Fairfield, Springfield, Beaver, Boardman, and Poland townships; Villages of New Middletown and Poland; City of Struthers;
			Identify land preservation funding sources (6 months)	-	
			Develop and disseminate Educational Brochure about the benefits of land preservation and funding sources available (12 months)	$2,000	
			5 landowners committing to preserving their land	-	

Partner with Key Organizations to Assist with WAP Implementation					
Objective	**Target Audience**	**Implementation Timeframe**	**Milestone**	**Estimated Cost**	**Partners (P)/ Technical Assistance (TA)**
Partner with Municipalities and other Organizations to assist with Education and Outreach or Cost Assistance for Urban Stormwater Issues	Yellow Creek Watershed MS4 communities and permit holders	Within 12 months after WAP approval then ongoing	Make contact with City and County Planners / MS4 Coordinators (6 months)	-	Mahoning County Engineer Office(P), MS4 communities(P), Mahoning County SWCD (P) Eastgate(P), AWARE (P)
			Work with city, township, and county planners to encourage Low Impact Design for new developments and/or redevelopment projects (18 months)	-	
			Partner with organizations that currently provide urban education and outreach (12 months)	-	

VIII. POST IMPLEMENTATION- LOAD REDUCTIONS

Because a watershed plan is not a regulatory or an enforceable document, actions presented in Section VII were determined under the assumption that landowners and/or commercial property owners will be willing to participate in cost sharing programs to implement BMPs. The load reductions identified were developed using the modeling programs discussed in Section V and are based on the assumption no BMPs are currently in use or have been used and the BMPs identified will be installed as part of plan implementation.

Funding for plan implementation depends on the watershed's economic climate, as well as the longevity and stipulations of funding outlets (i.e. grants, agency funds, etc.). Water quality monitoring for load reductions is contingent upon funding available to purchase proper monitoring equipment to evaluate identified parameters. Until funding is acquired for water quality analysis, post implementation monitoring for load reductions will be analyzed based on BMP installation.

IX. FUTURE PLANS

The Yellow Creek Watershed Action Plan presents information regarding land uses, land management practices, and historic and current water quality issues present within the watershed. The information may not common knowledge to the watershed's community leaders and/or residents. Therefore, those water quality results and action items developed for this plan will be presented to the public through various methods: members of AWARE and their interactions with watershed officials and residents; AWARE education and outreach events; presentations at township and village and city council meetings, and made available on websites such as Eastgate's. Informing the public of the contents of this plan will hopefully spark a willingness to adjust land use management practices and create an uptick in positive impacts on water quality.

It is the goal of Eastgate for the WAP to be reviewed, referenced, and used by other organizations within the Yellow Creek Watershed including but not limited to: AWARE, county SWCD's, engineers, city and county planning departments, local health departments, stormwater managers, township trustees, city officials, and other organizations concerned about the water quality of the watershed. A top priority will be obtaining funding to implement objectives outlined in the Section VII. However, partnerships with other organizations that plan to do the same will be helpful. A major component of the cost-share programs success is the education and outreach component of the WAP. Field days and workshops regarding agricultural and urban land uses and BMPs will be held. Partnerships among organizations such as other county SWCD and NRCS offices, ODNR, and watershed groups focusing on water quality and sustainable land uses, will prove to be integral in promoting practices to improve the health of the watershed.

The Yellow Creek Watershed Action Plan is a living document. As such, it is important that the plan is updated at a minimum every 5 years to keep it relevant. Revisions will be made to reflect new water quality data, changes in the watershed landscape, and/or reflect the action items implemented throughout the watershed. As action items are implemented they will be removed from the plan upon project completion. Updates will be guided by Eastgate and/or an identified watershed coordinator and will engage all local stakeholders. Public access to the Yellow Creek Watershed Action Plan will be made through Eastgate's agency website, AWARE's website, Mahoning SWCD, and Columbiana SWCD. Until such time a watershed coordinator is hired and housed within an agency, Eastgate will store and maintain the WAP and document files used in developing the WAP.

X. ENDORSEMENTS AND DISTRIBUTION LIST

We, the undersigned, agree to support the implementation of the Yellow Creek Watershed Action Plan by partnering with other watershed stakeholders, offering technical assistance, and/or pursuing funding on our own to implement the WAP.

Organization	Signature	Title
Alliance for Watershed Action and Resource Education		
Aqua Ohio, Inc.		
Beaver Township		
Boardman Township		
City of Struthers		
Columbiana and Mahoning County Natural Resource Conservation Service		
Columbiana County Commissioners		

Organization	Signature	Title
Columbiana County Engineers Office		
Columbiana County Health Department		
Columbiana Soil and Water Conservation District		
Eastgate Regional Council of Governments		
Fairfield Township		
Mahoning County Commissioners		
Mahoning County Engineers Office		
Mahoning Soil and Water Conservation District		
Mill Creek MetroParks		

Endorsements

Organization	Signature	Title
Nation Resources Conservation Service		
Ohio DNR – Division of Soil Resources		
Ohio EPA – Division of Surface Water		
Ohio State University Extension		
Poland Township		
Nation Resources Conservation Service		
Ohio DNR – Division of Soil Resources		
Springfield Township		
Unity Township		

Endorsements

Organization	Signature	Title
Village of New Middletown		
Village of Poland		

XI. REFERENCES

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5 Ohio Rev. Code, §504(2010). Retrieved from http://codes.ohio.gov/orc/504.

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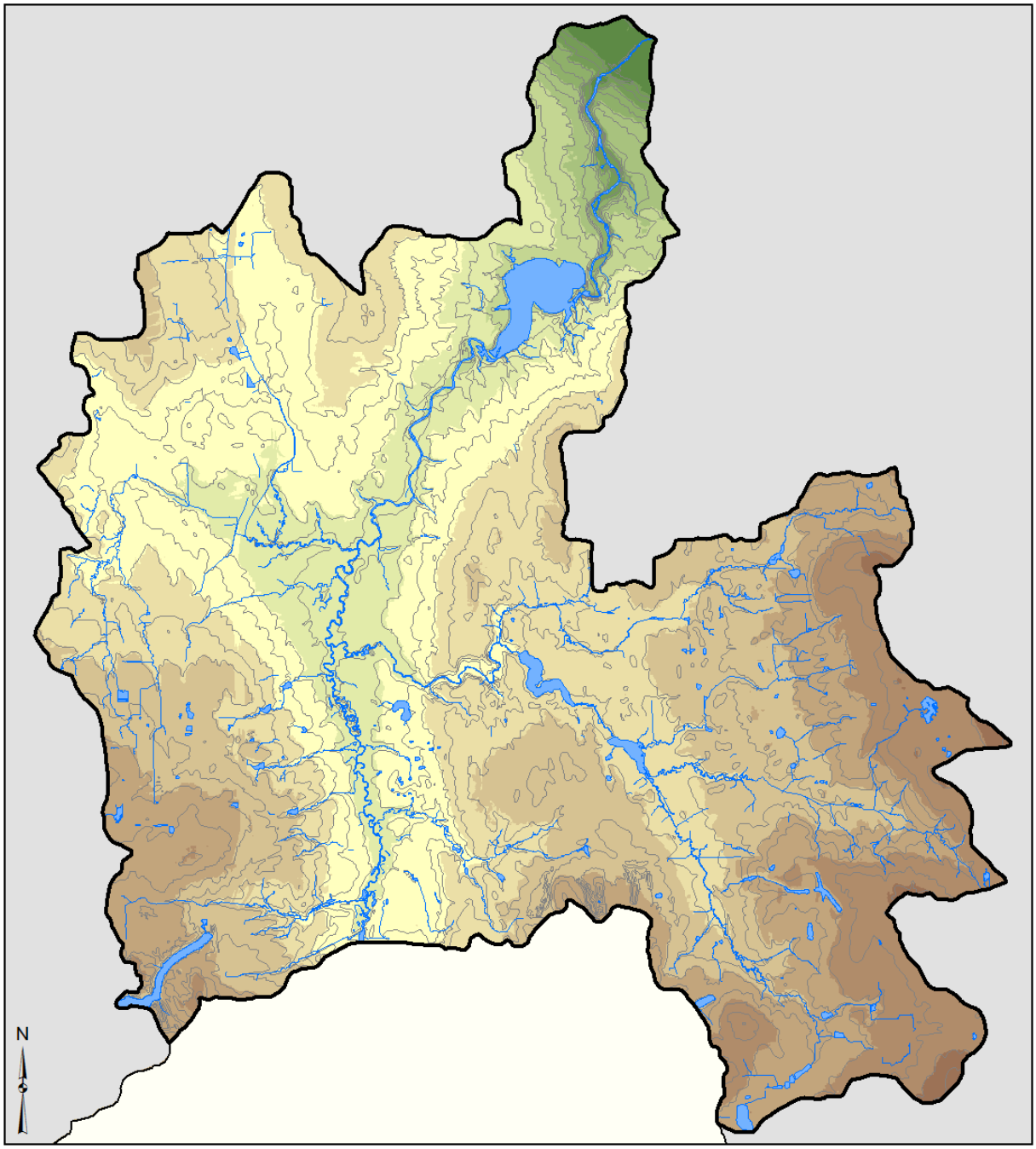
APPENDIX A

Supplemental Maps

Topography

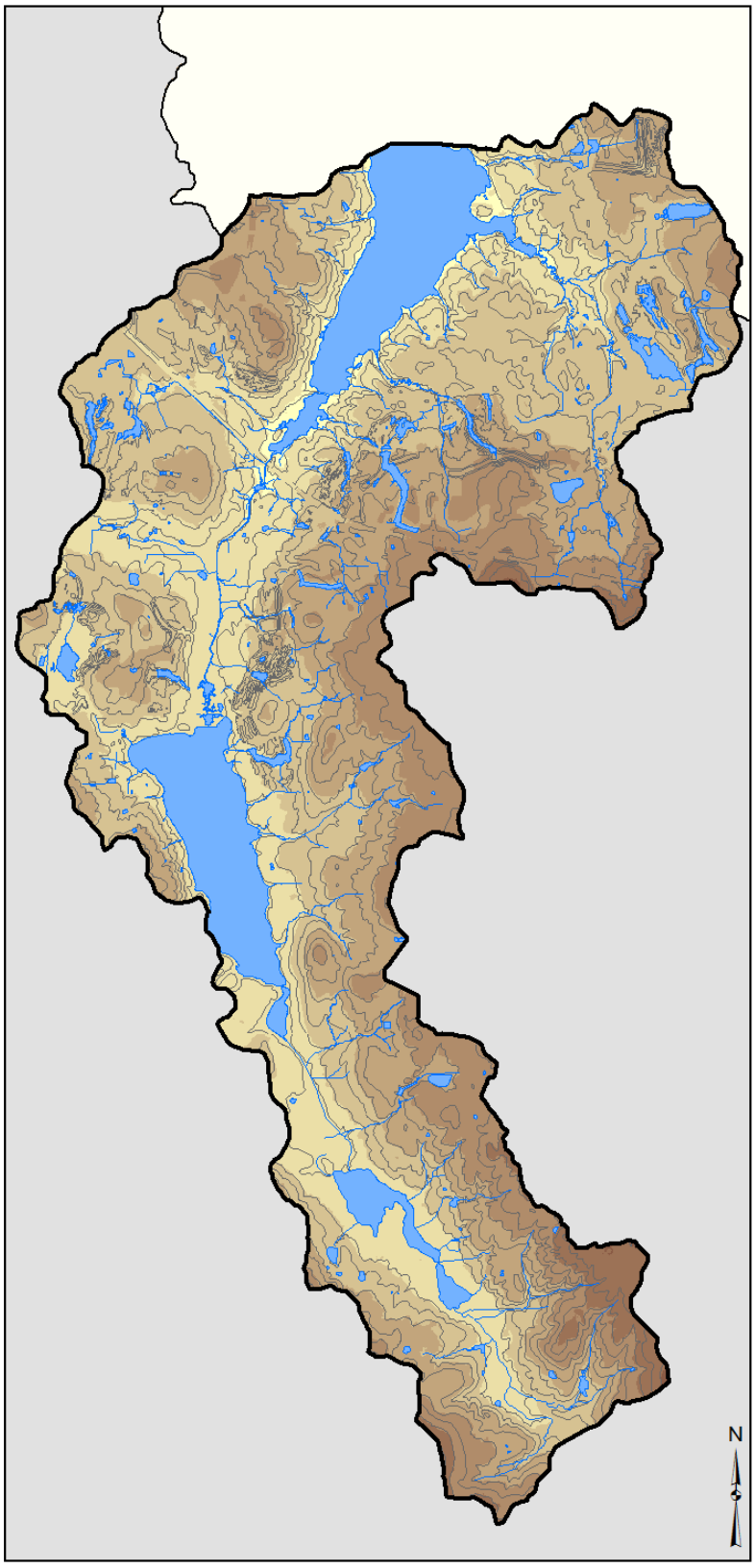
Sub-Watershed 050301030806, Burgess Run-Yellow Creek



Source: United Stated Geological Survey, Ohio Statewidelmagery Program, Mahoning County GIS, 2013

Topography

Sub-Watershed 50301030805
Headwaters Yellow Creek

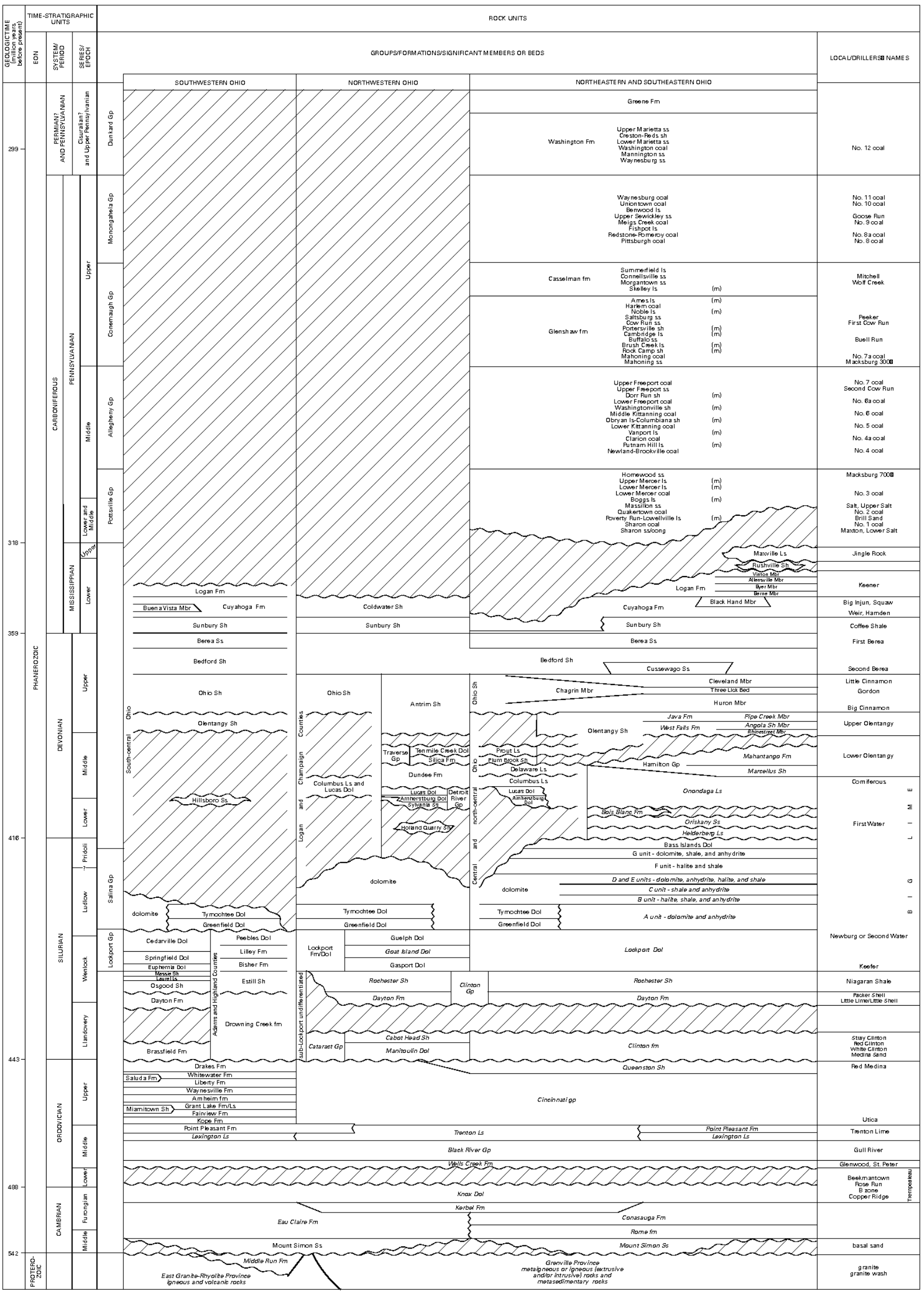


Source:
United Stated Geological Survey, Ohio Statewide Imagery Program, Mahoning County GIS, 2013

GENERALIZED COLUMN OF BEDROCK UNITS IN OHIO

Dennis N. Hull, chief compiler, 1990
revised by Glenn E. Larsen, 2000; Ernie R. Slucher, 2004

STATE OF OHIO
BobTaft, Governor
DEPARTMENT OF NATURAL RESOURCES
Samuel W. Speck, Director
DIVISION OF GEOLOGICAL SURVEY
Thomas M. Berg, Chief



Compilation based on published, unpublished, and web-based sources and personal communications with staff of the Division of Geological Survey, the United States Geological Survey, and geological sciences departments at numerous mid-continent region universities. Time-stratigraphic divisions primarily from the International Commission on Stratigraphy (www.stratigraphy.org). Geologic time dates from: Gradstein, Ogg, Smith, et al, 2004, A Geologic Time Scale 2004: Cambridge University Press.

2/04

Drafted by Robert L. Stewart, Sr.,
Lisa Van Doren

Sh	shale	Dol	dolomite	Fm	Formation
Ss	sandstone	Cong	conglomerate	Mbr	Member
Ls	limestone	(m)	marine zone	Gp	Group

Depositional hiatus or interval removed by erosion — unconformity

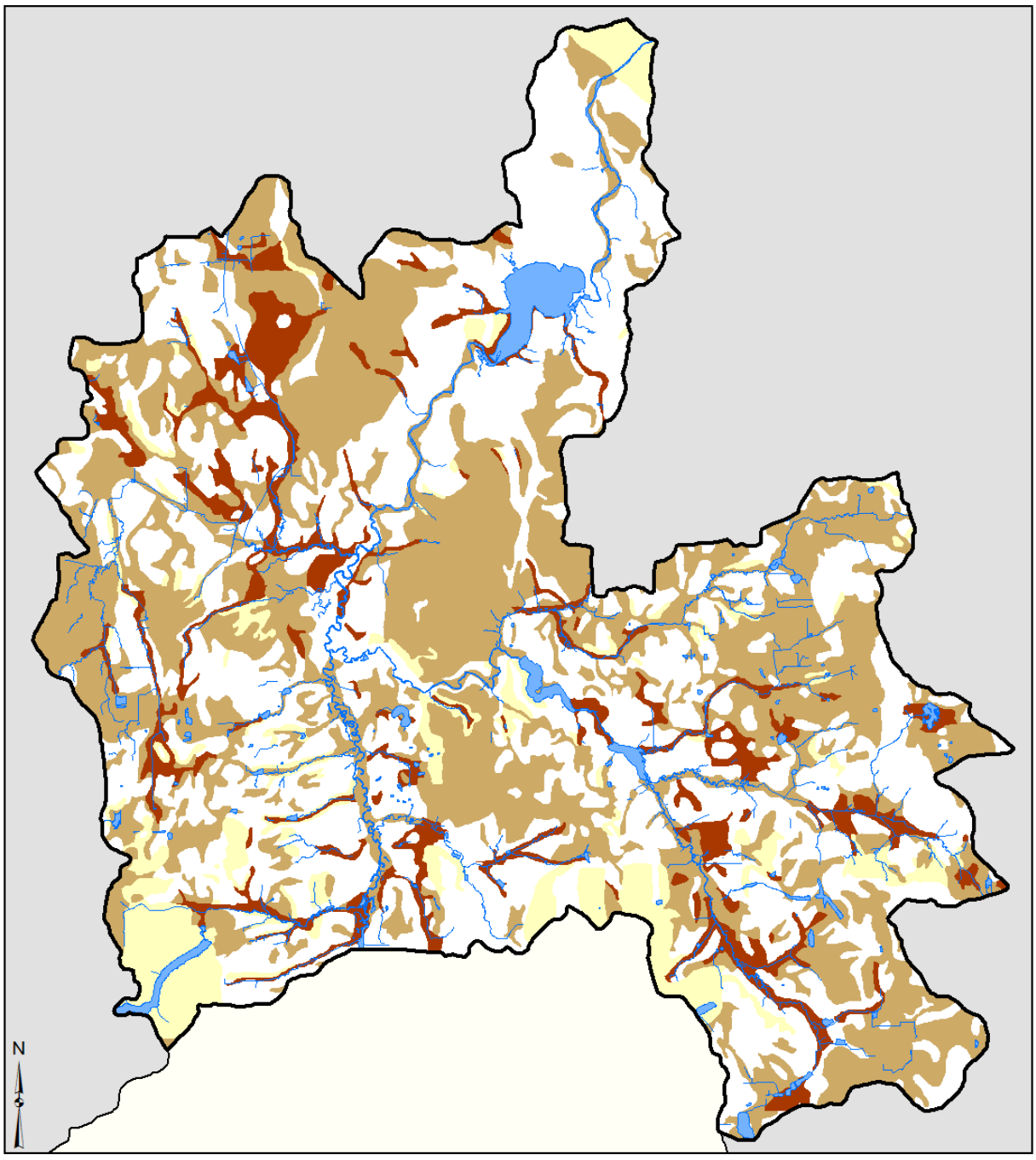
Fault or tectonic zone

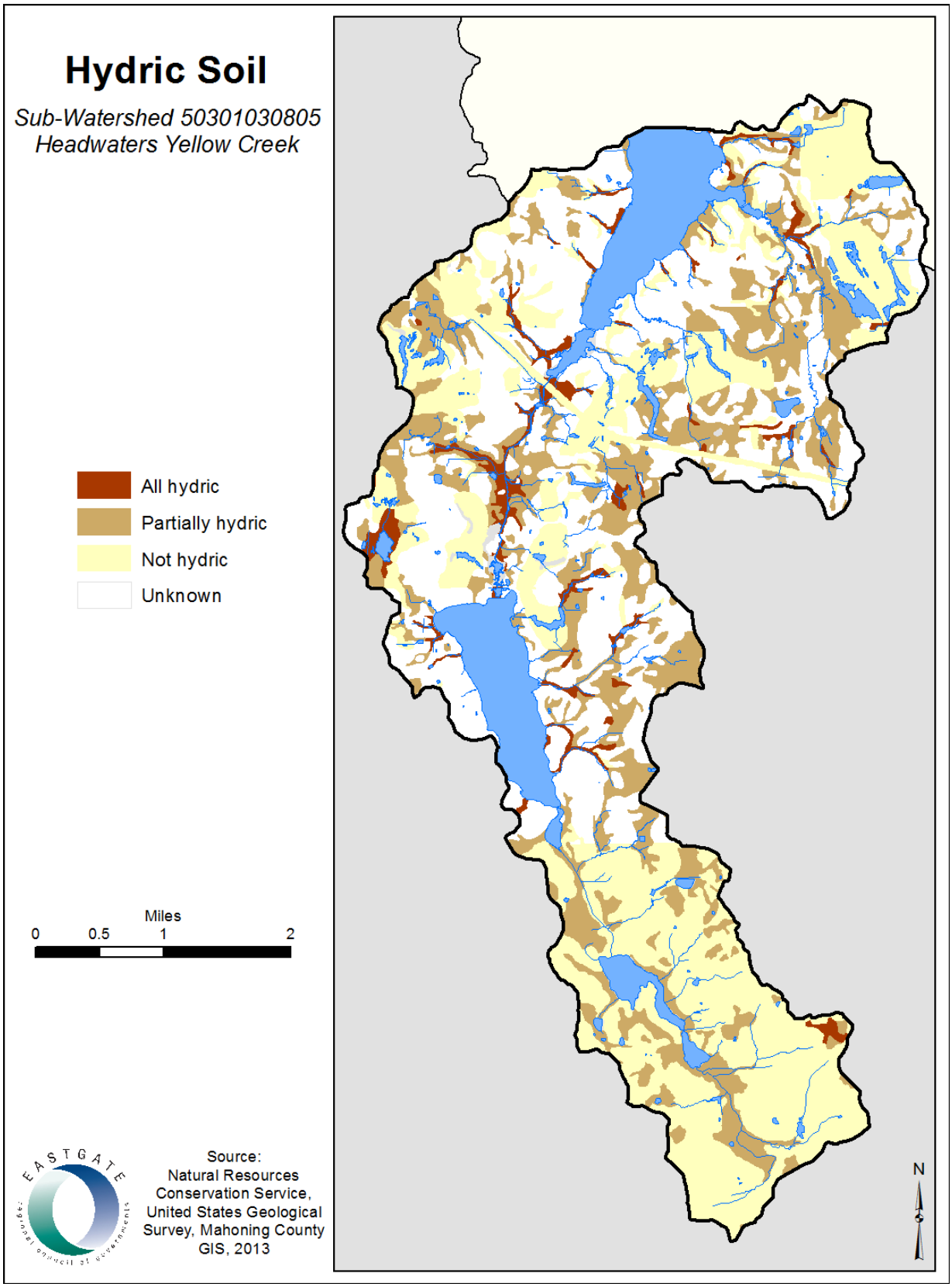
Note: Lower case lithologic or stratigraphic names indicate informal status of unit. Units found in the subsurface only are indicated in italics.

recycled paper

Hydric Soil

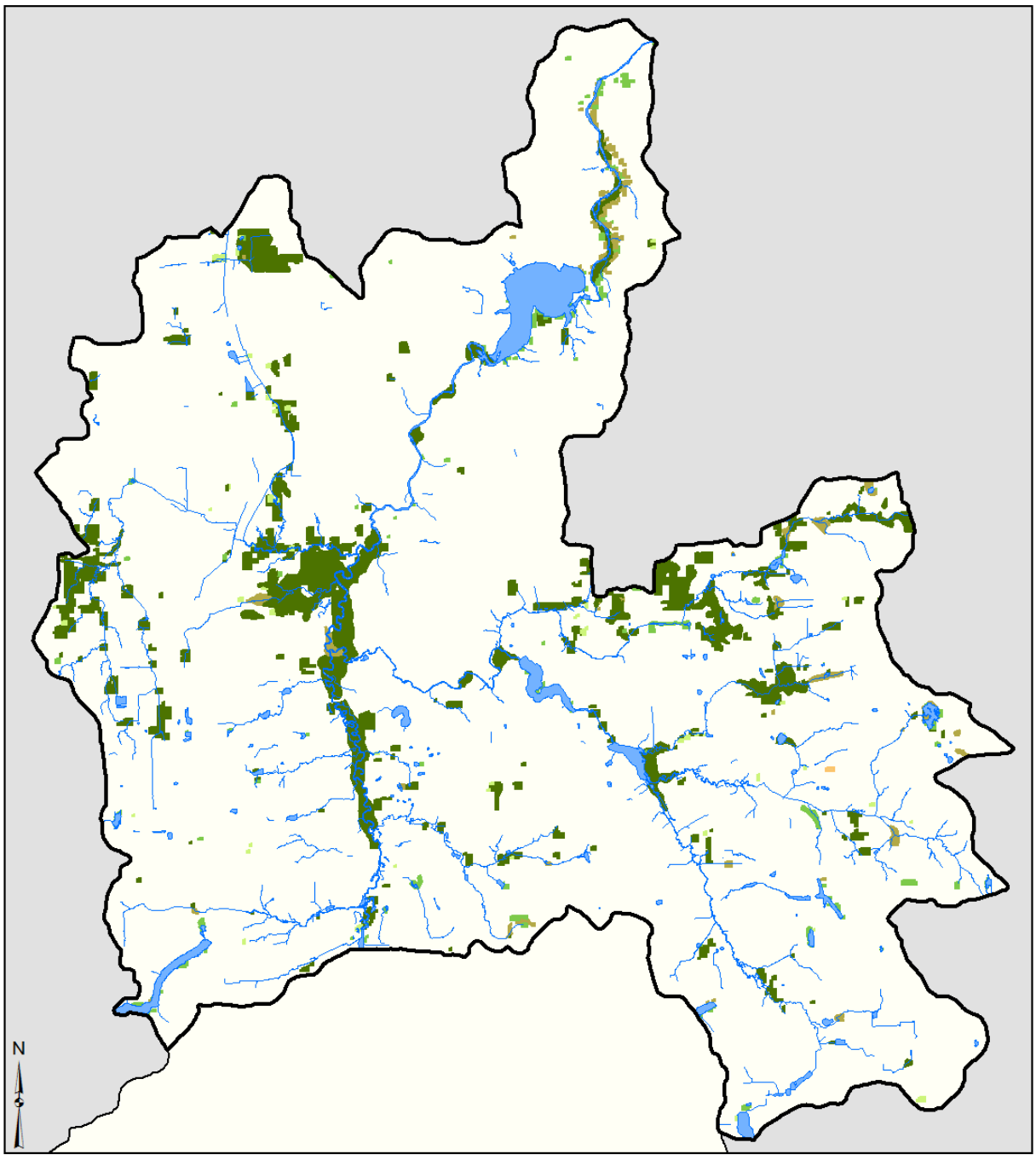
Sub-Watershed 050301030806, Burgess Run-Yellow Creek




Hydric Soil
Sub-Watershed 50301030805
Headwaters Yellow Creek
All hydric
Partially hydric
Not hydric
Unknown
Miles
0
0.5
1
2
N
Source:
Natural Resources
Conservation Service,
United States Geological
Survey, Mahoning County
GIS, 2013

Wetlands

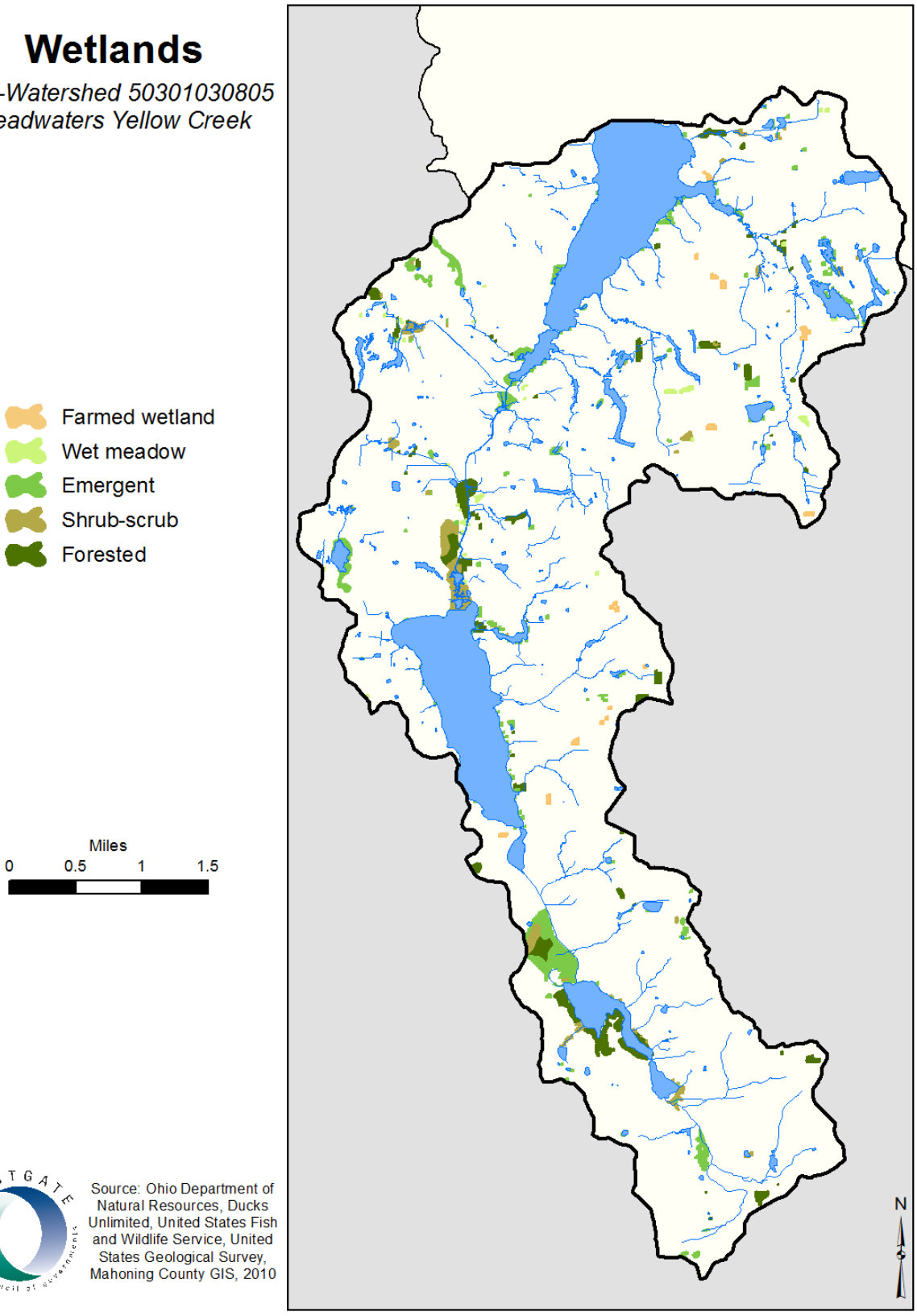
Sub-Watershed 050301030806, Burgess Run-Yellow Creek



Source: Ohio Department of Natural Resources, Ducks Unlimited, United States Fish and Wildlife Service, Mahoning County GIS, 2013

Wetlands

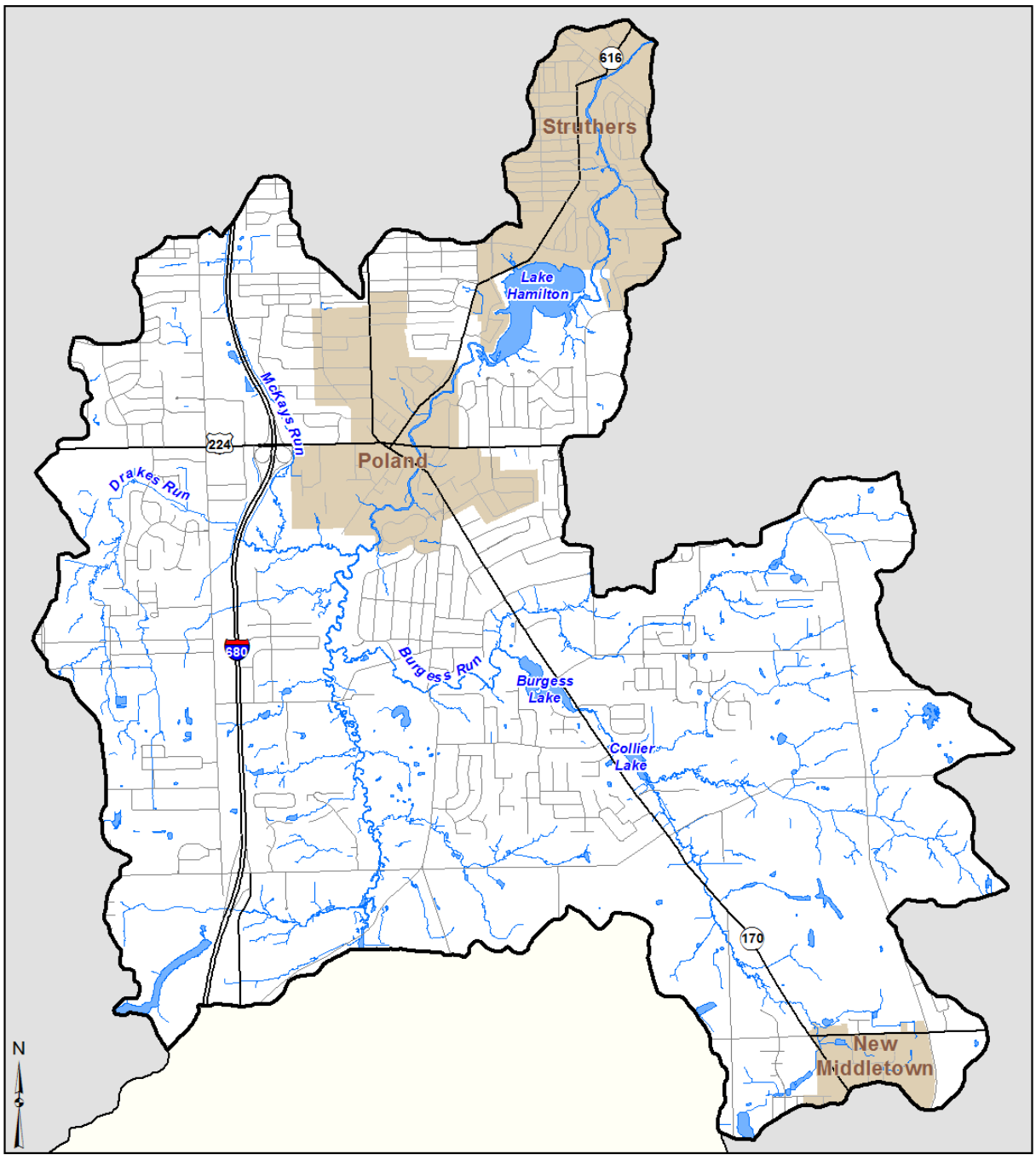
Sub-Watershed 50301030805
Headwaters Yellow Creek



Source: Ohio Department of Natural Resources, Ducks Unlimited, United States Fish and Wildlife Service, United States Geological Survey, Mahoning County GIS, 2010

Water Features

Sub-Watershed 050301030806, Burgess Run-Yellow Creek



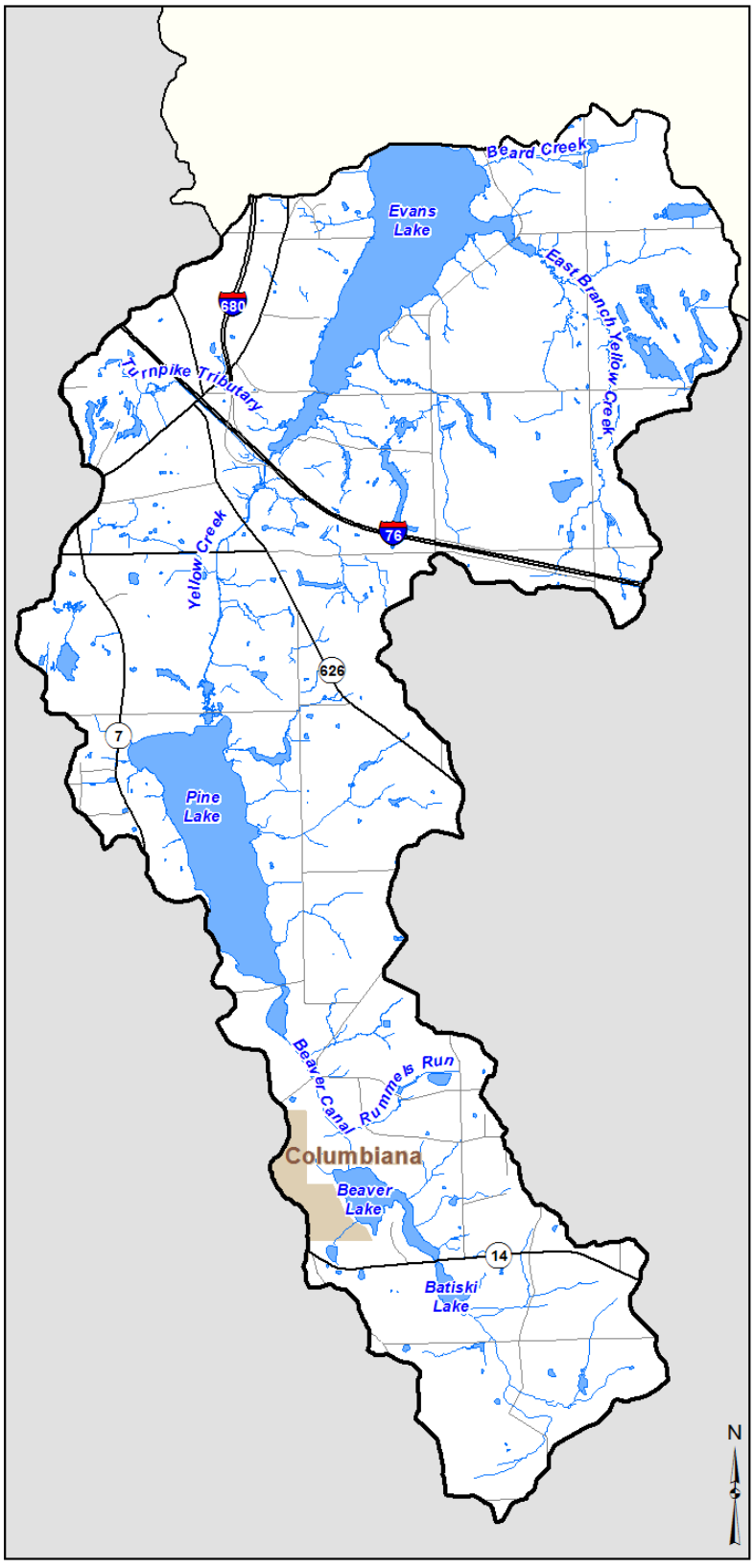
Miles
0 0.25 0.5 1

Lake/Pond
Stream

Source: Natural Resources Conservation Service, United States Geological Survey, Mahoning County GIS, 2013

Water Features

Sub-Watershed 50301030805
Headwaters Yellow Creek



Lake/Pond

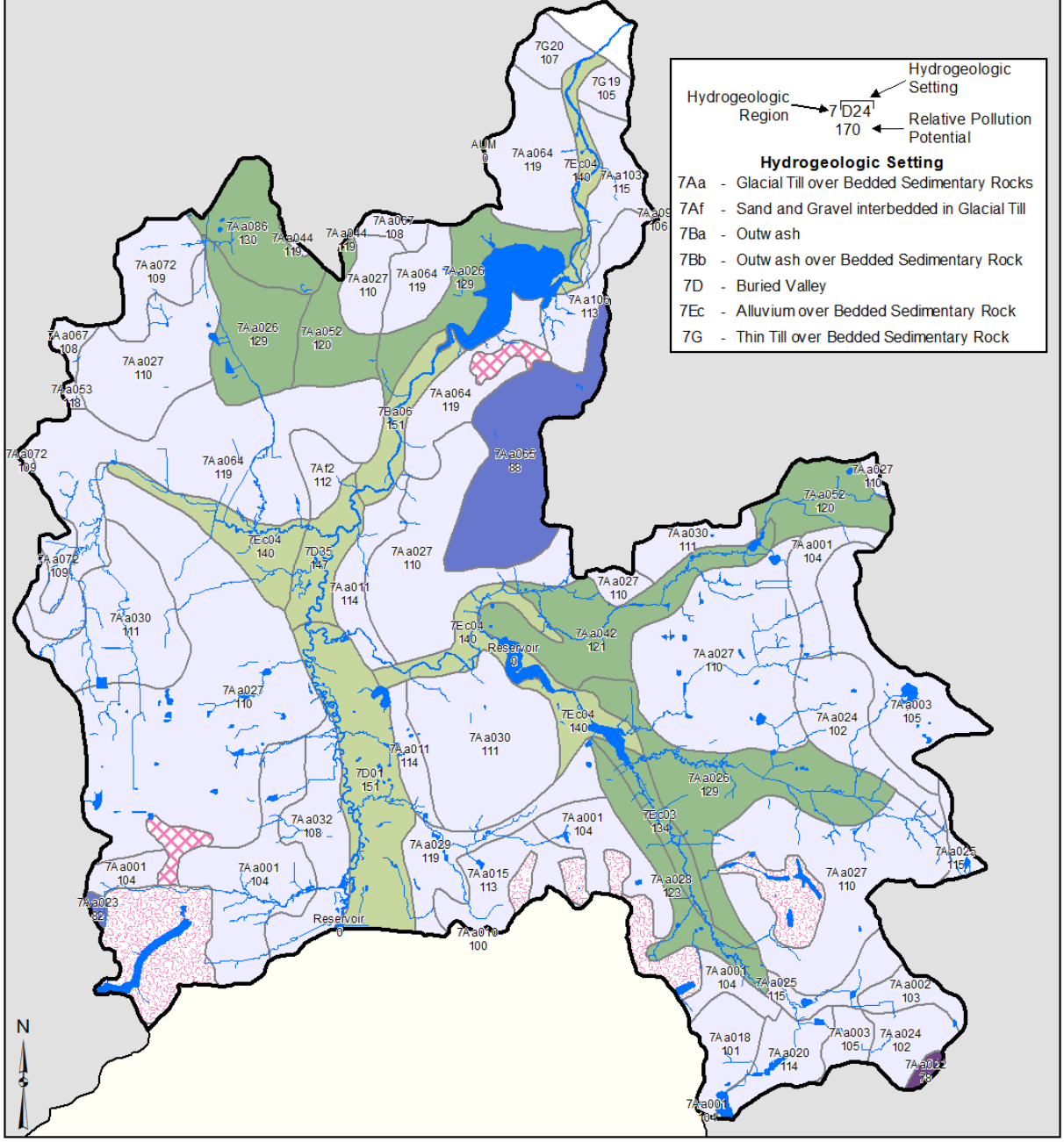
Stream

Miles
0 0.5 1 1.5

Source: Natural Resources Conservation Service, United States Geological Survey, Mahoning County GIS, 2013

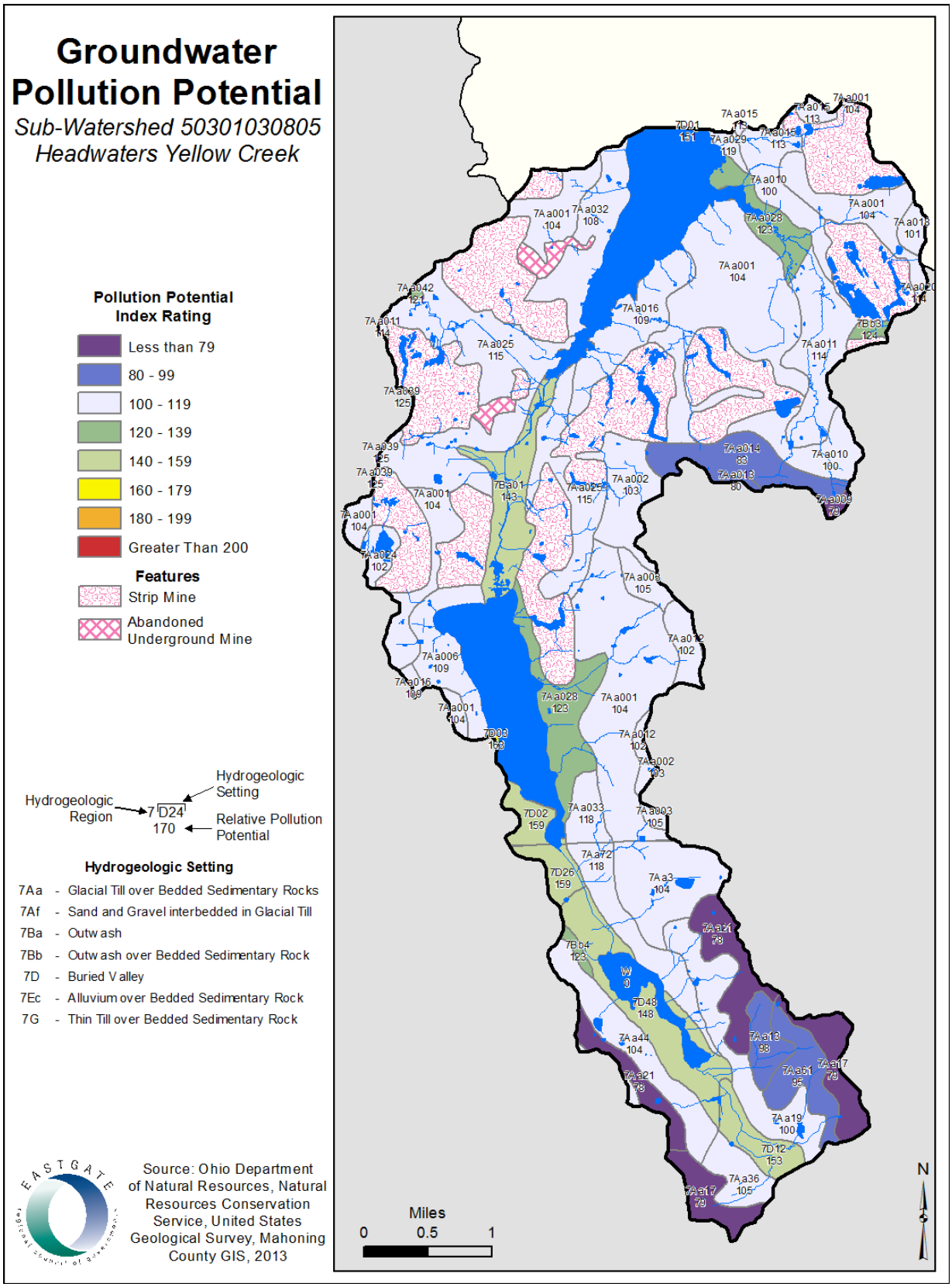
Groundwater Pollution Potential

Sub-Watershed 050301030806, Burgess Run-Yellow Creek



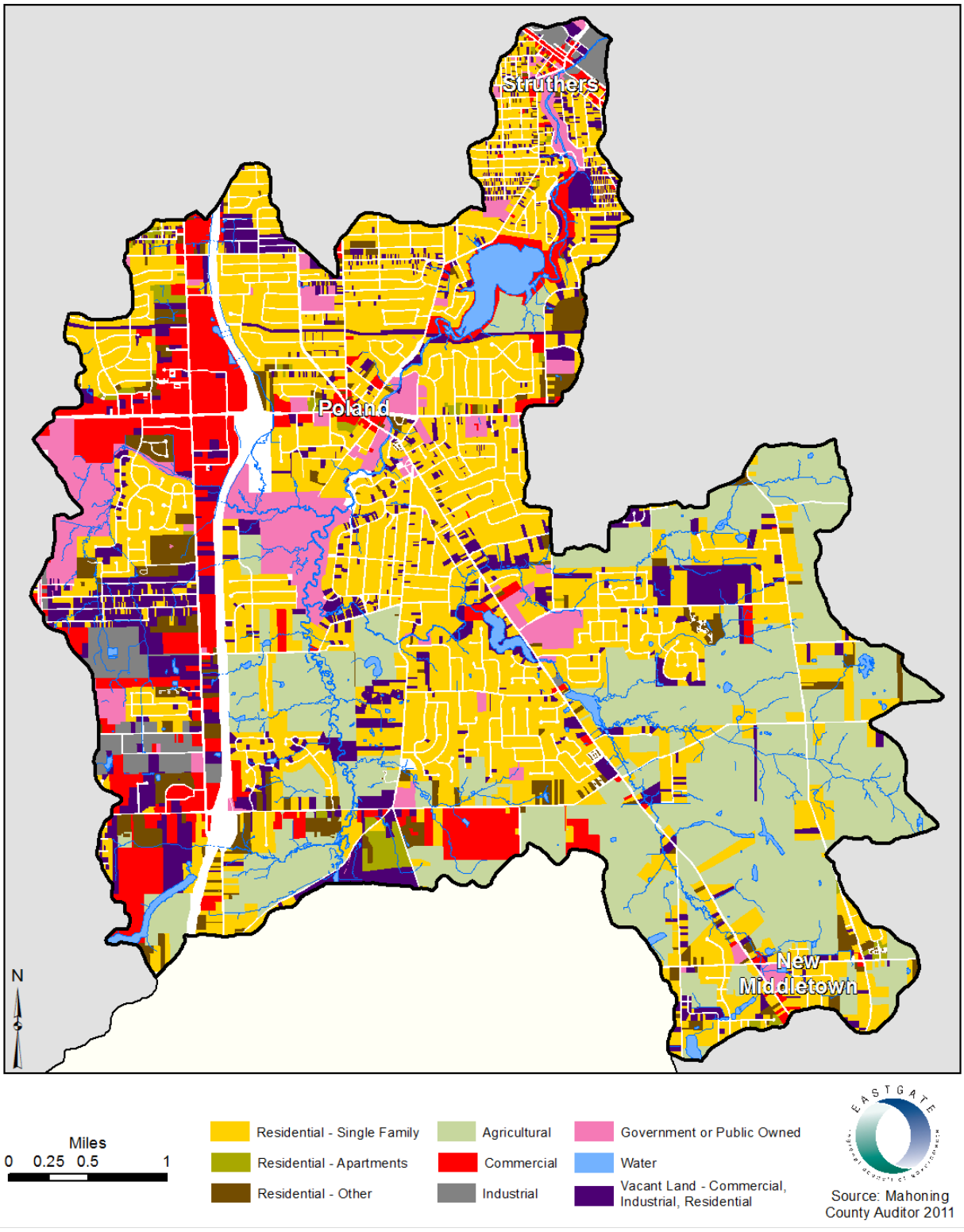
Groundwater Pollution Potential

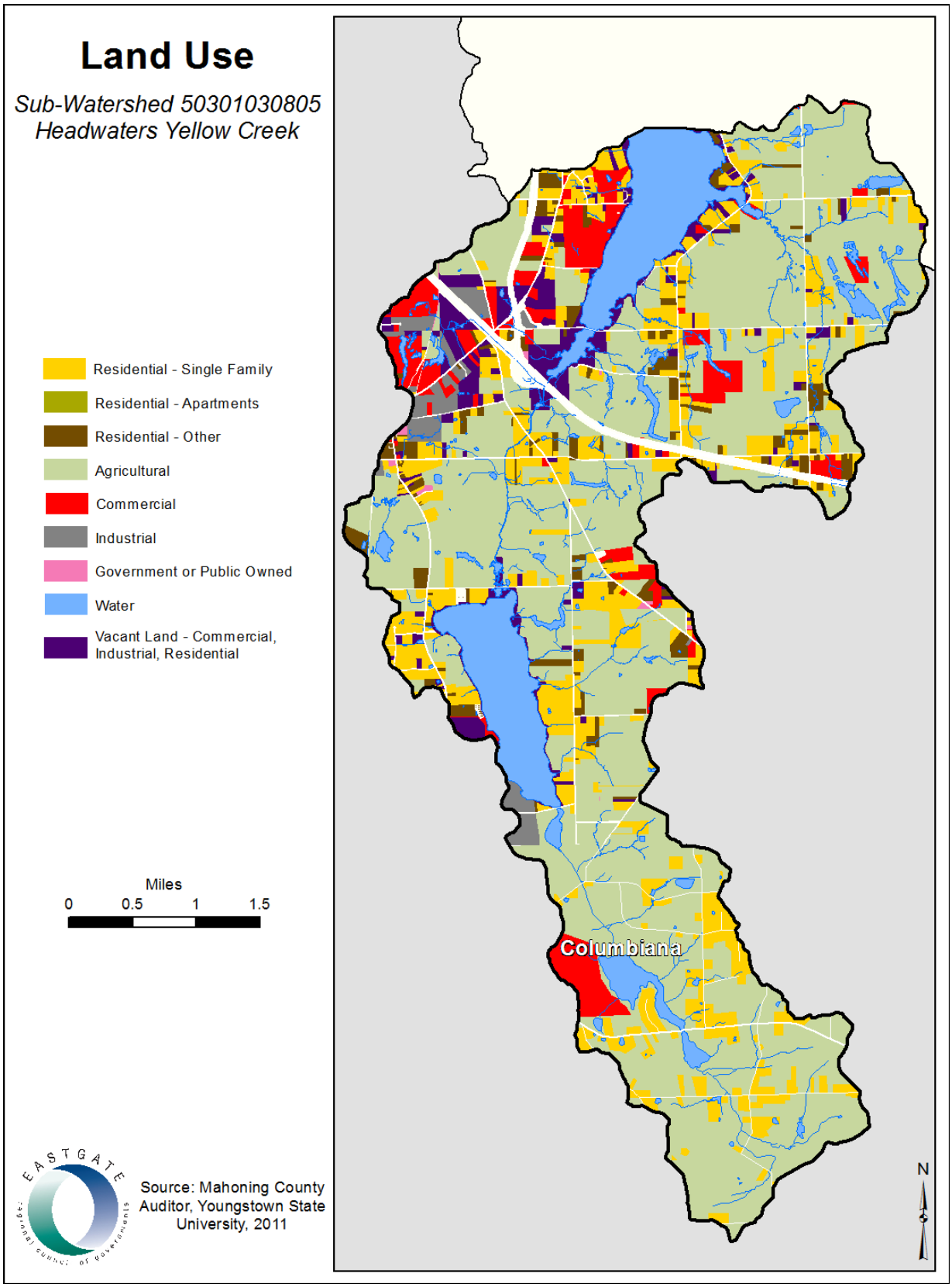
Sub-Watershed 50301030805
Headwaters Yellow Creek



Land Use

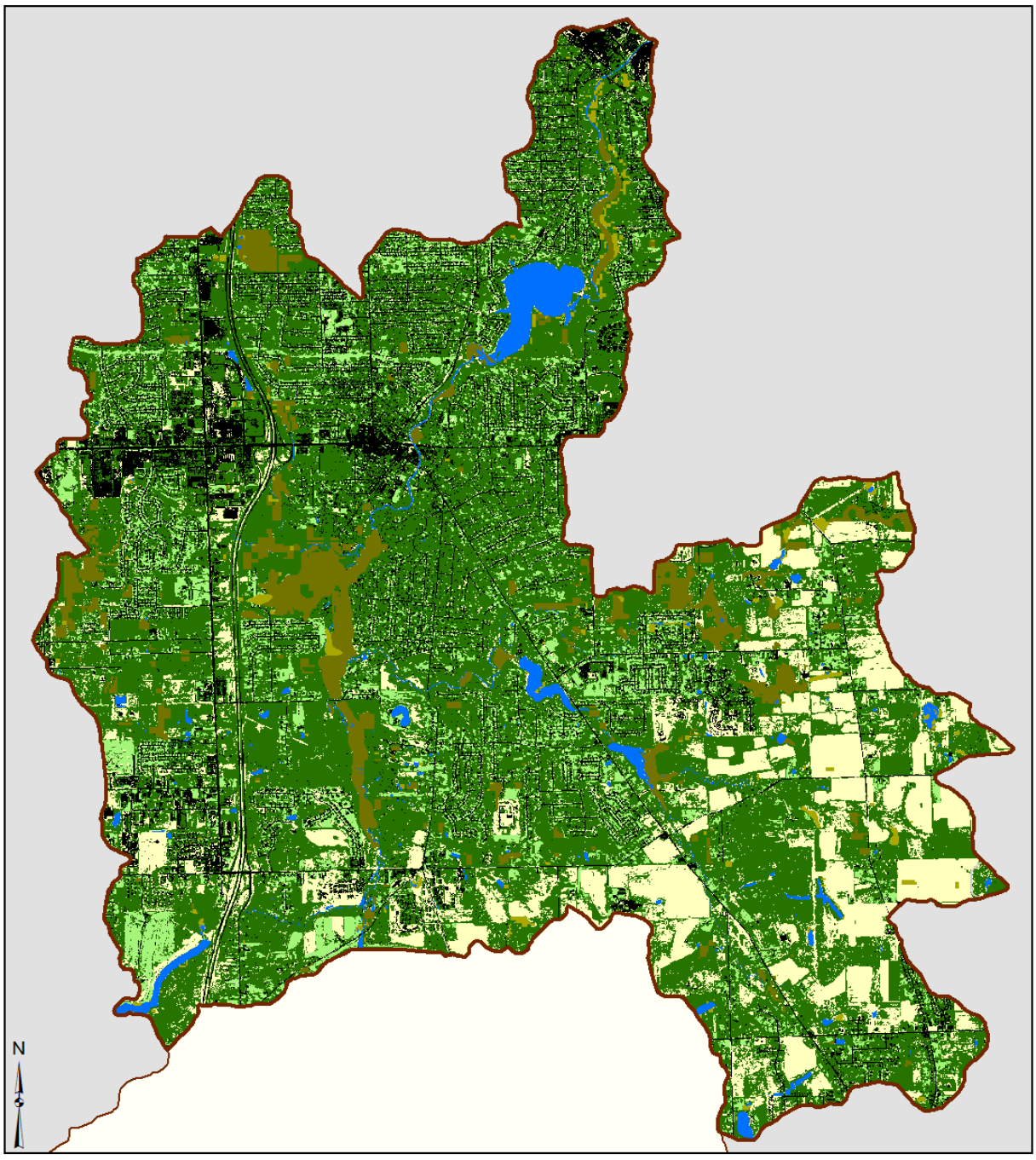
Sub-Watershed 050301030806, Burgess Run-Yellow Creek




Land Use
Sub-Watershed 50301030805
Headwaters Yellow Creek
Residential - Single Family
Residential - Apartments
Residential - Other
Agricultural
Commercial
Industrial
Government or Public Owned
Water
Vacant Land - Commercial, Industrial, Residential
Miles
0
0.5
1
1.5
Columbiana
N
Source: Mahoning County Auditor, Youngstown State University, 2011

Land Cover

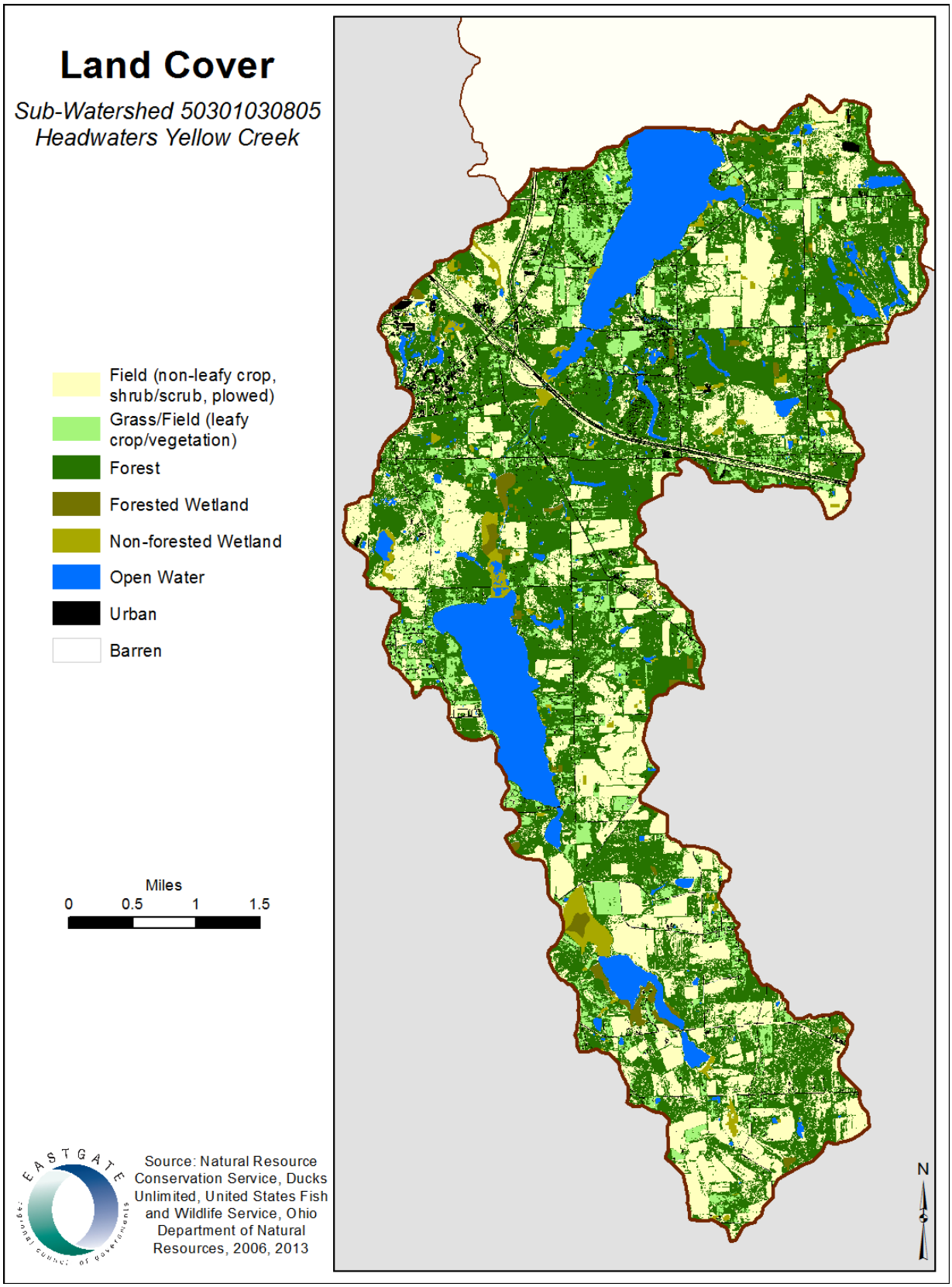
Sub-Watershed 050301030806, Burgess Run-Yellow Creek



Miles
0 0.25 0.5 1

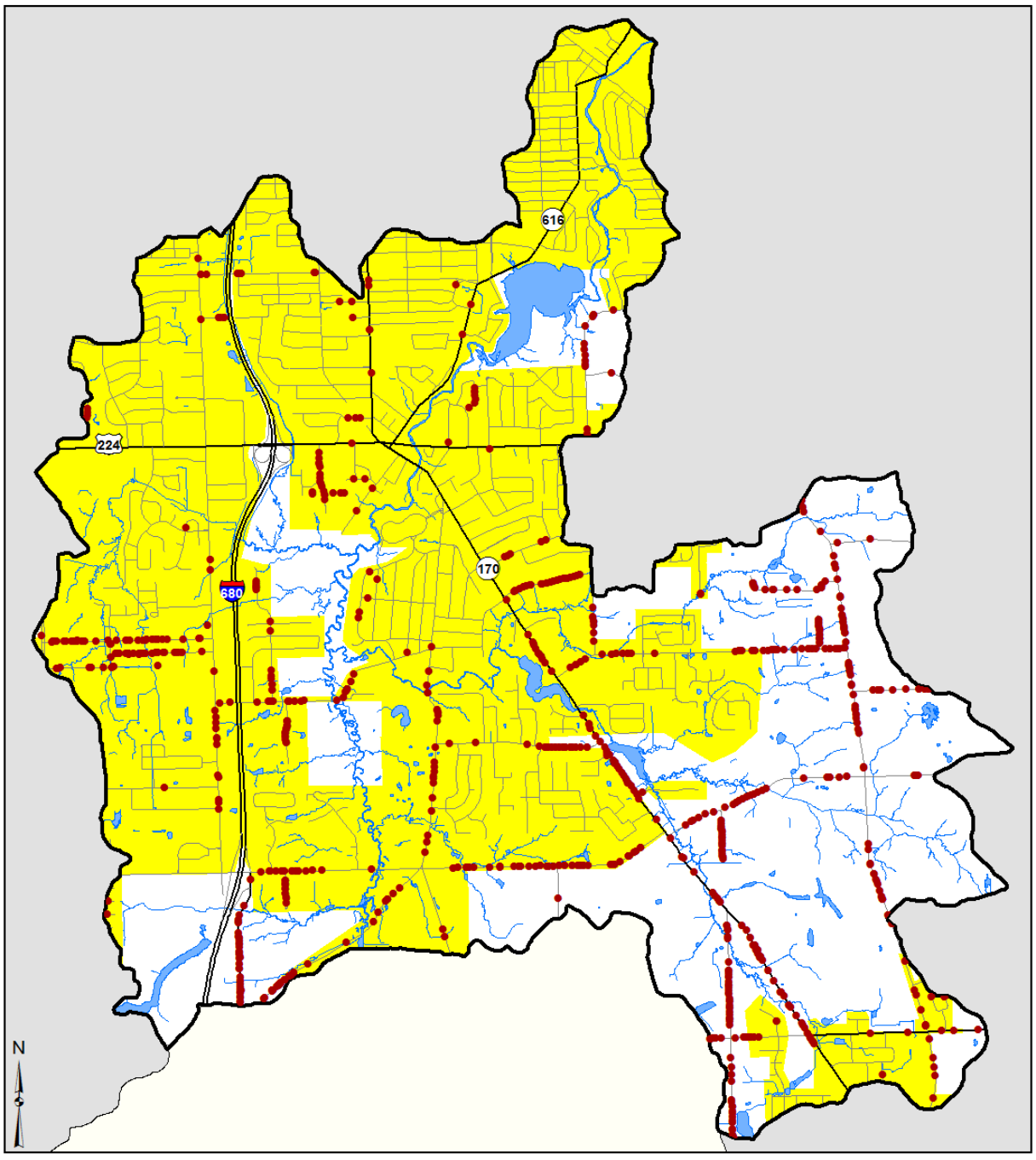
- Field (non-leafy crop, shrub/scrub, plowed)
- Grass/Field (leafy crop/vegetation)
- Forest
- Forested Wetland
- Non-forested Wetland
- Open Water
- Urban
- Barren

Source: Natural Resource Conservation Service, Ducks Unlimited, United States Fish and Wildlife Service, Ohio Department of Natural Resources, 2006, 2013


Land Cover
Sub-Watershed 50301030805
Headwaters Yellow Creek
Field (non-leafy crop, shrub/scrub, plowed)
Grass/Field (leafy crop/vegetation)
Forest
Forested Wetland
Non-forested Wetland
Open Water
Urban
Barren
Miles
0
0.5
1
1.5
N
Source: Natural Resource Conservation Service, Ducks Unlimited, United States Fish and Wildlife Service, Ohio Department of Natural Resources, 2006, 2013

Septic Systems and Sanitary Sewers

Sub-Watershed 050301030806, Burgess Run-Yellow Creek



Miles
0 0.25 0.5 1

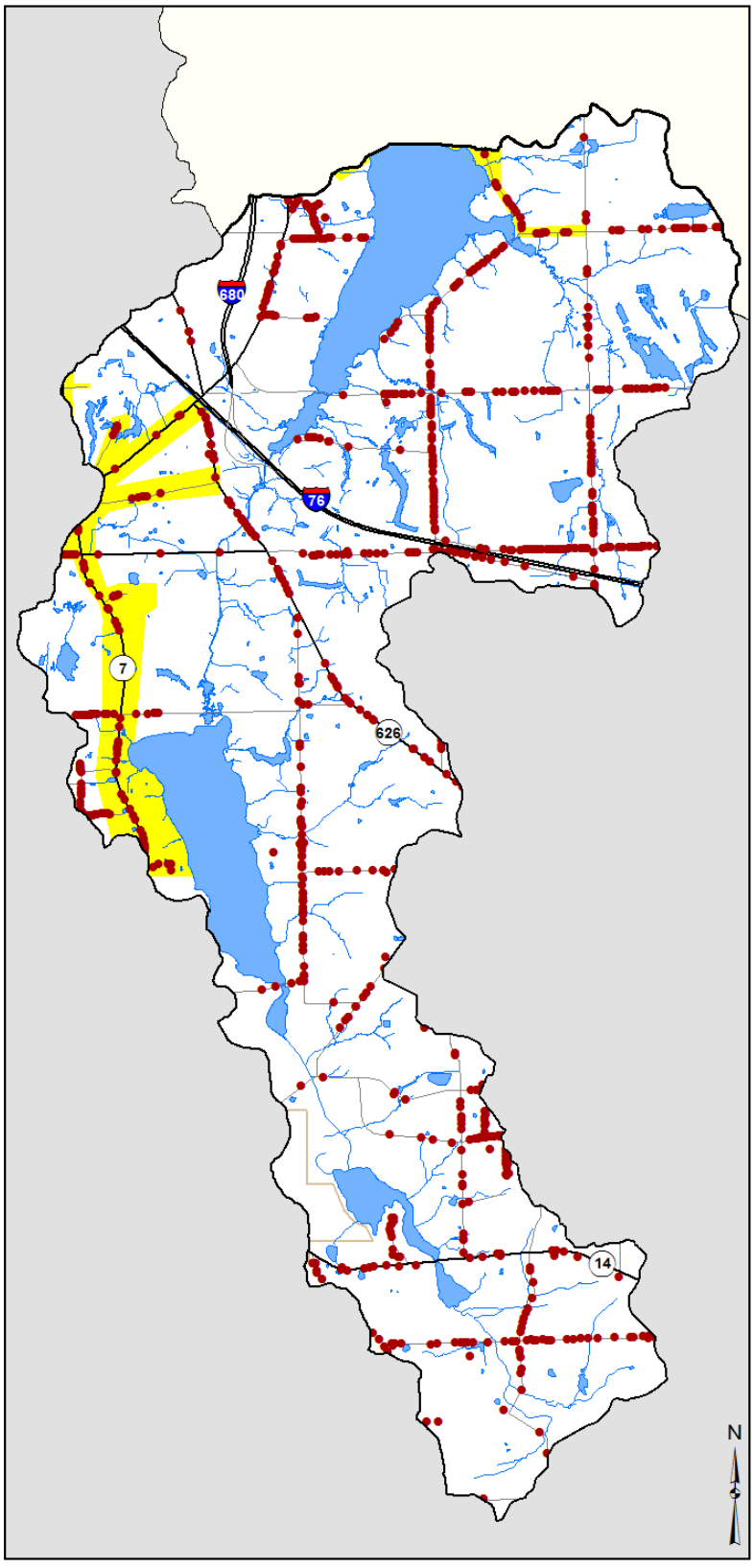
Septic System

Sewered, Existing and Planned

Source: Mahoning County Health Deaprtment, Columbiana County Health Department, 2013

Septic Systems and Sanitary Sewers

Sub-Watershed 50301030805
Headwaters Yellow Creek

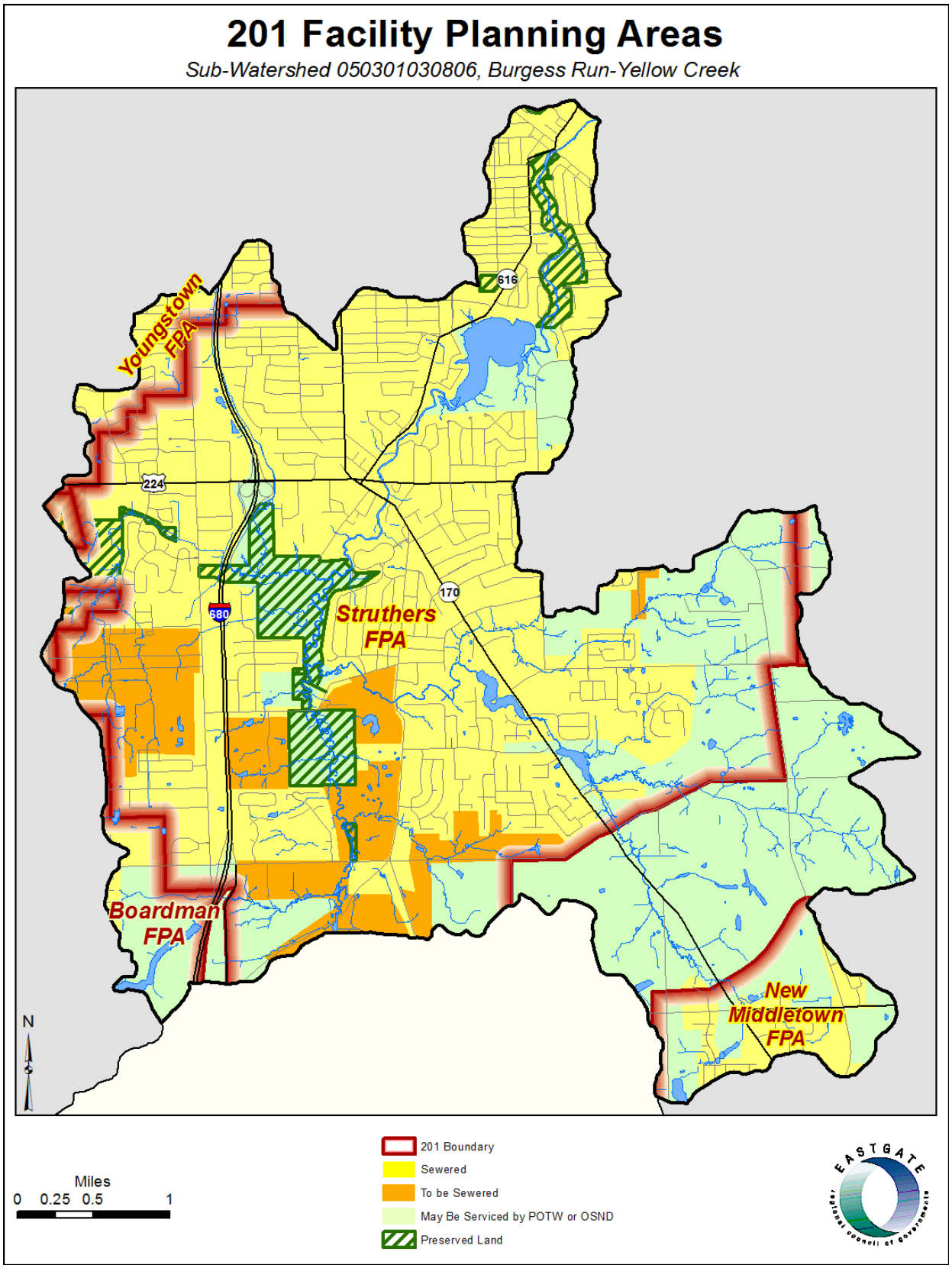


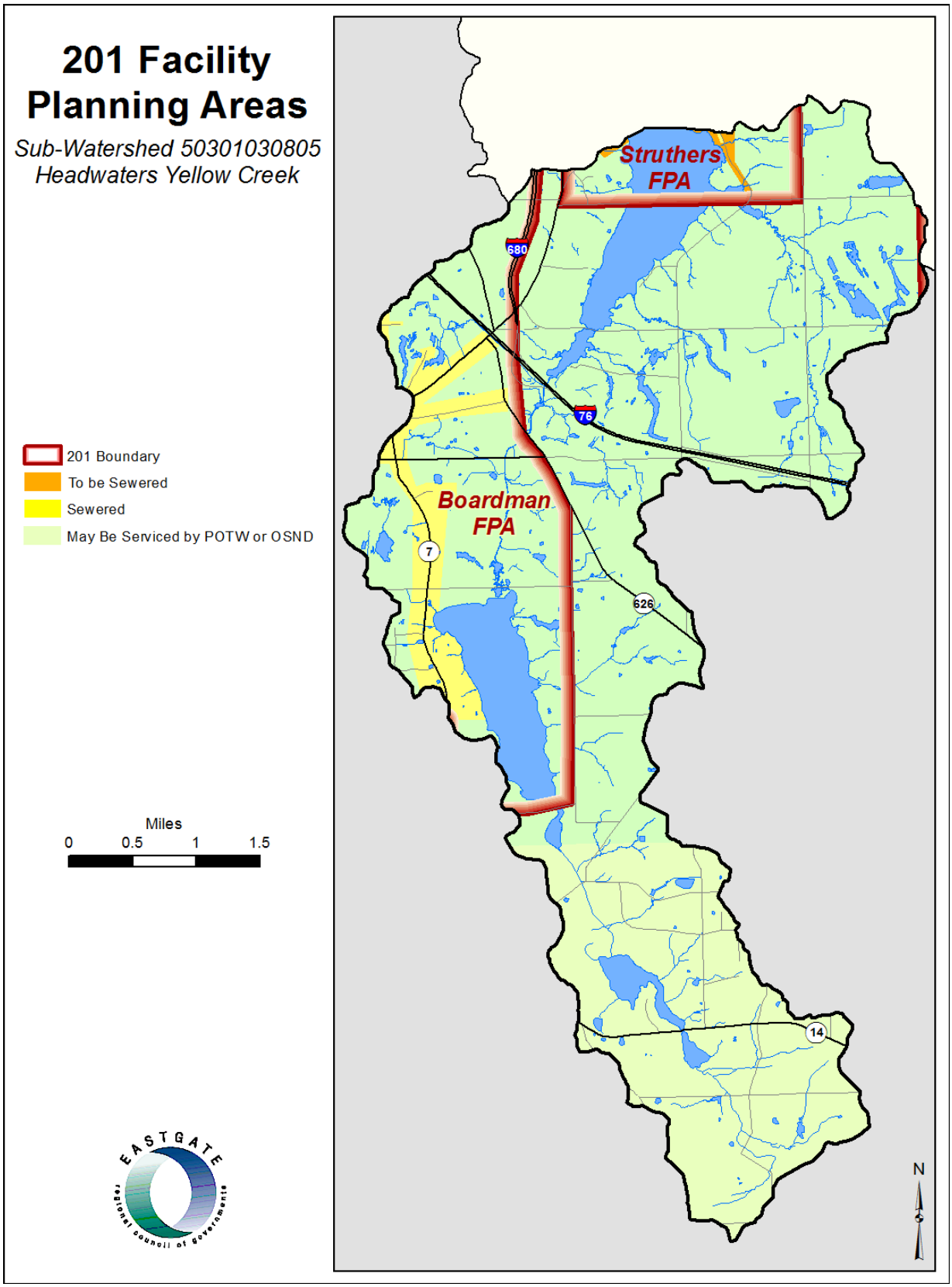
Septic System

Sewered, Existing and Planned

Miles
0 0.5 1 1.5

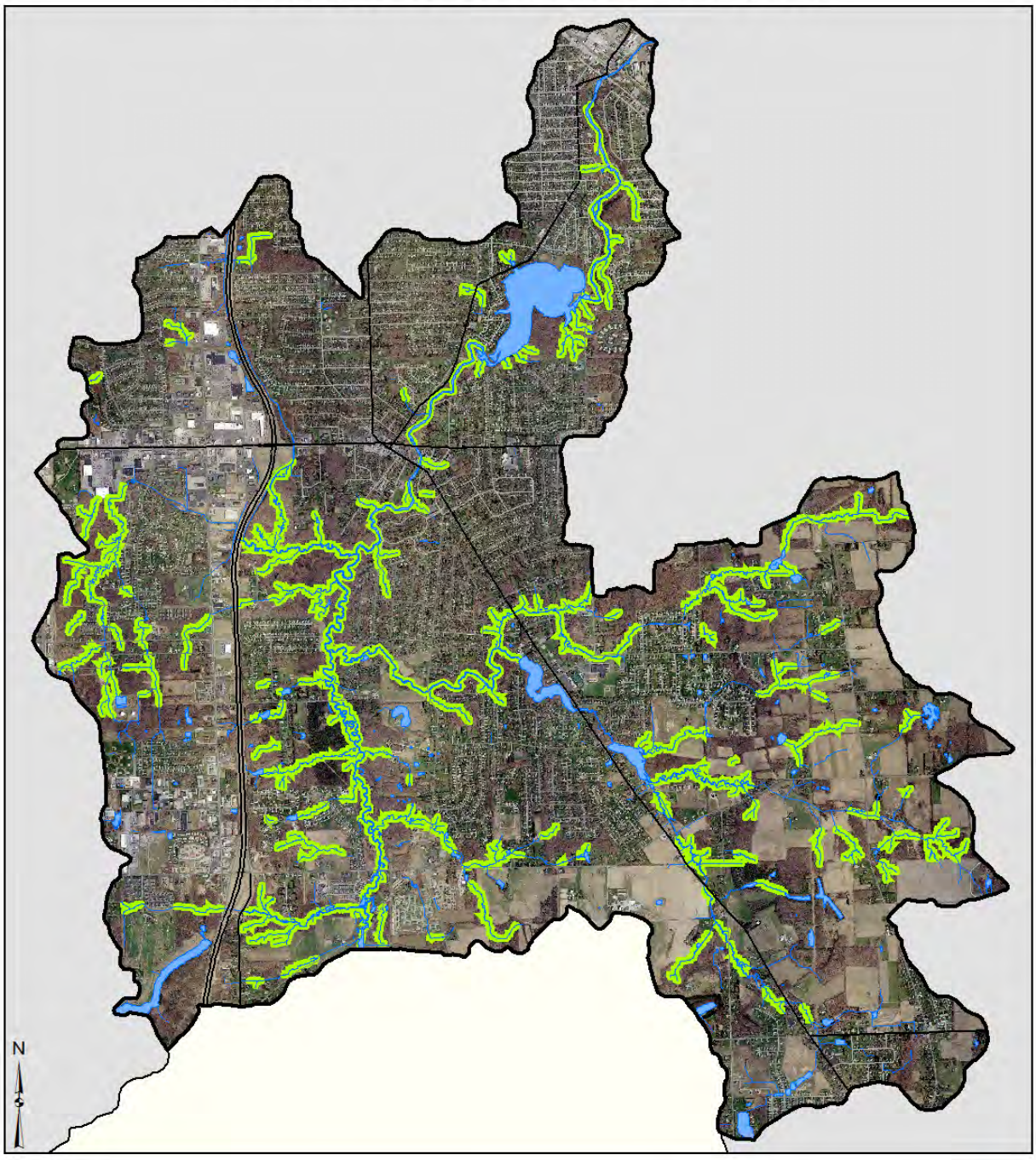
Source:
Mahoning County Health Department,
Columbiana County Health Department,
2013

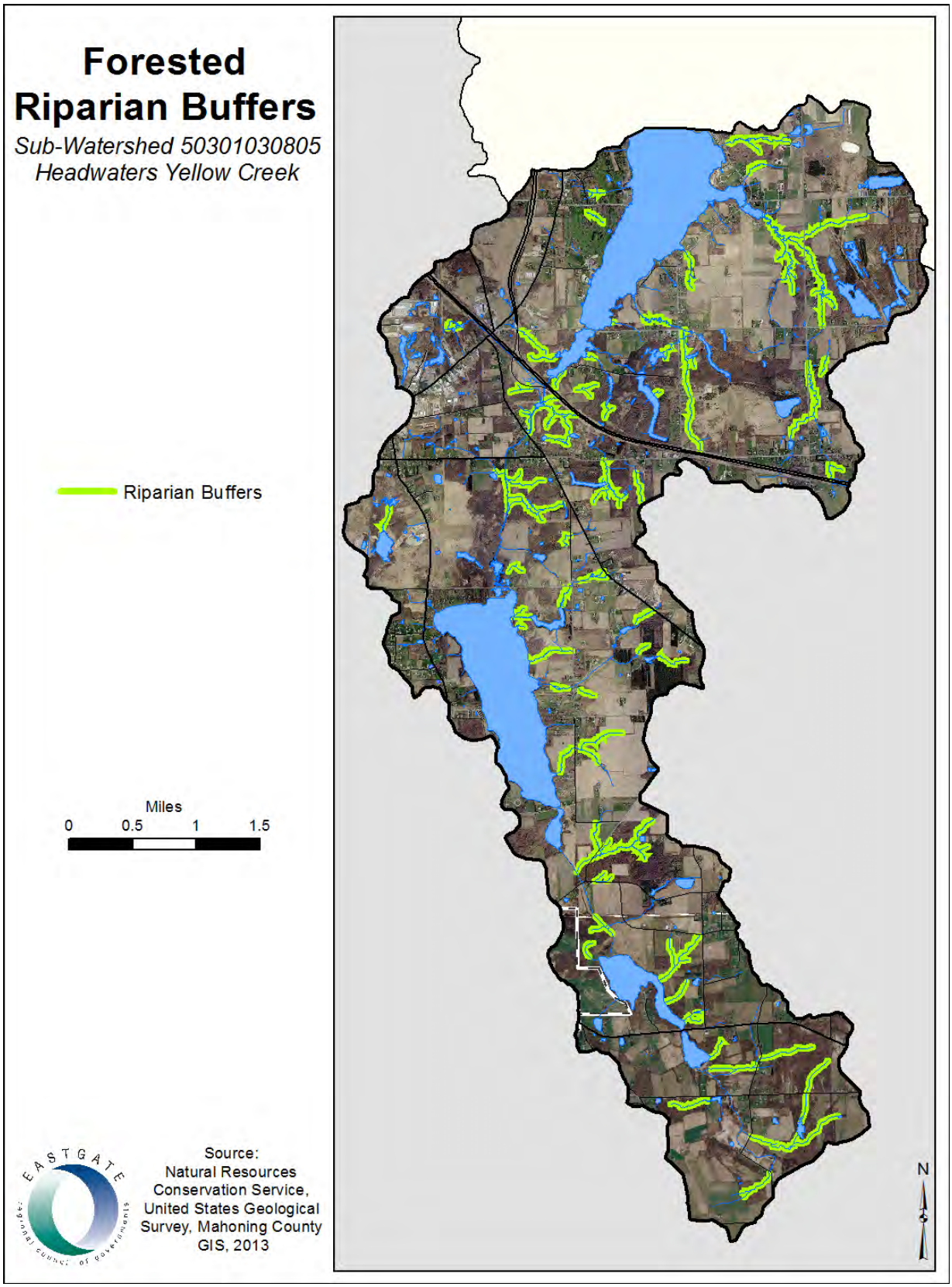

201 Facility Planning Areas
Sub-Watershed 050301030806, Burgess Run-Yellow Creek
Youngstown FPA
Struthers FPA
Boardman FPA
New Middletown FPA
616
224
680
170
N
Miles
0 0.25 0.5 1
201 Boundary
Sewered
To be Sewered
May Be Serviced by POTW or OSND
Preserved Land
EASTGATE
Regional Council of Governments


201 Facility Planning Areas
Sub-Watershed 50301030805
Headwaters Yellow Creek
201 Boundary
To be Sewered
Sewered
May Be Serviced by POTW or OSND
Miles
0
0.5
1
1.5
Struthers FPA
Boardman FPA
680
76
7
626
14
N
EASTGATE
regional council of governments

Forested Riparian Buffers

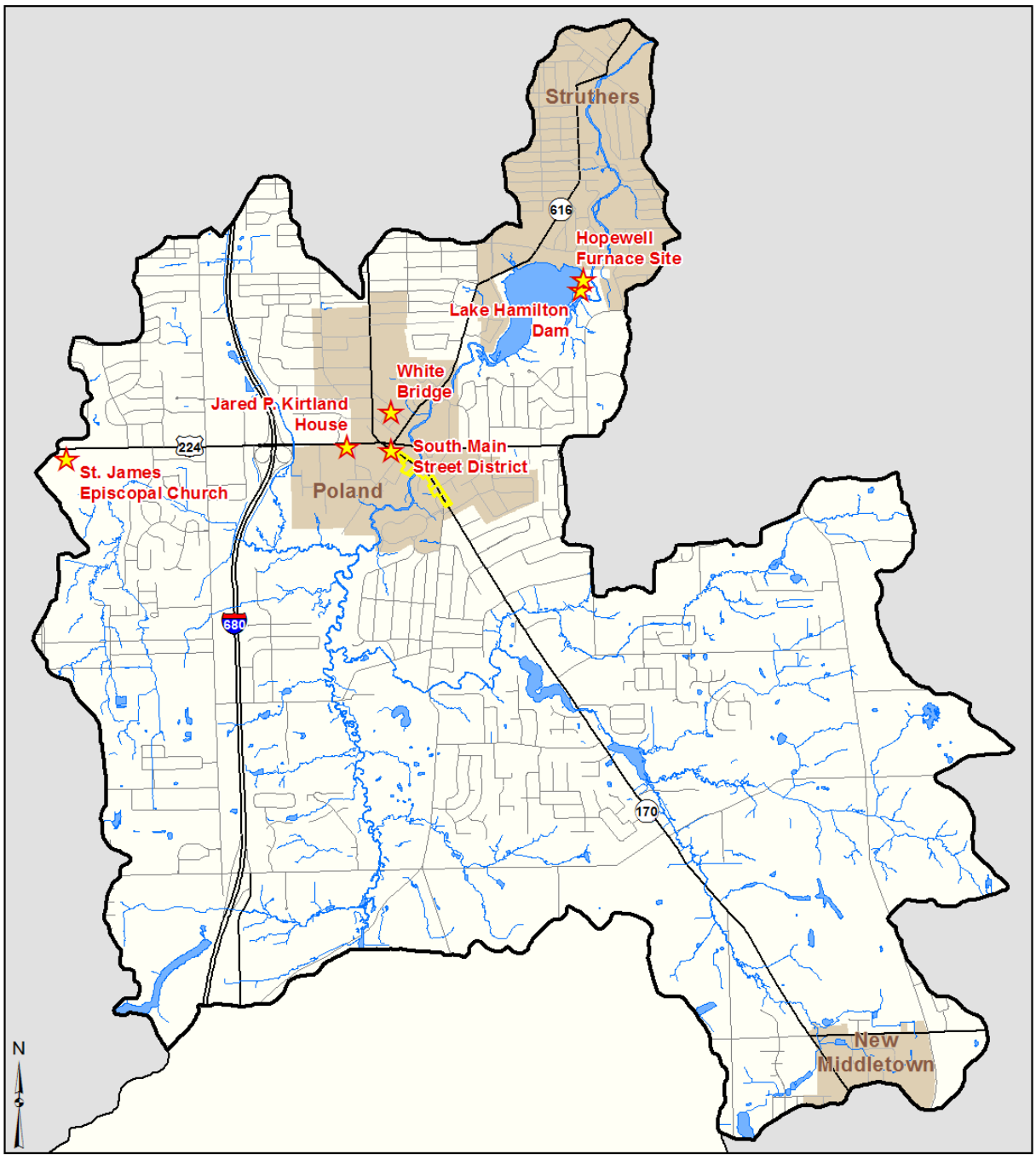
Sub-Watershed 050301030806, Burgess Run-Yellow Creek




Forested
Riparian Buffers
Sub-Watershed 50301030805
Headwaters Yellow Creek
Riparian Buffers
Miles
0
0.5
1
1.5
EASTGATE
regional council of governments
Source:
Natural Resources
Conservation Service,
United States Geological
Survey, Mahoning County
GIS, 2013
N

Historic Sites

Sub-Watershed 050301030806, Burgess Run-Yellow Creek



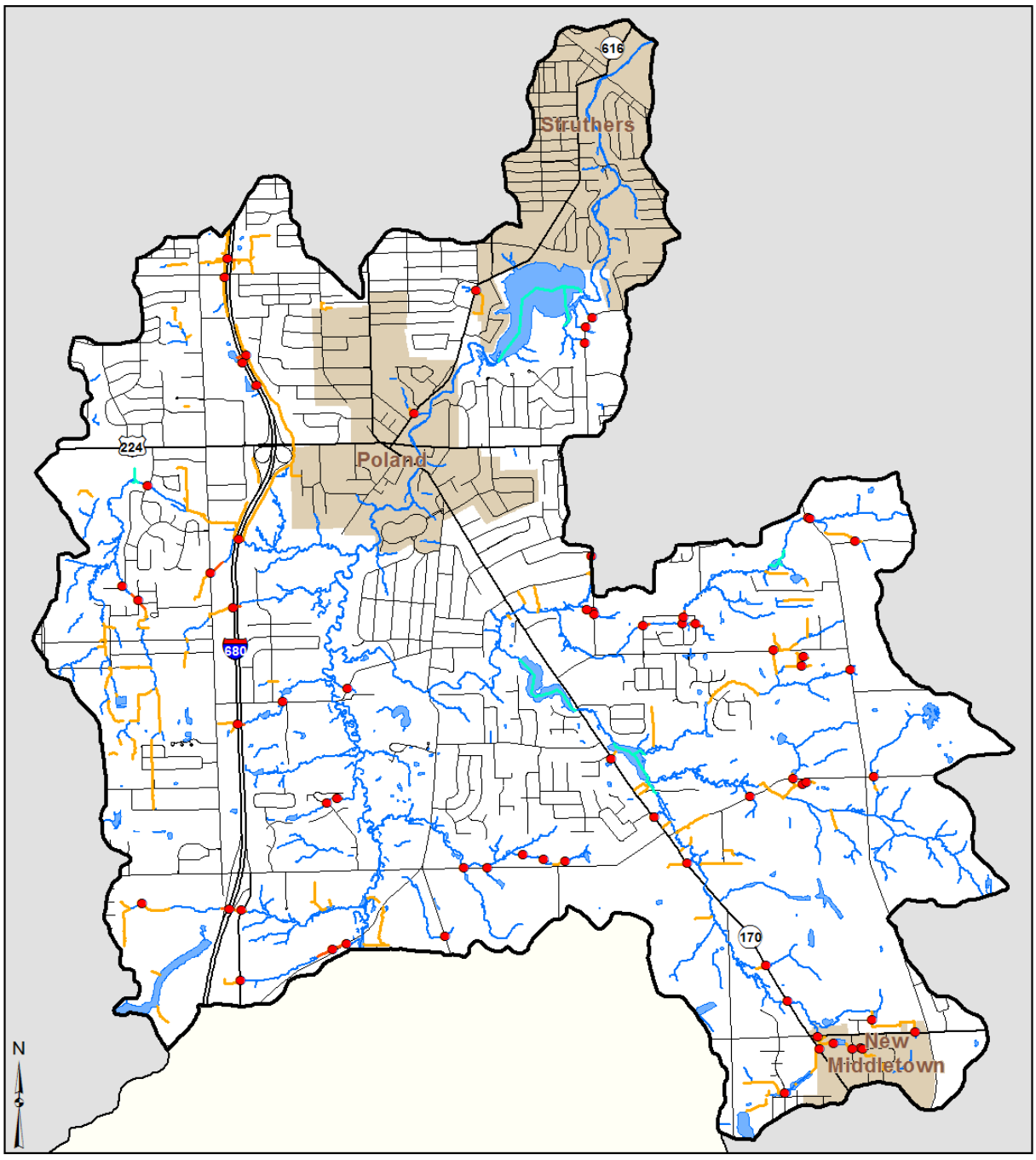
Miles
0 0.25 0.5 1

National Register Historic Site
National Register Historic District

Source:
National Register of
Historic Places, National
Park Service, 2013

Stream Types

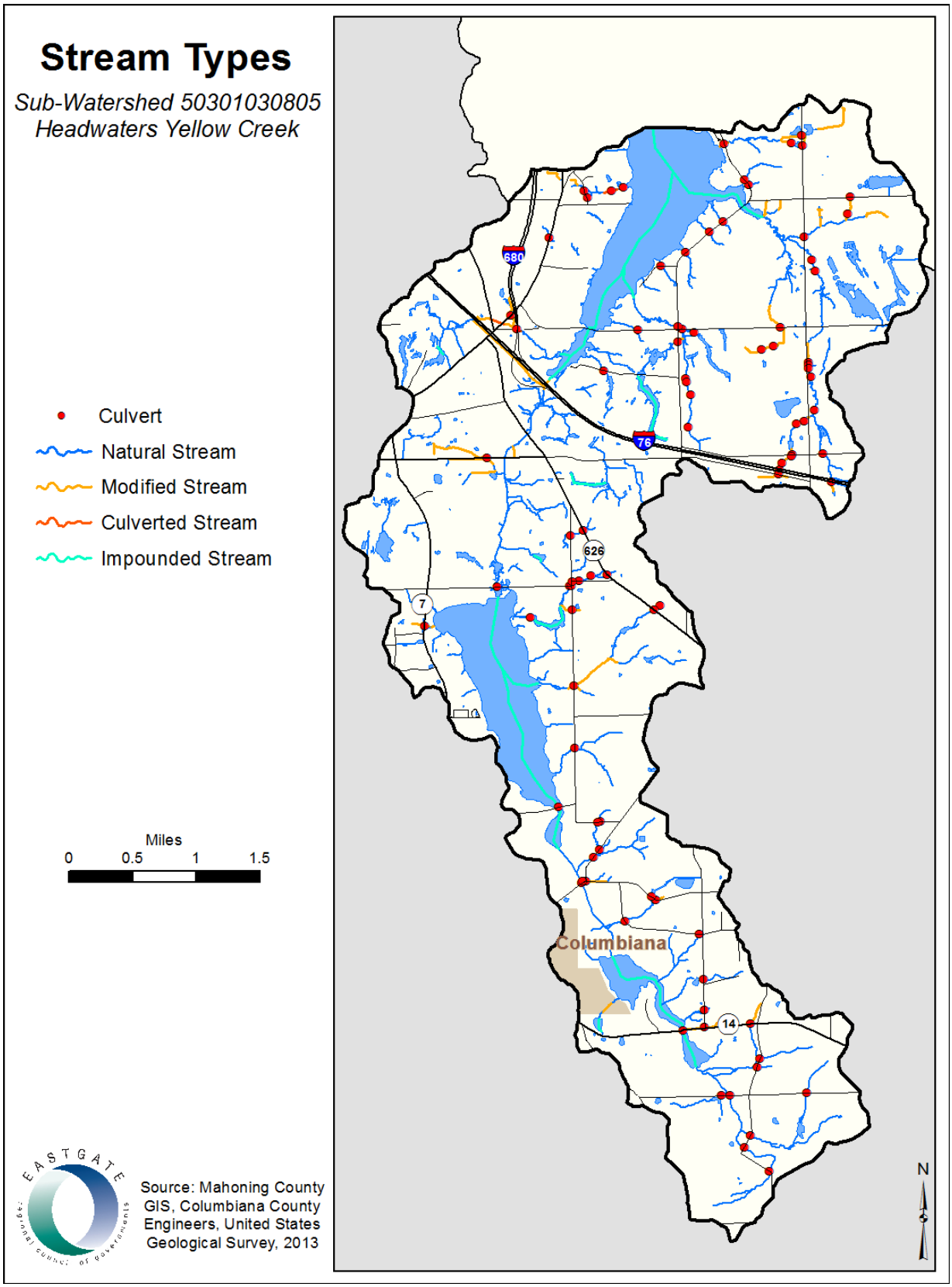
Sub-Watershed 050301030806, Burgess Run-Yellow Creek



Miles
0 0.25 0.5 1

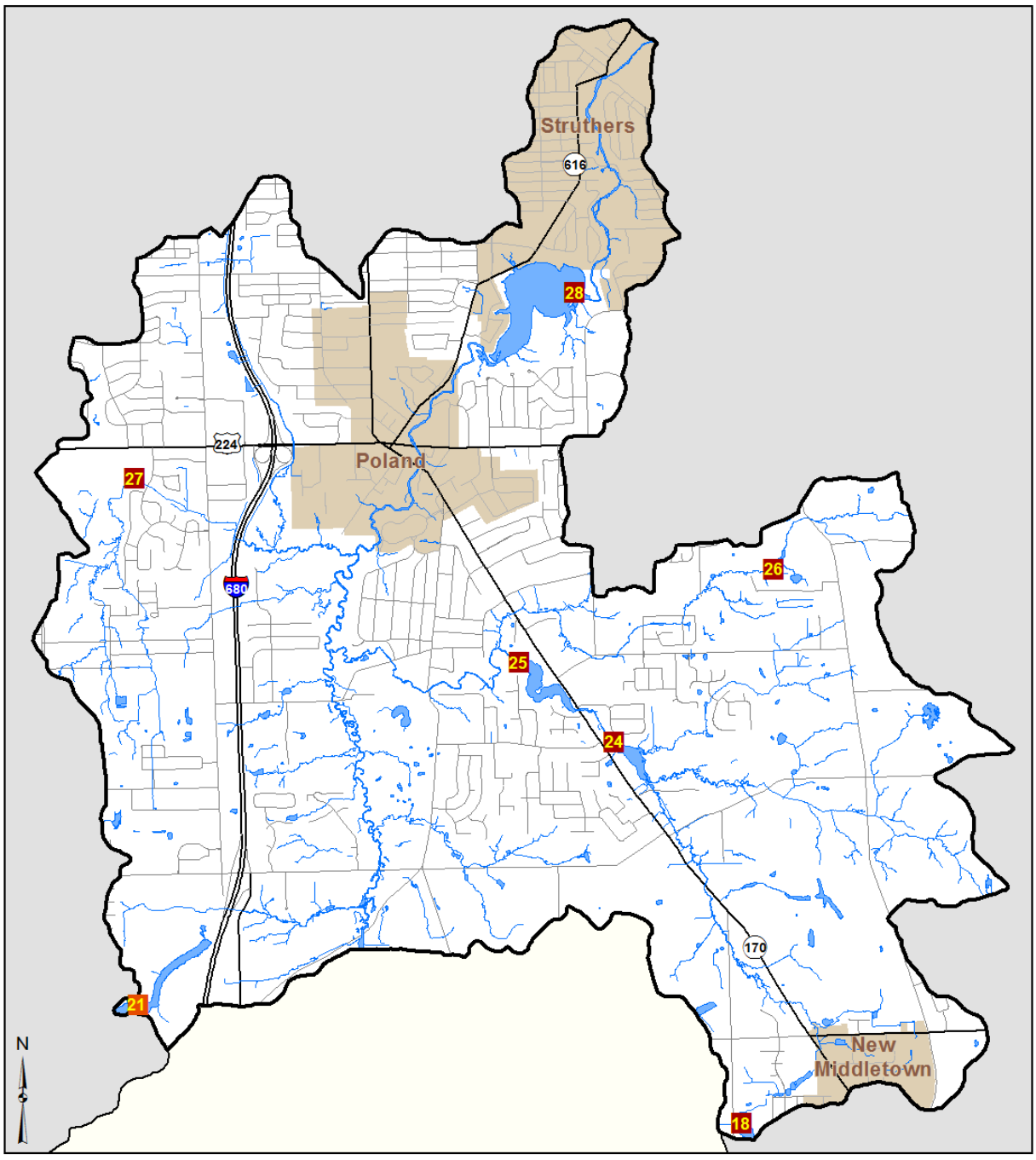
Culvert
Natural Stream
Impounded Stream
Modified Stream
Culverted Stream

Source: Mahoning County GIS, Columbiana County Engineers, United States Geological Survey, 2013


Stream Types
Sub-Watershed 50301030805
Headwaters Yellow Creek
Culvert
Natural Stream
Modified Stream
Culverted Stream
Impounded Stream
Miles
0
0.5
1
1.5
680
76
626
7
14
Columbiana
N
EASTGATE
Source: Mahoning County GIS, Columbiana County Engineers, United States Geological Survey, 2013

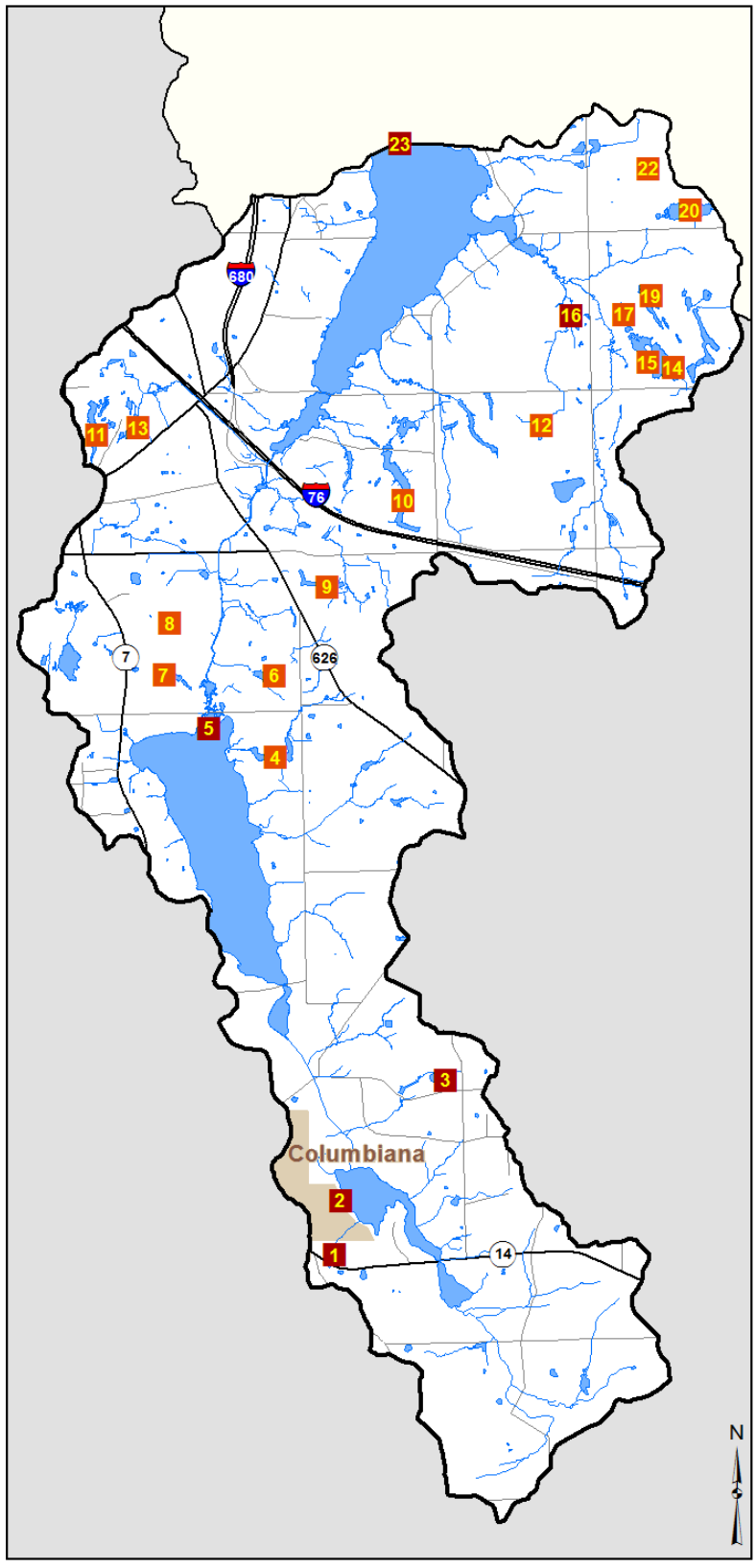
Dams and Impoundments

Sub-Watershed 050301030806, Burgess Run-Yellow Creek



Dams and Impoundments

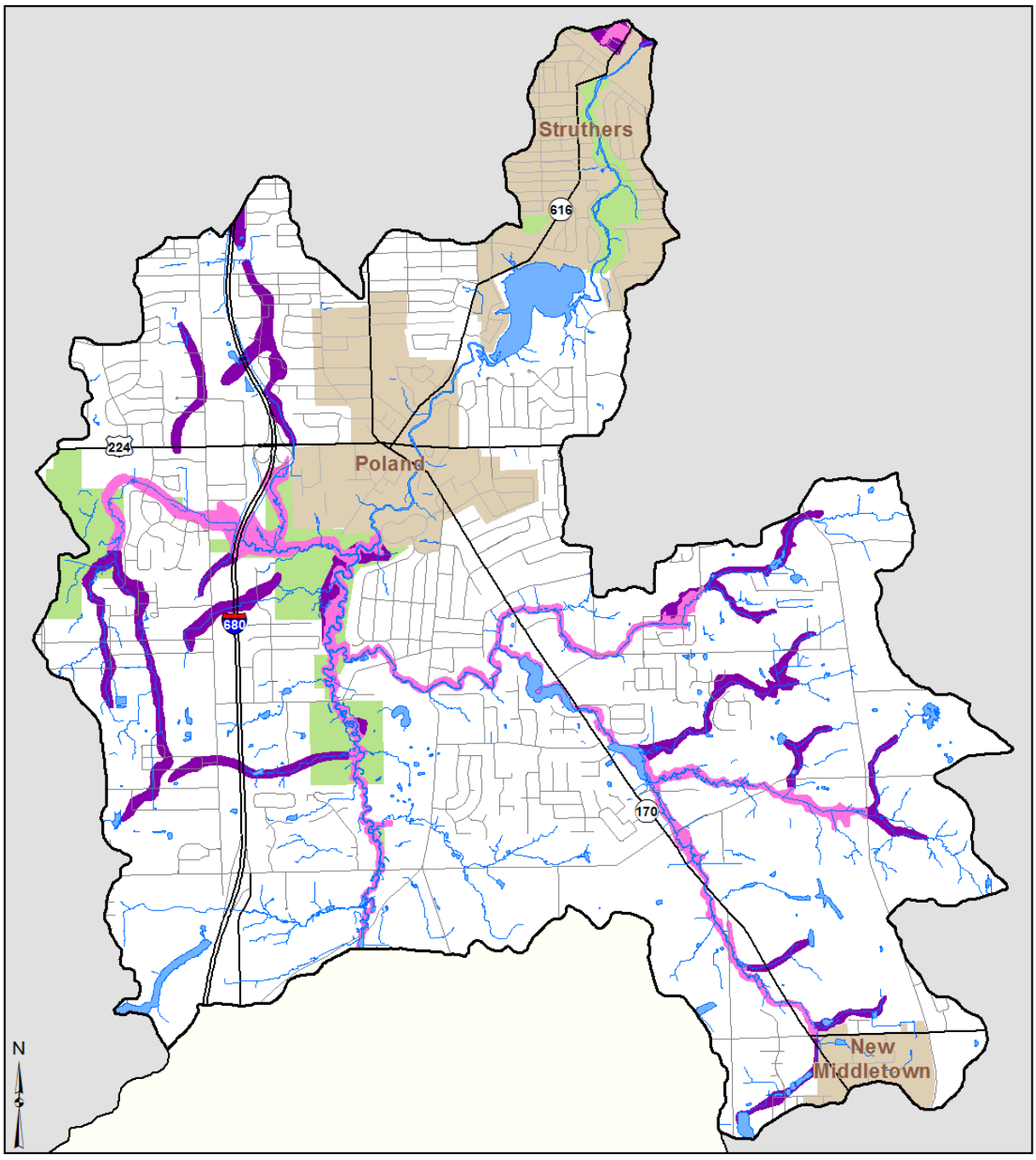
Sub-Watershed 50301030805
Headwaters Yellow Creek



Source: Ohio Department of Natural Resoures, 2013

Floodplains

Sub-Watershed 050301030806, Burgess Run-Yellow Creek



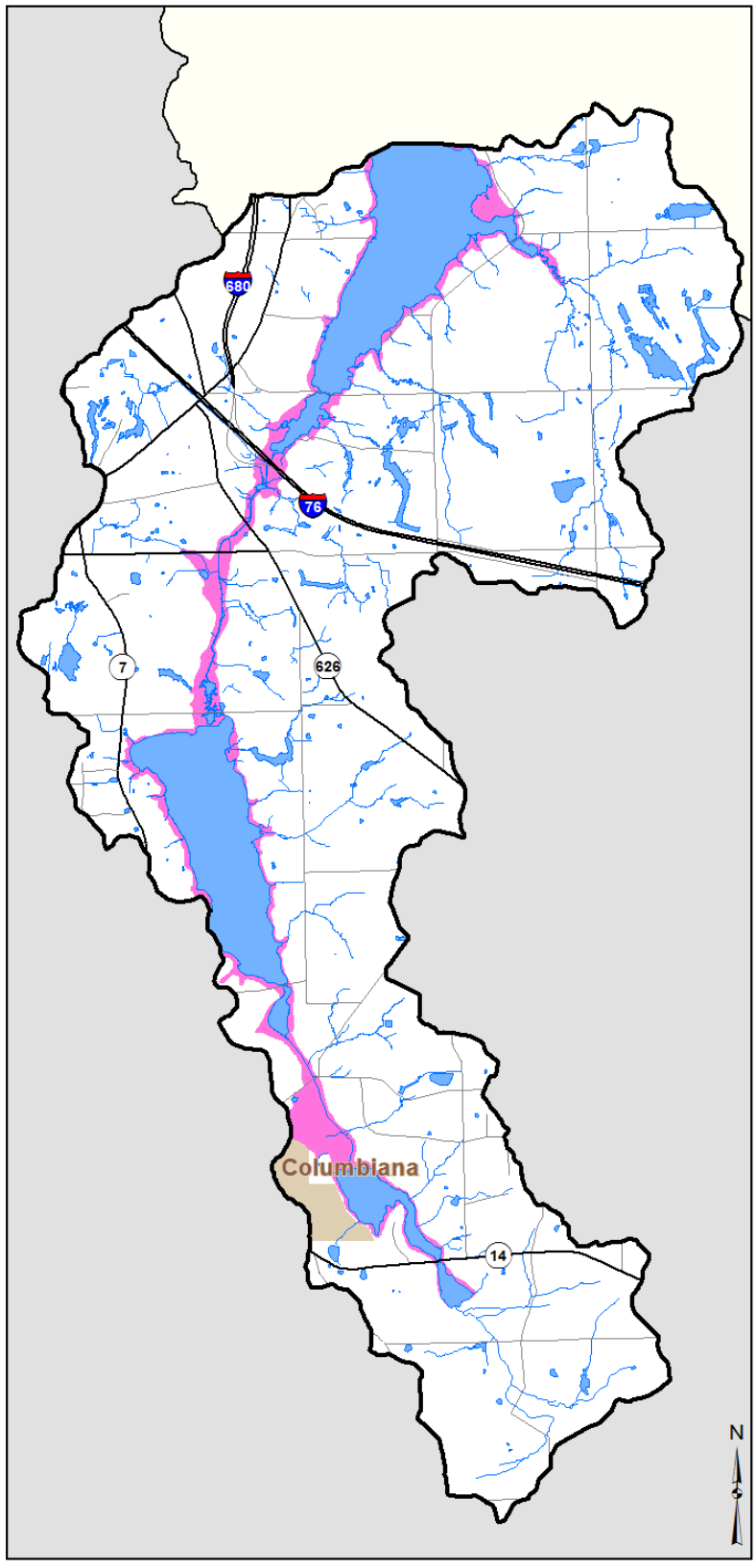
Miles
0 0.25 0.5 1

100-yr Floodplain
500-yr Floodplain

Source: Ohio Department of Natural Resources, Federal Emergency Management Agency, 2013

Floodplains

Sub-Watershed 50301030805
Headwaters Yellow Creek

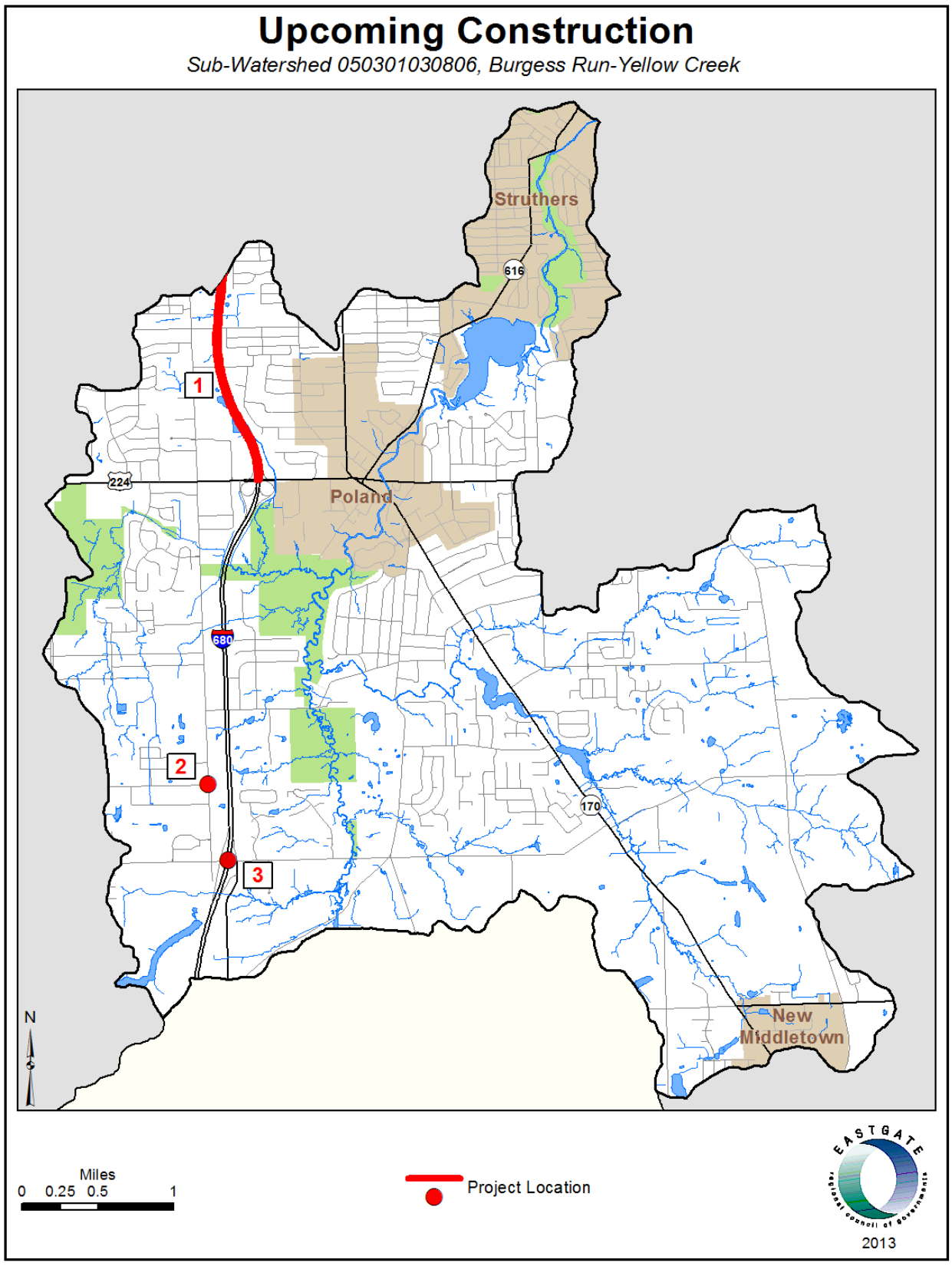


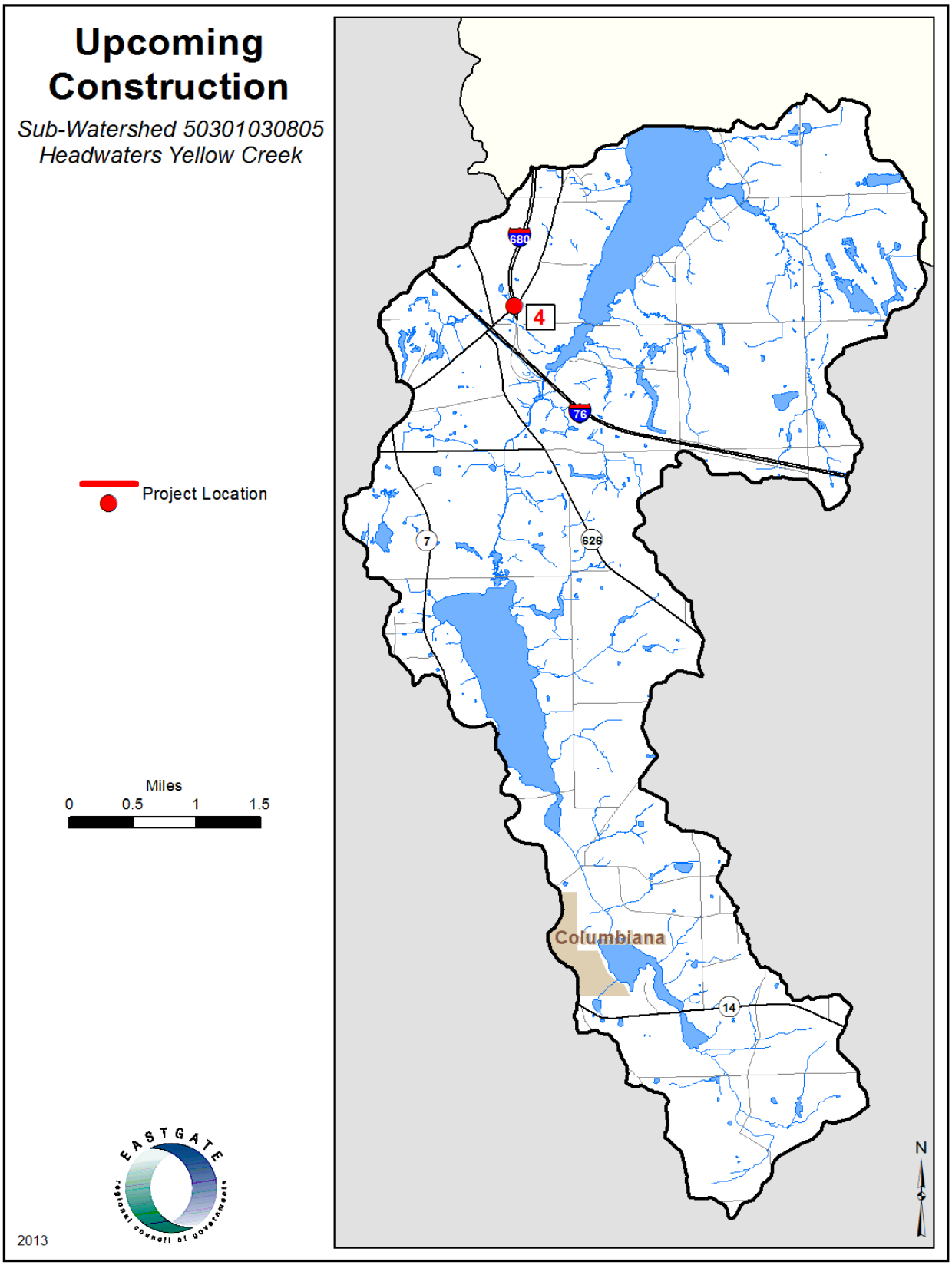
100-yr Floodplain
500-yr Floodplain

Miles
0 0.5 1 1.5

EASTGATE regional council of governments

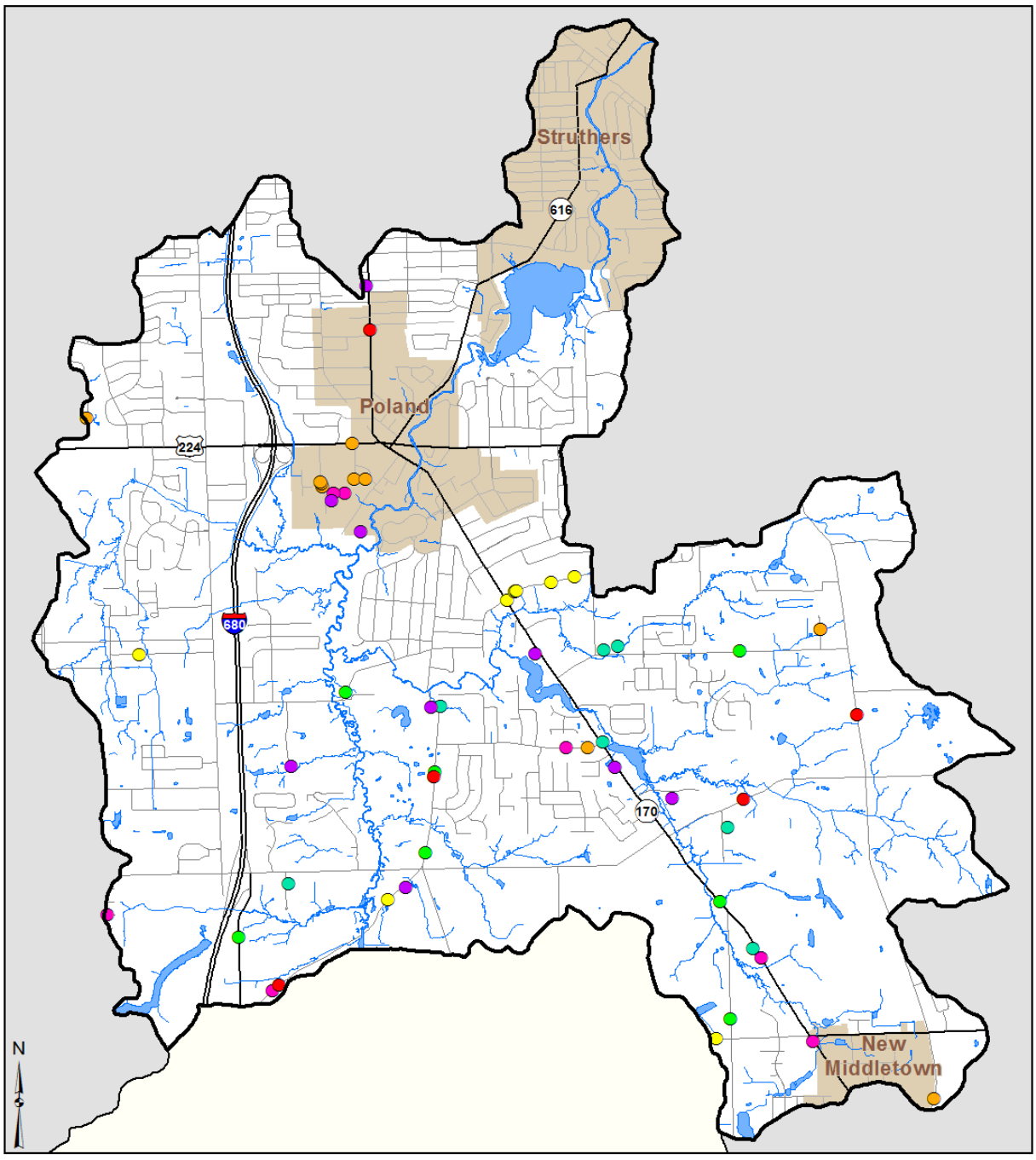
Source: Ohio Department of Natural Resources, Federal Emergency Management Agency, 2013


Upcoming Construction
Sub-Watershed 050301030806, Burgess Run-Yellow Creek
Struthers
Poland
New Middletown
616
224
680
170
1
2
3
N
Miles
0 0.25 0.5 1
Project Location
EASTGATE
regional council of governments
2013


Upcoming Construction
Sub-Watershed 50301030805
Headwaters Yellow Creek
Project Location
Miles
0 0.5 1 1.5
680
4
76
7
626
Columbiana
14
N
EASTGATE
regional council of governments
2013

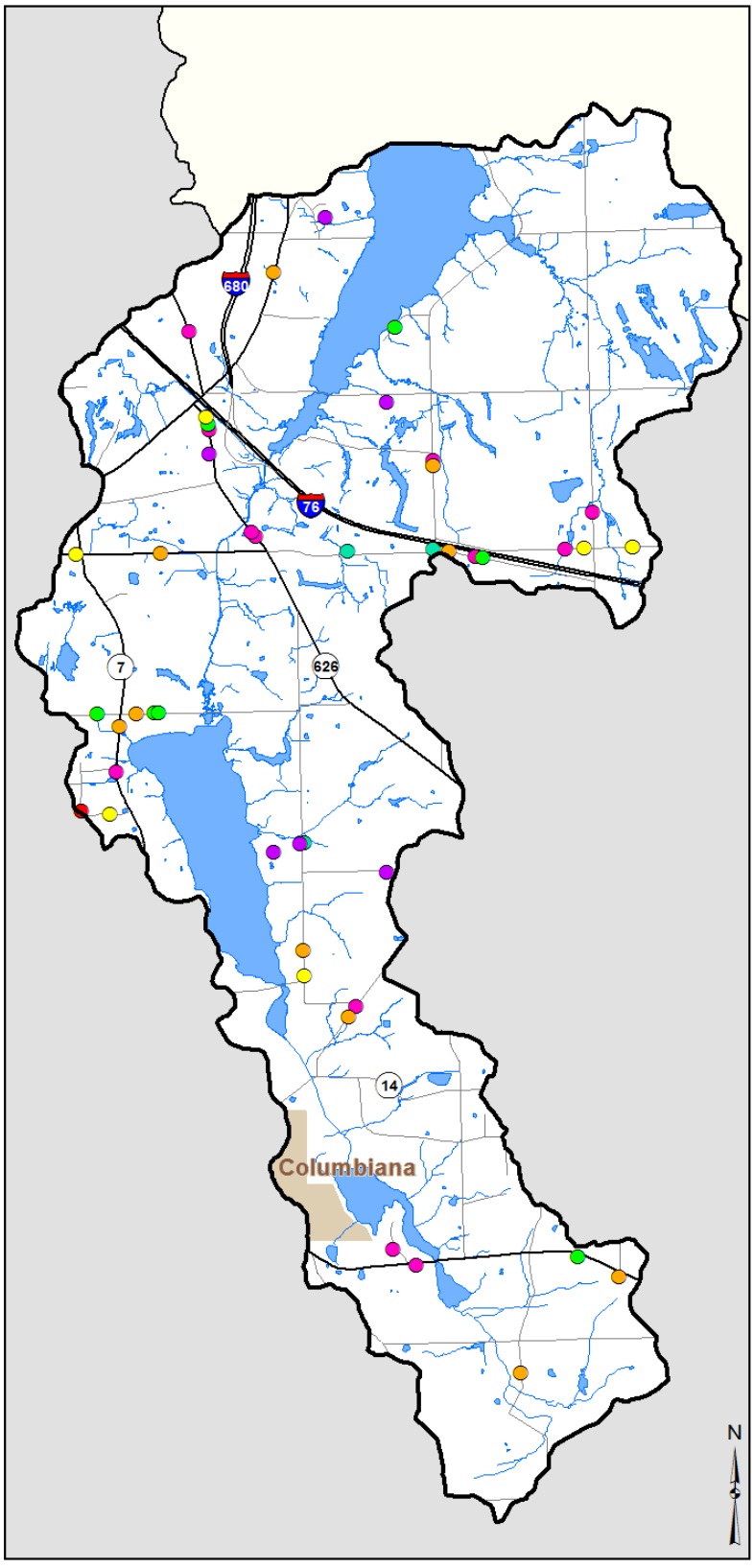
Failing Septic Systems

Sub-Watershed 050301030806, Burgess Run-Yellow Creek



Failing Septic Systems

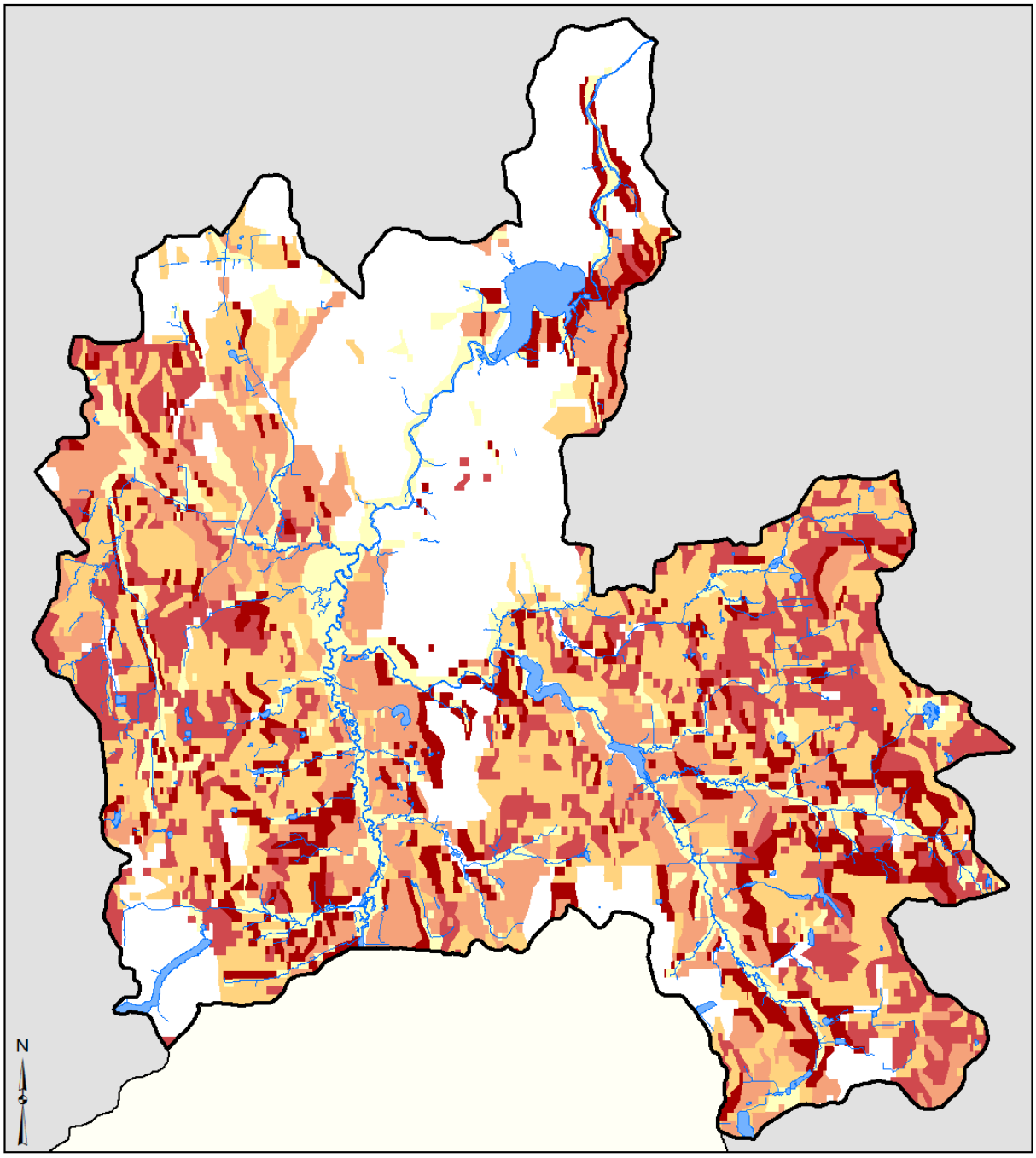
Sub-Watershed 50301030805
Headwaters Yellow Creek



Source:
Mahoning County Health Department, Columbiana County Health Department, 2013

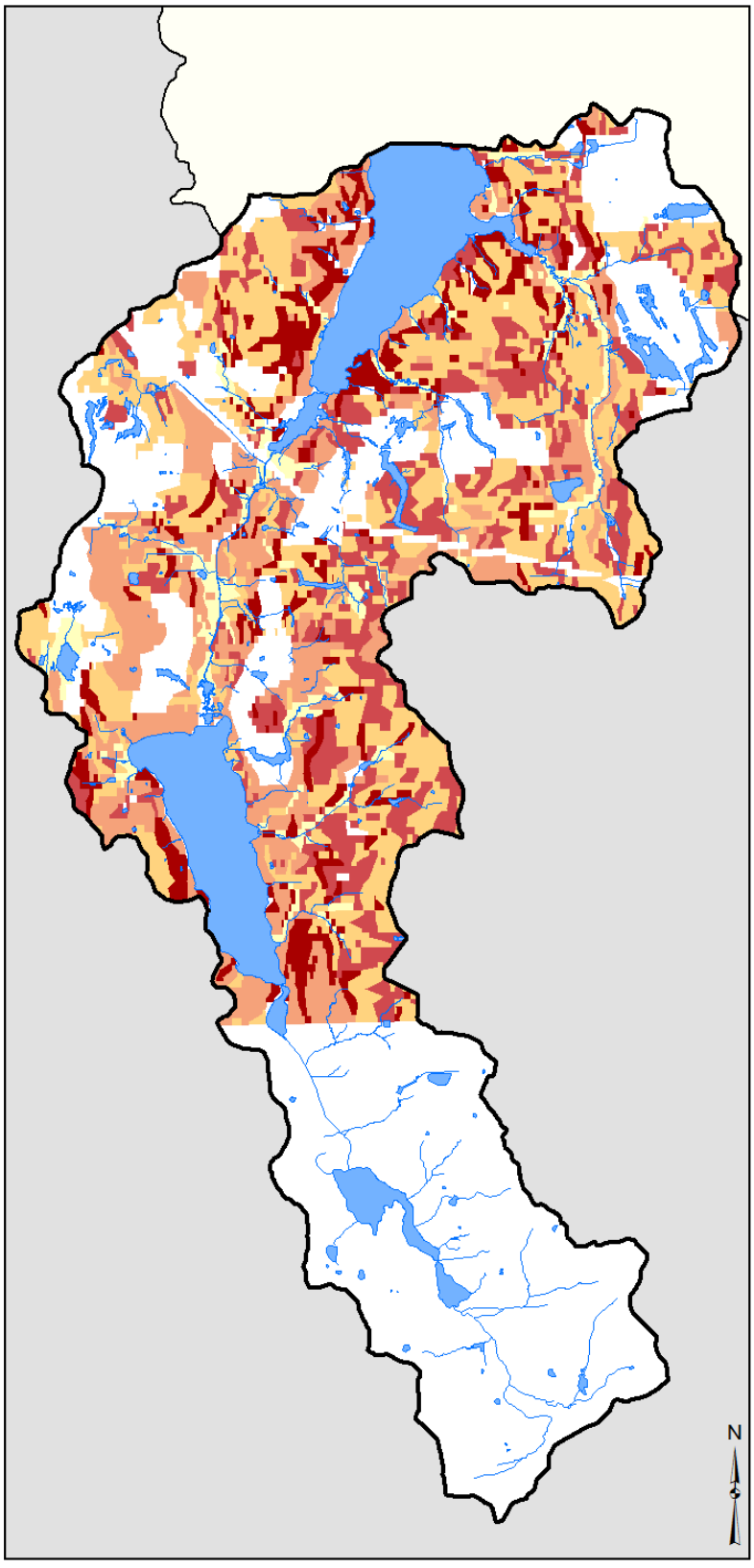
Erosion Potential of Bare Soil

Sub-Watershed 050301030806, Burgess Run-Yellow Creek



Erosion Potential of Bare Soil

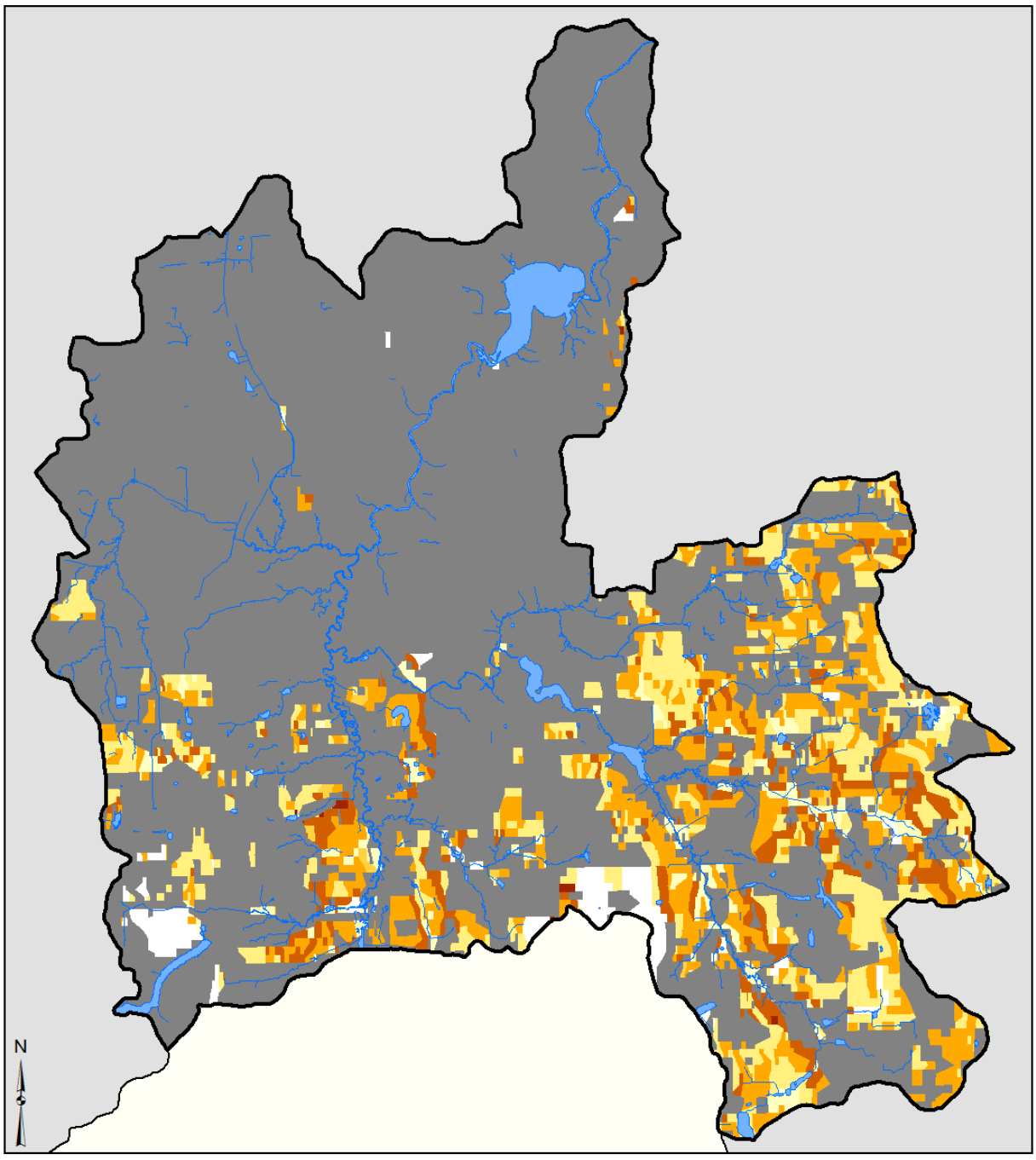
Sub-Watershed 50301030805
Headwaters Yellow Creek

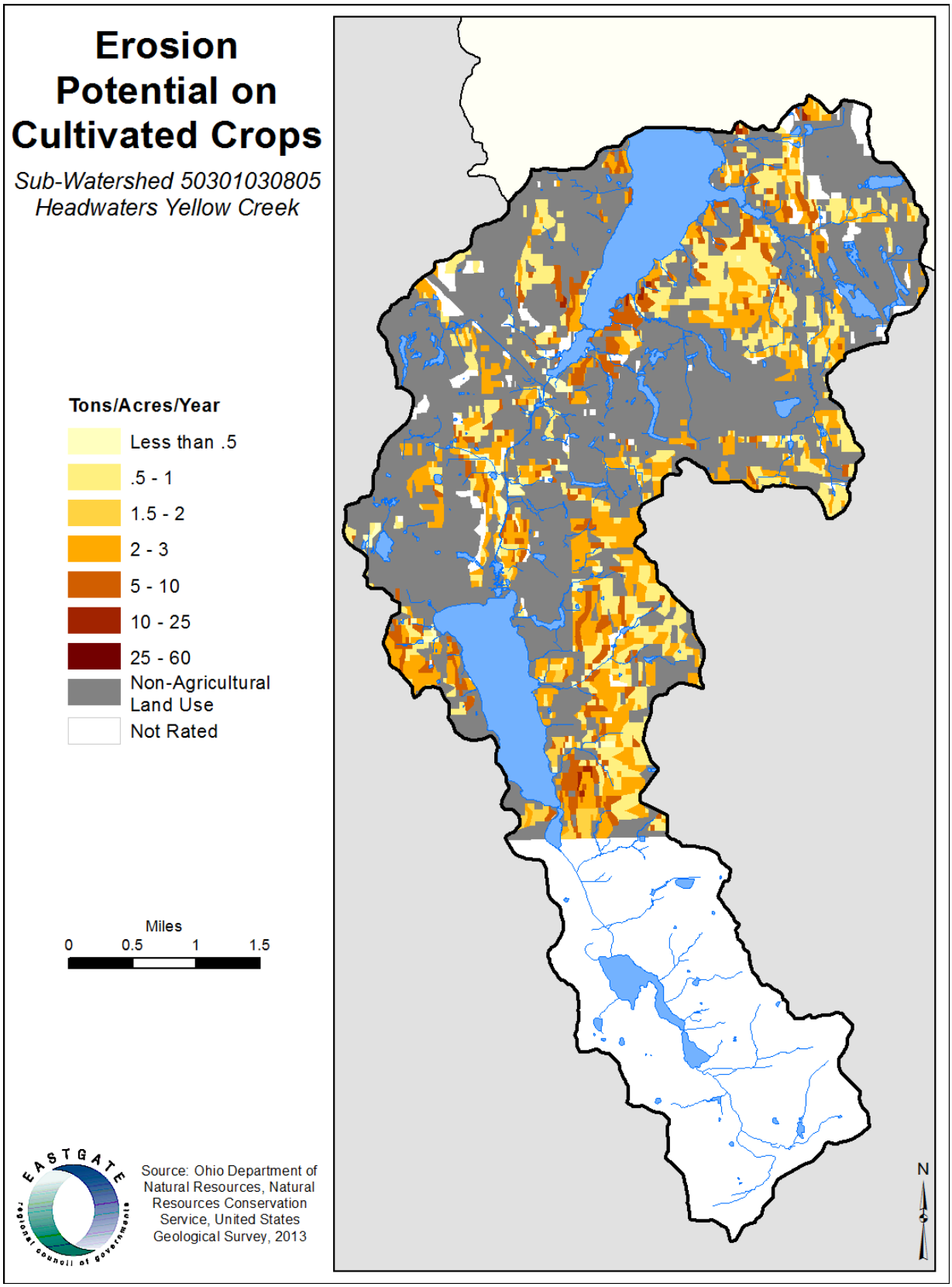


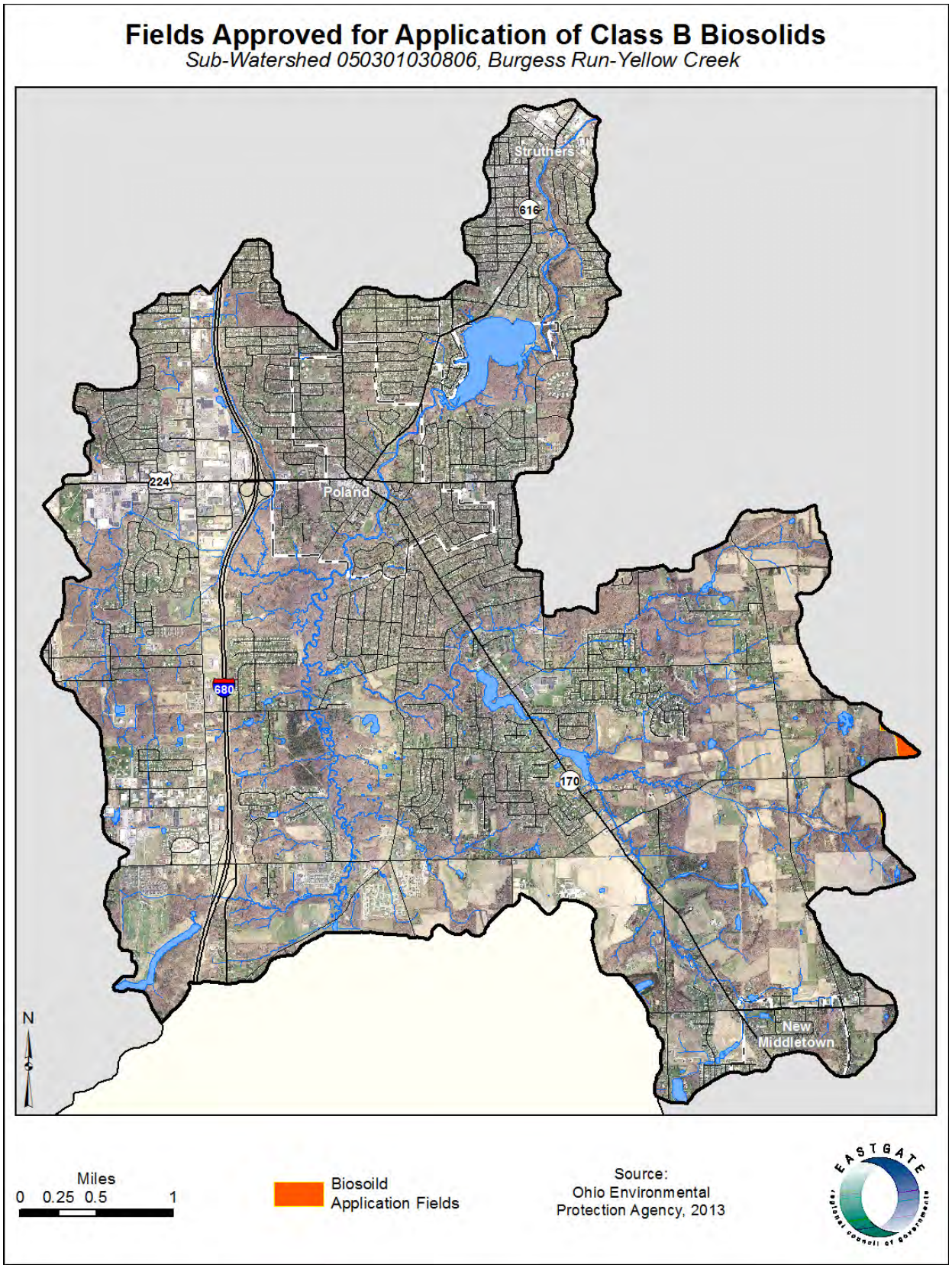
Source:
ODNR, NRCS,
USGS, Mahoning
County GIS, 2013

Erosion Potential on Cultivated Crops

Sub-Watershed 050301030806, Burgess Run-Yellow Creek




Erosion Potential on Cultivated Crops
Sub-Watershed 50301030805
Headwaters Yellow Creek
Tons/Acres/Year
Less than .5
.5 - 1
1.5 - 2
2 - 3
5 - 10
10 - 25
25 - 60
Non-Agricultural Land Use
Not Rated
Miles
0
0.5
1
1.5
N
EASTGATE
regional council of governments
Source: Ohio Department of Natural Resources, Natural Resources Conservation Service, United States Geological Survey, 2013


Fields Approved for Application of Class B Biosolids
Sub-Watershed 050301030806, Burgess Run-Yellow Creek
Struthers
616
224
Poland
680
170
New Middletown
N
Miles
0 0.25 0.5 1
Biosoild Application Fields
Source: Ohio Environmental Protection Agency, 2013
EASTGATE regional council of governments

Fields Approved for Application of Class B Biosolids

Sub-Watershed 50301030805
Headwaters Yellow Creek