NORTHEAST OHIO FOUR COUNTY REGIONAL PLANNING AND DEVELOPMENT ORGANIZATION

Nimishillen Creek Watershed - State Action Plan Update

DRAFT REPORT

September 2011

The preparation of this report was financed in part through a water quality management planning grant provided through the State of Ohio Environmental Protection Agency under the provisions of the American Recovery and Restoration Act (ARRA), and with funds from NEFCO's dues-paying members.

This report is submitted in fulfillment of Deliverable 4, from NEFCO's Scope of Work, Exhibit 1-A of NEFCO's water quality management contract with Ohio EPA. The scope calls for NEFCO to update the Nimishillen Creek Watershed Action Plan including the addition of any urban flooding and ditch clean out projects and the assessment of current agricultural drainage needs.

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I. Introduction

Purpose

The intent of the Nimishillen Creek Watershed Action Plan is to:

1. Develop a plan to protect and/or restore the water quality of the Nimishillen Creek and its tributaries to meet state water quality standards and ensure the health and safety of watershed residents.
2. Raise public awareness, especially among the watershed's residents, of the pollution sources and solutions in the Nimishillen Creek Watershed.
3. Consolidate existing watershed information from previous reports and studies into a single user-friendly report; as well as, create a reporting format that can easily be updated when new information becomes available.

Fundamental Water Quality Goals

1. Restore to state water quality standards the Nimishillen Creek and its tributaries.
2. Restore and protect the riparian corridor.
3. Reduce water quantity (flooding) problems in the watershed.

Watershed Issues Overview

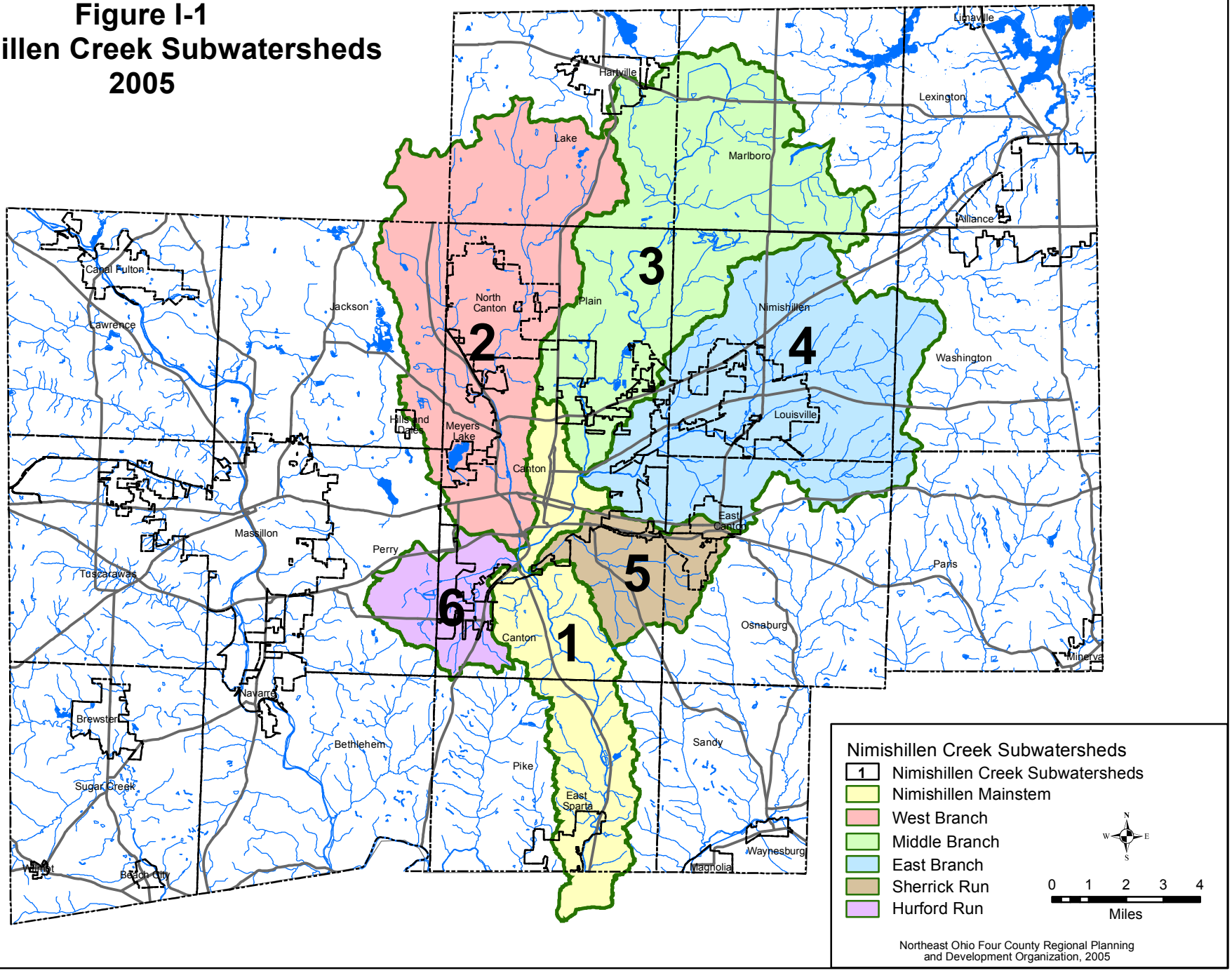
The Nimishillen Creek Watershed is located in a diverse portion of Northeast Ohio containing agricultural areas, suburban development, historic urban cities, and heavily industrial areas (Figure I-1). As would be expected with such a rich mix, issues affecting water quality in the watershed are equally diverse. Specific water quality issues and needed actions are discussed at length in the subwatershed plans located in Section VII; however, similar issues face many of the Nimishillen Creek basins. The primary issues to be addressed in the plan are:

- Promote Environment Education and Outreach
- Protect and Restore Riparian Corridors
- Reduce Pollution from Failing Wastewater Treatment Systems
- Ameliorate Impacts from Acid Mine Drainage
- Diminish the Impacts from Storm Water Runoff from Urban, Suburban, Agriculture, and Industrial Areas
- Protect and Restore the Floodplain

Updates and Revisions

Maintenance and revisions of the Nimishillen Creek Watershed State Action Plan will be the primary responsibility of the Northeast Ohio Four County Regional Planning and Development Organization (NEFCO). NEFCO is the designated water quality planning agency for Stark and Summit Counties and conducts regional planning on various issues, including watershed management. Updates and revisions will be made as new or updated information becomes available, as projects are completed, and/or as the plan's goals are achieved.

Figure I-1
Nimishillen Creek Subwatersheds
2005



Nimishillen Creek Watershed Partners

Originally formed in 2002, The Nimishillen Creek Watershed Partners is a voluntary group consisting of Nimishillen Creek stakeholders with the mission "to promote the restoration of the Creek's water quality to fishable, swimable standards and the protection of the Creek corridor." Stakeholders involved with the watershed partners come from various sectors, including citizens, local/elected government officials, the business and industrial community, park districts employees, farmers, teachers, and students. Membership is open to individual, family, or organization that subscribes to the purposes of the watershed partners. The Nimishillen Creek Watershed Partners' officers are listed below, but a general list of the Partners members are not listed due to privacy concerns. Contact the Watershed Partners Secretary for more membership information. The Watershed Partners is not a 501(c)3 organization and has no immediate plans to become this type of nonprofit organization.

Structure

The Nimishillen Creek Watershed Partners adopted bylaws in June, 2004 (Appendix B). Members nominate and elect a Core Committee to direct the groups activities. Up to fifteen members can be elected to the Core Committee with at least five Committee members being residents of Nimishillen Creek Watershed. They can appoint non-voting members from state, federal, or regional agencies to serve on the committee. Core Committee members are elected to a four-year term.

The Nimishillen Creek Watershed Partners also elect officers from the Core Committee members. The Chair must be a Nimishillen Creek Watershed resident, while the Vice-Chair and Secretary can be any member of the Core Committee. All officer positions are serve a two-year term. A treasury will be appointed by the Core Committee should it become necessary.

Current Officers

Chair: Jan Lukens, Marlboro Township Resident
Vice-Chair: Darrin Petko, Stark County Park District
Secretary: Eric Akin, NEFCO

Development of the Action Plan

The Nimishillen Creek Action Plan is the continuation of efforts started by NEFCO in the 1990s to develop the Nimishillen Creek Comprehensive Watershed Management Plan (CWMP). The CWMP was divided into four phases and included a riparian zone analysis, land use/land cover data, information on potential pollution sources, an general action plan, and a home sewage treatment system plan. The first two Phases of NEFCO's plan were completed in 2000, Phase III was finished in 2001, and the fourth Phase in 2003. The CWMP was developed with considerable input and guidance for local and statewide stakeholders.

However, an update Nimishillen Creek CWMP was needed to reflect the current watershed planning standards, new water quality programs, and information that has become available since its completion. Specifically, the action plan portion of the CWMP (Phase III) was completed prior to the new watershed action plan endorsement standards from Ohio Environmental Protection Agency (EPA) and the Ohio Department of Natural Resources. The previous NEFCO plan was also completed prior to new regulations such as the National Pollution Discharge Elimination System (NPDES) Storm Water Program Phase II, Ohio EPA's Total Maximum Daily Load (TMDL) program, and NEFCO's water quality monitoring efforts.

In 2010, NEFCO initiated a review an update of the Action Plan to include new and updated information and programs. Specifically, the update incorporates data and recommendations contained in the Nimishillen Creek TMDL which was approved by U.S. EPA on December 16, 2009. The update also includes new information regarding the home sewage treatment system plan.

This report is a stand alone plan that consolidates information from the previous phases of the Nimishillen Creek CWMP, includes new programs and regulations, and provides the most up to date information about the watershed. This Action Plan was completed with continued input and review from Nimishillen Creek stakeholders.

The Action Plan has been accepted by the NEFCO General Policy Board consisting of government officials from Stark, Summit, Portage, and Wayne Counties. Their resolution is included after the title page. The Nimishillen Creek Watershed Partners will officially endorse the plan once it has been fully endorsed by the State. The Watershed Partners and the Watershed Coordinator will then solicit endorsement from the municipalities and townships within the Nimishillen Creek Watershed.

Education, Marketing Strategies, and Outreach Goals

The education strategies are clearly described in the Subwatershed Plan portion (Section VII) of this plan. In general, education will be target to people who can provide the greatest benefit for stream protection and restoration. That would include such stakeholders as riparian landowners, elected officials, and educators. This will include getting stakeholders "hands-on" experience with watershed work through activities such as creek clean-ups and volunteer water quality monitoring.

A marketing strategy was not developed for inclusion in this plan. One will be developed in the future if needed.

II. Watershed Inventory

Introduction

The intent of the Nimishillen Creek Action Plan is to protect and/or restore the water quality of the Nimishillen Creek and its associated tributaries by developing a Comprehensive Watershed Management Plan (CWMP) following endorsement guidelines established by the State of Ohio. This watershed inventory provides information needed to address water quality issues, like data on water resource, geology, socioeconomic factors, land usage, and cultural resources. Each section in the inventory was completed using the most up to date information available.

Watershed Information and Map

The Nimishillen Creek is located primarily in Stark County in Northeast Ohio. The watershed's unique Hydrologic Unit Code (HUC) number is 05040001 05. It is further divided into six 12-digit HUC subwatersheds which are listed in Table II-1

Table II-1: 12-Digit Hydrologic Unit Code (HUC) Subwatershed in the Nimishillen Creek Watershed

Subwatershed	HUC Number	Size (acres)
Middle Branch	05040001 05 01	16,192
Middle Branch	05040001 05 04	16,640
East Branch	05040001 05 02	29,824
West Branch	05040001 05 03	29,888
Mainstem	05040001 05 05	14,592
Mainstem	05040001 05 06	13,184

For this report, the two Middle Branch watersheds (HUCs 05040001 05 01 and 05040001 05 04) were combined into one subwatershed for the Middle Branch. This is the Nimishillen Creek Watershed 3 shown in Figure I-1. Similarly, the two Mainstem watershed (HUCs 05040001 05 05 and 05040001 05 06) were divided into three watershed labeled Watershed 1, 5, and 6 in Figure I-1. The 12-digit HUC watersheds for West and East Branches of Nimishillen Creek are the same as the Nimishillen Creek Watershed 2 and 4, respectively, in Figure I-1. The subwatershed listed in Table II-1 can be further divided into 30 smaller subwatershed areas if needed for planning or implementation purposes.

Physical Description

The Nimishillen Creek Watershed shown in Figure I-1 is located in the northeastern portion of the Muskingum River Watershed in the Ohio River drainage basin in which Nimishillen Creek is a major subwatershed. For the purpose of this plan and to remain consistent with previous NEFCO studies, the Nimishillen Creek Major Subwatershed will be referred to as the Nimishillen Creek Watershed. Additionally, NEFCO has divided the Nimishillen Creek Watershed into six (6) major subwatersheds. This will improve the accuracy of determining specific hydrologic habitat modifications and/or stream

segments within the watershed that may receive a higher priority for protection and of measuring the progress of restoration efforts in the future.

The headwaters of the Nimishillen Creek Mainstem primarily originate in three distinct areas. The headwaters of the West Branch Nimishillen Creek are located to the west of the Village of Hartville and just south of the Akron-Canton Airport. Flowing south, the West Branch of Nimishillen Creek flows through the City of North Canton and the City of Canton to its confluence with the Nimishillen Creek Mainstem near river mile (RM) 12.1. The headwaters of the Middle Branch Nimishillen Creek are located in Marlboro Township in northern Stark County. Flowing southwesterly, the Middle Branch Nimishillen Creek flows along the western portion of Plain Township, before entering the City of Canton where it combines with the East Branch to form the Nimishillen Creek Mainstem at RM 15.0.

The headwaters of the East Branch Nimishillen Creek are located to the north, east and south of the City of Louisville. Flowing southwesterly, the East Branch Nimishillen Creek flows to the City of Louisville before entering the City of Canton and joining with the Middle Branch near RM 15.0 forming the Mainstem. Continuing to flow south, the Nimishillen Creek Mainstem flows through the City of Canton and the Village of East Sparta, prior to its confluence with Sandy Creek just south of the Stark and Tuscarawas County boundaries.

Administrative Boundaries

Located within the watershed boundaries, in part or in whole, are the following government jurisdictions shown in Figure II-2:

Cities (County):

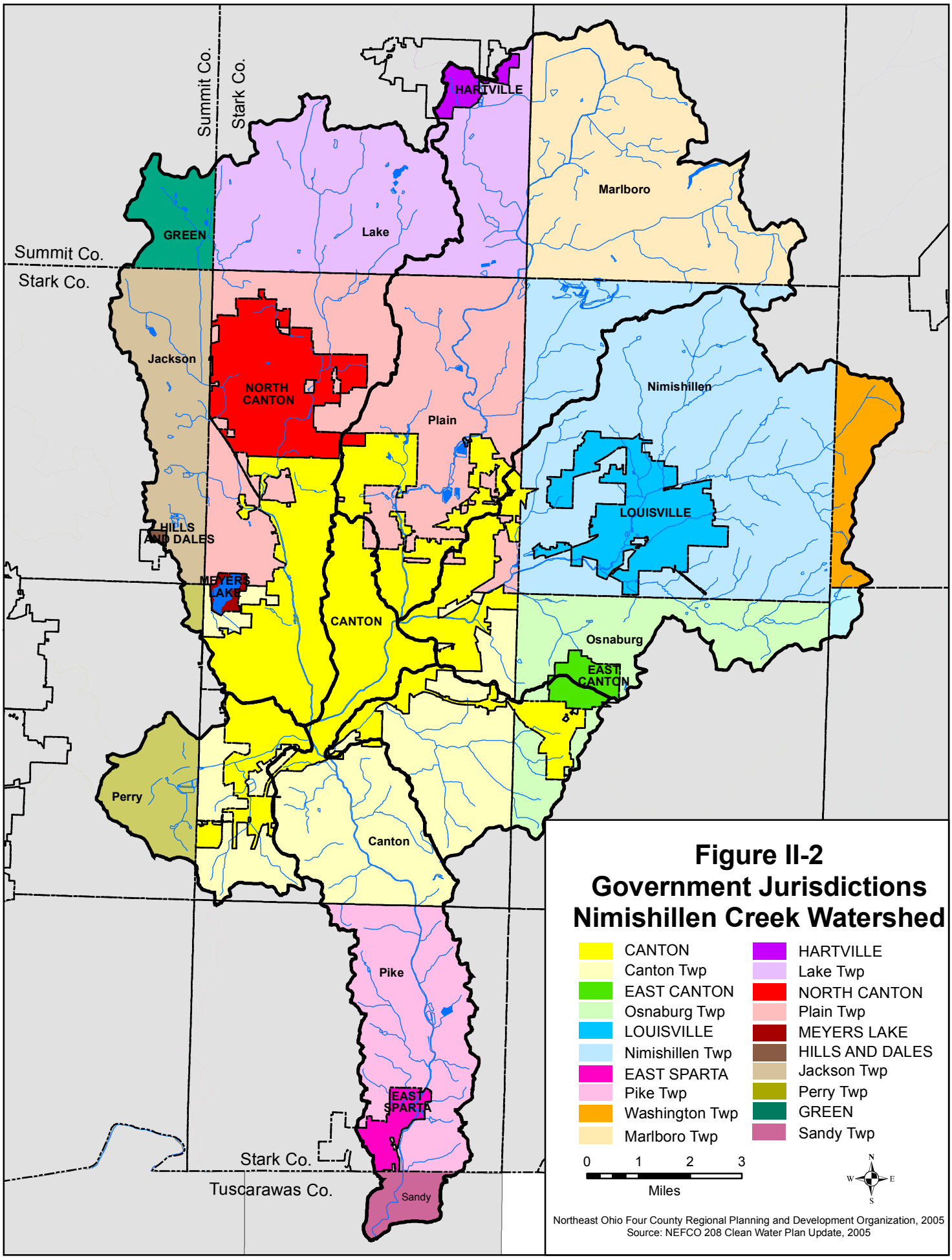
- Canton (Stark)
- Louisville (Stark)
- Green (Summit)
- North Canton

Villages (County):

- East Canton (Stark)
- Hartville (Stark)
- Meyers Lake (Stark)
- East Sparta (Stark)
- Hills and Dales (Stark)

Townships(County):

- Canton (Stark)
- Lake (Stark)
- Nimishillen (Stark)
- Paris (Stark)
- Pike (Stark)
- Sandy (Tuscarawas)
- Jackson (Stark)
- Marlboro (Stark)
- Osnaburg (Stark)
- Perry (Stark)
- Plain (Stark)
- Washington (Stark)


Summit Co.
Stark Co.
HARTVILLE
Marlboro
GREEN
Lake
Summit Co.
Stark Co.
Jackson
NORTH CANTON
Plain
Nimishillen
LOUISVILLE
HILLS AND DALES
MEYERS LAKE
CANTON
Osnaburg
EAST CANTON
Perry
Canton
Pike
EAST SPARTA
Stark Co.
Tuscarawas Co.
Sandy
Figure II-2
Government Jurisdictions
Nimishillen Creek Watershed
CANTON
Canton Twp
EAST CANTON
Osnaburg Twp
LOUISVILLE
Nimishillen Twp
EAST SPARTA
Pike Twp
Washington Twp
Marlboro Twp
HARTVILLE
Lake Twp
NORTH CANTON
Plain Twp
MEYERS LAKE
HILLS AND DALES
Jackson Twp
Perry Twp
GREEN
Sandy Twp
0 1 2 3
Miles
N
W
E
S
Northeast Ohio Four County Regional Planning and Development Organization, 2005
Source: NEFCO 208 Clean Water Plan Update, 2005

Districts

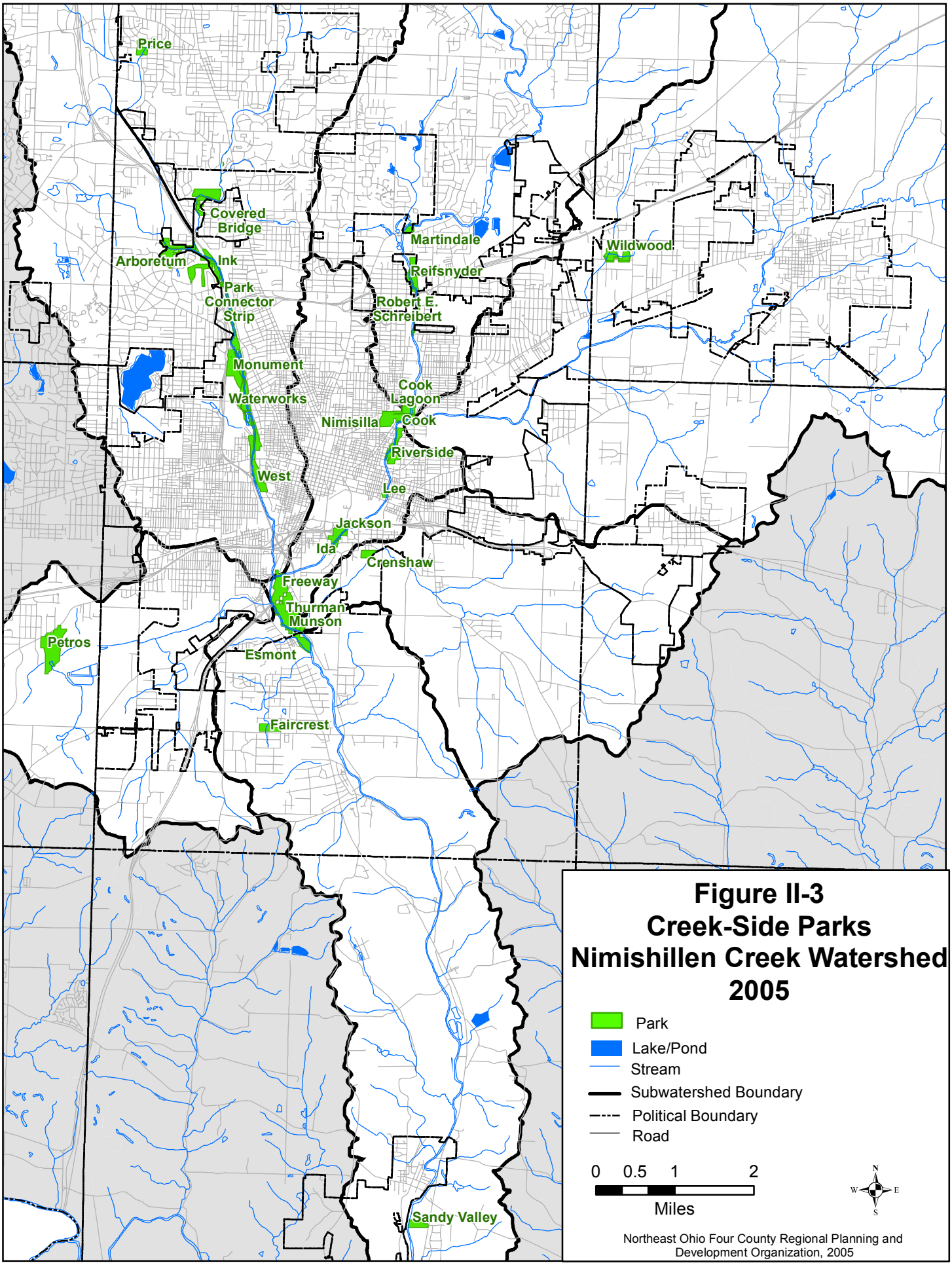
Park

There are over 60 parks and public recreation areas in the Nimishillen Creek Watershed managed by five separate park districts. Watershed communities with park lands are the City of Canton, North Canton, East Sparta, and Louisville. Also, the Stark County Park District maintains four parks within the watershed. The majority of the parks are concentrated within the City of Canton with few parks in the headwater areas of Nimishillen Creek.

All parks within the Nimishillen Creek Watershed, to some degree, provide recreational, community health, and environmental benefits to surrounding areas. However, for this plan only the parks directly adjacent to Nimishillen Creek and its tributaries will be discussed. If properly managed, parks located along the creek can provide numerous water quality benefits like stream shading, runoff filtration, soil stabilization, floodplain protection, and wildlife habitat. Conversely, a poorly managed riparian park can have significant water quality impacts.
Table II-2 lists and Figure II-3 shows all the parks directly adjacent to Nimishillen Creek and its tributaries. These creek-side parks not only can be the first areas considered for possible water quality protection or restoration project, but can also be used for educational programs, like volunteer stream monitoring, for Nimishillen Creek.

The Stark County Park District has long range plans to develop a trail and greenway corridor along the Nimishillen Creek's Mainstem, East Branch, Middle Branch, and West Branch. In 2004, Stark Parks has purchased or acquired land adjacent to Nimishillen Creek and was in negotiations to purchase another 30 riparian acres. Appendix C contains a map of Stark Parks' trail and greenways master plan.

Table II-2: Parks Adjacent to Nimishillen Creek and its Tributaries			
District	**Park Name**	**Size (Acres)**	**Subwatershed**
Canton	Arboretum	41.5	West Branch
	Park Connector Strip	0.5	Mainstem
	Cook	14	East and Middle Branches
	Covered Bridge	62	West Branch
	Crenshaw	20	Sherrick Run
	Freeway	4	Mainstem
	Jackson	6	Mainstem
	Ida	8	Mainstem
	Ink	17	West Branch
	Lee	3	Mainstem
	Martindale	19	Middle Branch
	Monument	19	West Branch
	Nimisilla	23	East and Middle Branches
	Oak	16	Middle Branch
	Reifsynder	60	Middle Branch
	Riverside (not park)	9	Mainstem
	Robert E. Schreiber	20	Middle Branch
	Stadium	76	West Branch
	Thurman Munson	38	Mainstem, Sherrick Run
	Waterworks	12	West Branch
	West	43	West Branch
East Sparta	Sandy Valley	13	Mainstem
Louisville	Wildwood	26	East Branch
North Canton	Price	19	West Branch
Plain Township	Diamond Community Park	39	Middle Branch
	Alpine Park	18	Middle Branch
	Schneider Park	42	Middle Branch
Stark County	Cook Lagoon	5	Middle Branch
	Esmont	12	Mainstem
	Faircrest	18	Mainstem
	Petros	94	Hurford Run


Price
Covered Bridge
Arboretum
Ink
Park Connector Strip
Monument
Waterworks
West
Martindale
Reifsnyder
Robert E. Schreibert
Wildwood
Cook Lagoon
Nimisilla
Cook
Riverside
Lee
Jackson
Ida
Crenshaw
Freeway
Thurman
Munson
Petros
Esmont
Faircrest
Sandy Valley
Figure II-3
Creek-Side Parks
Nimishillen Creek Watershed
2005
Park
Lake/Pond
Stream
Subwatershed Boundary
Political Boundary
Road
0 0.5 1 2
Miles
N
W
E
S
Northeast Ohio Four County Regional Planning and Development Organization, 2005

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Schools

As expected from a heavily populated urbanized/suburban area, there are several school districts that serve the Nimishillen Creek Watershed communities. Table II-3 summarizes all thirteen districts including number of students and schools. Programs aimed at students and/or teachers is an important part of any education and awareness type program.

Table II-3: School Districts Serving the Nimishillen Creek Watershed Communities

School District	Watershed Communities Served	*Total Enrollment: 2003-2004	Number of Elementary Schools	Number of Middle Schools	Number of High Schools
Canton City	Canton	11,798	17	4	2
Canton Local	Canton, Canton Twp., Pike Twp.	2,538	3	1	1
Green Local	City of Green	4,165	2	2	1
Jackson Local	Jackson Twp.	5,561	4	1	1
Lake Local	Hartville and Lake Twp.	3,359	3	1	1
Louisville City	Louisville and Nimishillen Twp.	3,274	4	1	1
Marlington Local	Marlboro and Washington Townships	2,738	3	1	1
Minerva Local	Paris Township	2,202	2	1	1
North Canton City	North Canton, Plain Twp., and Lake Twp.	4,924	4	1	1
Osnaburg Local	East Canton and Osnaburg Twp.	953	1	1	1
Perry Local	Perry Twp.	4,854	6	2	1
Plain Local	Canton, North Canton, and Plain Twp.	6,122	6	2	1
Sandy Valley	East Sparta and Pike Twp.	1,568	2	1	1
	Totals =	**54,056**	**57**	**19**	**15**

Source: Ohio Department of Education, 2004

Colleges and Universities

Several higher education institutions reside either within or near the Nimishillen Creek Watershed. Schools within the watershed boundaries include Walsh College, Kent State University - Stark Campus, Malone College, and Stark State College of Technology. Colleges or Universities within 25 miles of the watershed are Mount Union College, University of Akron, Kent State University, and the College of Wooster.

High education institutions can be utilized for various education, monitoring, and implementation programs. Students and faculty from Mount Union College have previously been active in the Nimishillen Creek Watershed Partners. A nutrient load reduction monitoring study at a constructed storm water wetland along the Middle Branch was completed in 2005 by Jim Eynon, a graduate student from Youngstown State University. Continued and even heightened involvement from these types of stakeholders will be encouraged, and additional opportunities in research, monitoring, and education will be explored.

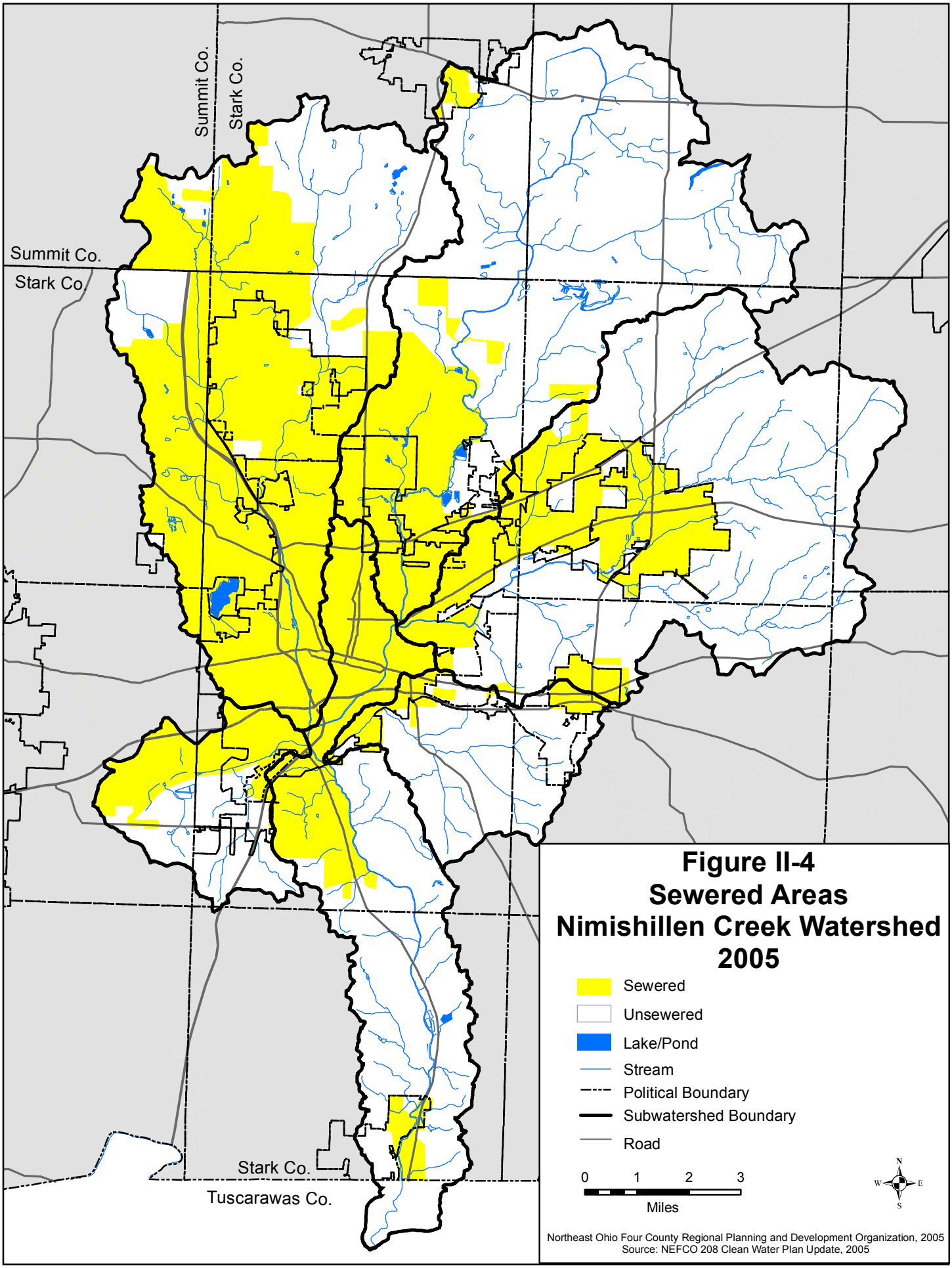
Our Water Webs

In 2008-2009, Kent State University at Stark, in response to discussions with the Herbert W. Hoover Foundation, began exploring the possibility of engaging in a multi-disciplinary study of the surrounding environment. The idea was to develop a network that would provide an opportunity for students, faculty, and the local community to investigate and learn about their environment, how they interact with it and how those interactions could be improved and enhanced. The overall goal is to better educate the watershed community about the environment and to work with the community to seek solutions to critical environmental issues. The first project of this effort that focuses on watersheds, the crucial roles they play in our lives, and the complexity of ways in which water webs and human networks must interact to preserve and protect this resource. The information can be viewed at www.ourwaterwebs.org.

Sewer

Figure II-4 shows the extent of sewers in the Nimishillen Creek Watershed. Generally, sewered areas are limited to the Cities of Canton, North Canton, and Louisville, plus the Villages of Hartville, East Canton, and East Sparta. Over half of the watershed area remains dependent on some type of home sewage treatment system (HSTS).

A facilities planning area (FPA) is a delineated area for sewer-related planning that clearly designates areas with sewers, areas where sewers can be extended, and areas that will not have sewer access. There are three FPAs in the Watershed: Canton-Nimishillen, Hartville, and East Sparta. In general, municipalities are the lead agencies for all sewer planning within their corporate limits, while the Stark County Sanitary Engineers Office is the lead agency for sewer projects in all


Summit Co.
Stark Co.
Summit Co.
Stark Co.
Stark Co.
Tuscarawas Co.
Figure II-4
Sewered Areas
Nimishillen Creek Watershed
2005
Sewered
Unsewered
Lake/Pond
Stream
Political Boundary
Subwatershed Boundary
Road
0 1 2 3
Miles
N
W
E
S
Northeast Ohio Four County Regional Planning and Development Organization, 2005
Source: NEFCO 208 Clean Water Plan Update, 2005

unincorporated area. However for the portion of the watershed in Summit County, called the Stark-Summit Service Area, the Stark County Sanitary Engineers Office and Summit County Department of Environmental Services jointly serve as the lead agency (NEFCO, 2004).

Soil and Water

The Stark Soil and Water Conservation District (SWCD) covers nearly the entire watershed. They offer a variety of services and programs to all Nimishillen Creek residents in Stark County. Programs include reviewing Storm Water Pollution Prevention Plans (SWP3), inspecting construction site for sediment control, and developing Resource Management Systems for farmers.

Summit SWCD serves the small portion of the watershed located in Summit County. They also conduct review on SWP3s and inspect construction sites for erosion control. Summit SWCD also has an Urban Streams Program to help protect streams from problems associated with development and urbanization like increased water volume and streambank erosion.

Resource Conservation and Development (RC&D) Program

The Resource Conservation and Development (RC&D) program was established by Congress in 1962 to expand opportunities for conservation districts, county governments, and individuals to improve their communities in multi-county areas through the formation of regional non-profit organizations. Local people create and organize each RC&D and provide a way for residents to join together to address environmental, economic, and community issues. The United States Department of Agriculture provides technical and financial assistance to the program.

There are two RC&D programs with jurisdiction in the Nimishillen Creek Watershed: Crossroads and Western Reserve RC&Ds. Crossroads RC&D covers the portion of the watershed in Stark and Tuscarawas Counties, while the Western Reserve RC&D has jurisdiction in the Summit County section of the basin. Both programs have a history of supporting watershed improvement and education projects, however neither currently have active projects in the Nimishillen Creek Watershed. Inclusion of these RC&Ds will be sought, when appropriate.

Muskingum Watershed Conservancy District

The Muskingum Watershed Conservancy District (MWCD) was created in 1933 for flood control and conservation. It is the largest conservancy district in Ohio covering all or part of eighteen counties. The District is controlled by the Conservation Court consisting of common pleas court judges from each of the 18 counties with the MWCD's administrative boundary. The Conservation Court appoints a five person Board of Directors which oversees the District's operations. The MWCD is based in New Philadelphia and is considered a local agency of government and not a state or federal entity.

The District has thirteen earthen and one concrete dams for flood control. The U.S. Army Corps of Engineers was given responsibility of the dams and flood control in 1939, an agreement that continues to this day. In addition to assisting the Corps of Engineers in flood protection, the MWCD is responsible for the conservation and recreation on its lands and reservoirs.

Since its inception, the MWCD has been a self-sustaining district funded through visitors' fees, land leases, contract services, and grants. The District has been the only one in Ohio not to assess a maintenance fee to property owners within its administrative boundary. However, the MWCD is in the process of establishing such an assessment for nearly all property owners within their administrative boundary, including properties in Stark and Summit Counties. Money generated by the assessment will be used throughout the watershed to upgrade and repair the aging flood control system, sediment removal, shoreline protection, water quality improvements, and reservoir management. The assessment must be approved by the Conservation Court. The MWCD goal is to start collecting the assessment in 2008.

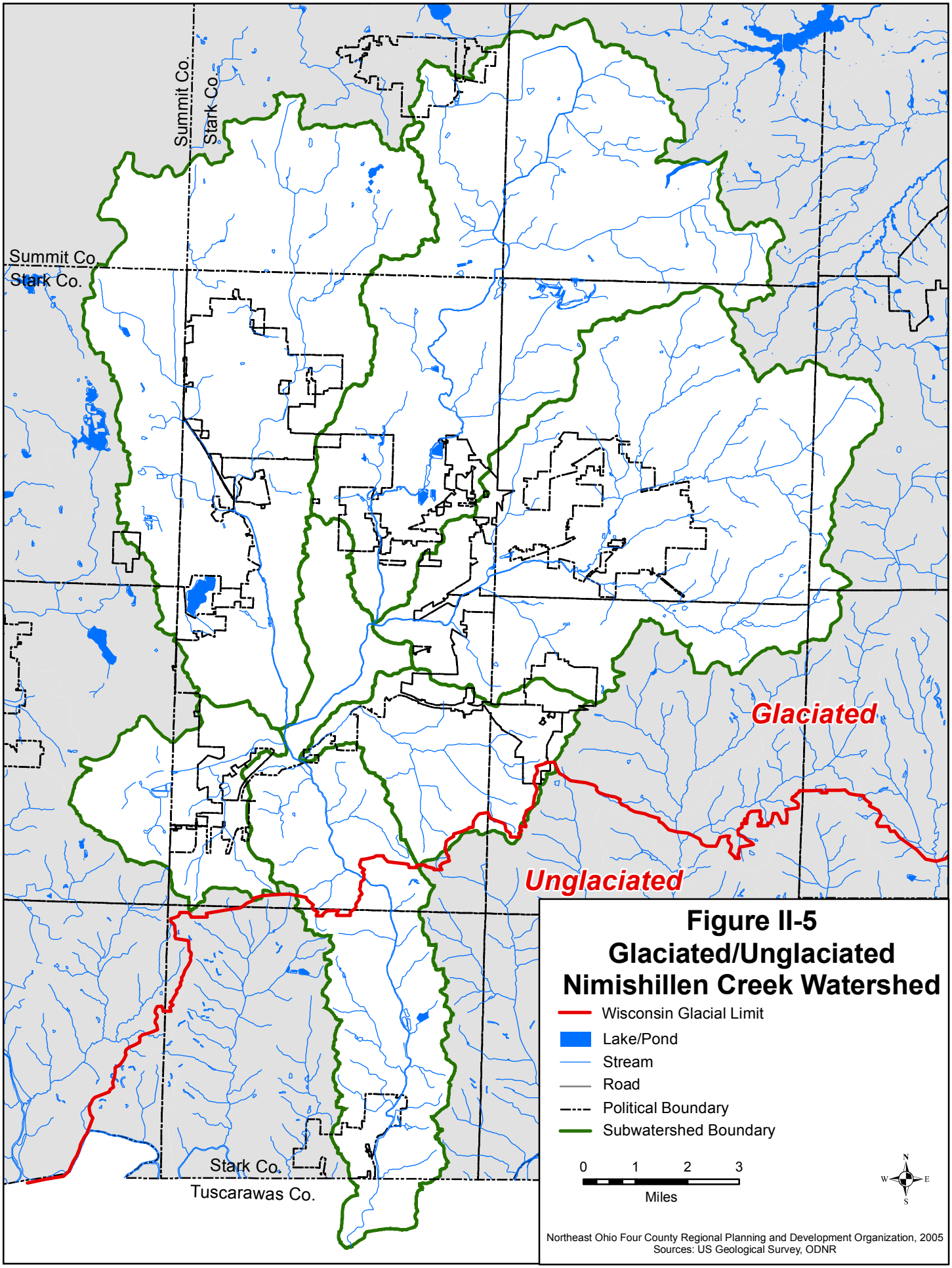
The Nimishillen Creek Watershed is located in the headwaters of the Muskingum River basin. So flood control, sediment reduction, and watershed improvement projects for Nimishillen Creek could be funded through the MWCD assessment. However, the MWCD administrative boundaries were drawn based on political boundaries and not watershed boundaries, so the portions of the Nimishillen Creek Watershed located in Lake, Marlboro, and Washington Townships are not technically in the MWCD. If the MWCD assessment is approved, property owners in these townships will not be assessed, but these areas would still be eligible for MWCD funded projects.

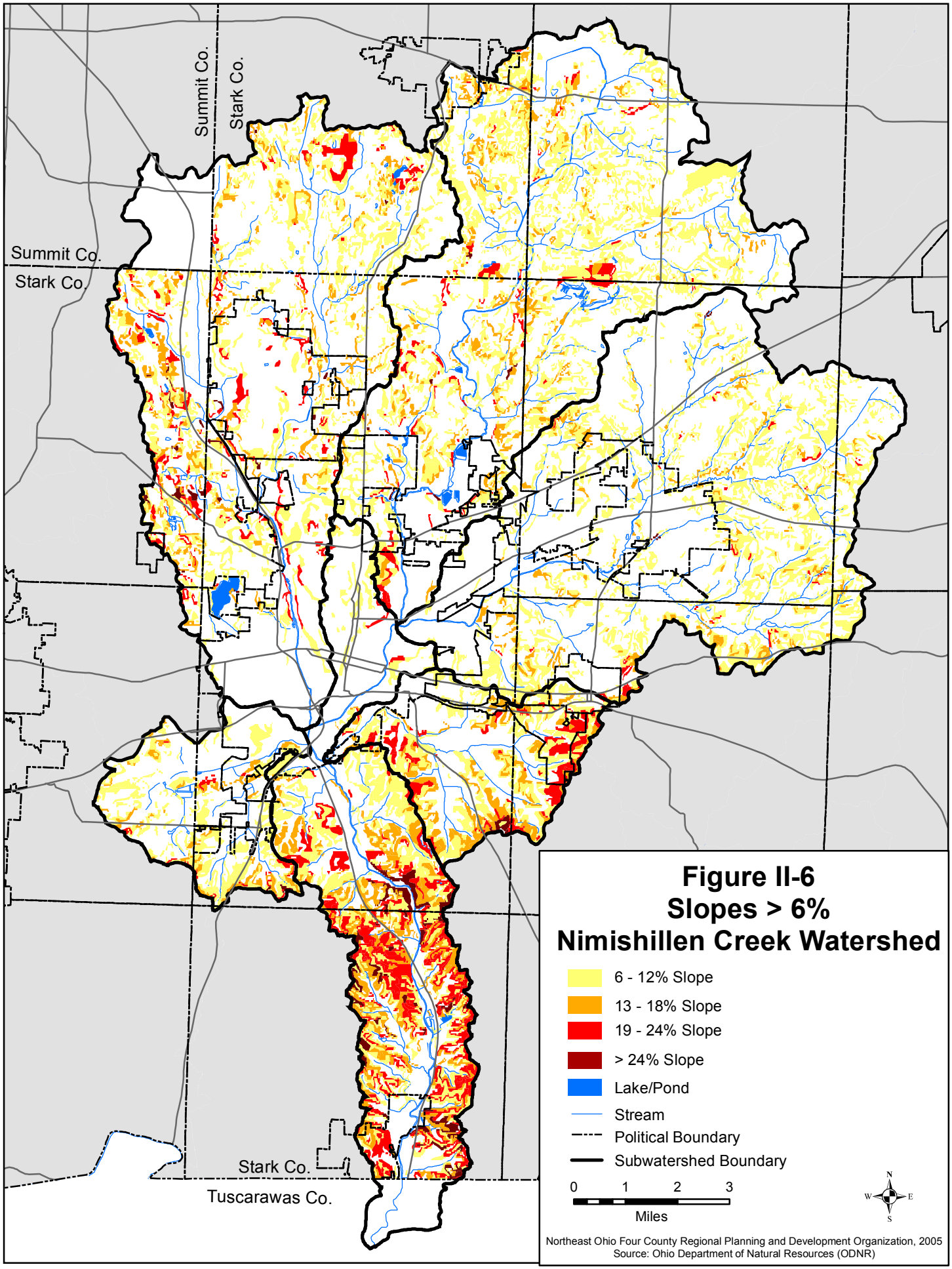
Geology

Topography, Land Form, and Slope

The Nimishillen Creek Watershed, like the rest of Stark County, lies in two subdivisions of the Appalachian Plateau province. The northern two-thirds of the watershed resides in the glaciated section of the Appalachian Plateau, and the southern one third in the unglaciated section (Figure II-5). The headwaters in the northern and central portions of the county have moderate relief and gentle slopes due to glacial actions and depositions. However, in the unglaciated southern portion of the watershed, Nimishillen Creek Mainstem has cut a narrow gorge through highlands resulting in steep sloping upland areas and broad flat expanses in the flood plains. As a result of glaciation, Nimishillen Creek currently flows southwardly and drains a major portion (32 percent) of Stark County (NEFCO, 2003).

Figure II-6 shows the areas in the watershed where slopes are greater than 6 percent, with the steepest slopes predominately occurring in the southern portion of the watershed. The townships of Canton, Osnaburg, and Pike in the southern


Summit Co.
Stark Co.
Summit Co.
Stark Co.
Glaciated
Unglaciated
Stark Co.
Tuscarawas Co.
Figure II-5
Glaciated/Unglaciated
Nimishillen Creek Watershed
Wisconsin Glacial Limit
Lake/Pond
Stream
Road
Political Boundary
Subwatershed Boundary
0 1 2 3
Miles
N
W
E
S
Northeast Ohio Four County Regional Planning and Development Organization, 2005
Sources: US Geological Survey, ODNR


Summit Co.
Stark Co.
Summit Co.
Stark Co.
Stark Co.
Tuscarawas Co.
Figure II-6
Slopes > 6%
Nimishillen Creek Watershed
6 - 12% Slope
13 - 18% Slope
19 - 24% Slope
> 24% Slope
Lake/Pond
Stream
Political Boundary
Subwatershed Boundary
0 1 2 3
Miles
N
W
E
S
Northeast Ohio Four County Regional Planning and Development Organization, 2005
Source: Ohio Department of Natural Resources (ODNR)

unglaciated section of the watershed have the most area affected by steep slopes. Consequently, the southern portion of the watershed has slower rates of development and urbanization in part due to poor conditions for home sewage treatment systems (HSTS).

Glacial History

Prior to glaciation, the topography of the entire watershed was similar to what is found in the southern portion today: steep sloped uplands with broad flat expanses in the lower lying areas. However, a succession of glaciers overran the area, and all but the southern portion of the land comprising the Nimishillen Creek Watershed was shaped and molded by glacial erosion and deposition.

The watershed area had several glaciers come and go during the Illinoian and the Wisconsin age glaciers. The Wisconsin glacier, which began its advance nearly 20,000 years ago, swept away or buried most of the drift laid down by the earlier Illinoian glaciers, before receding nearly 12,000 year ago.

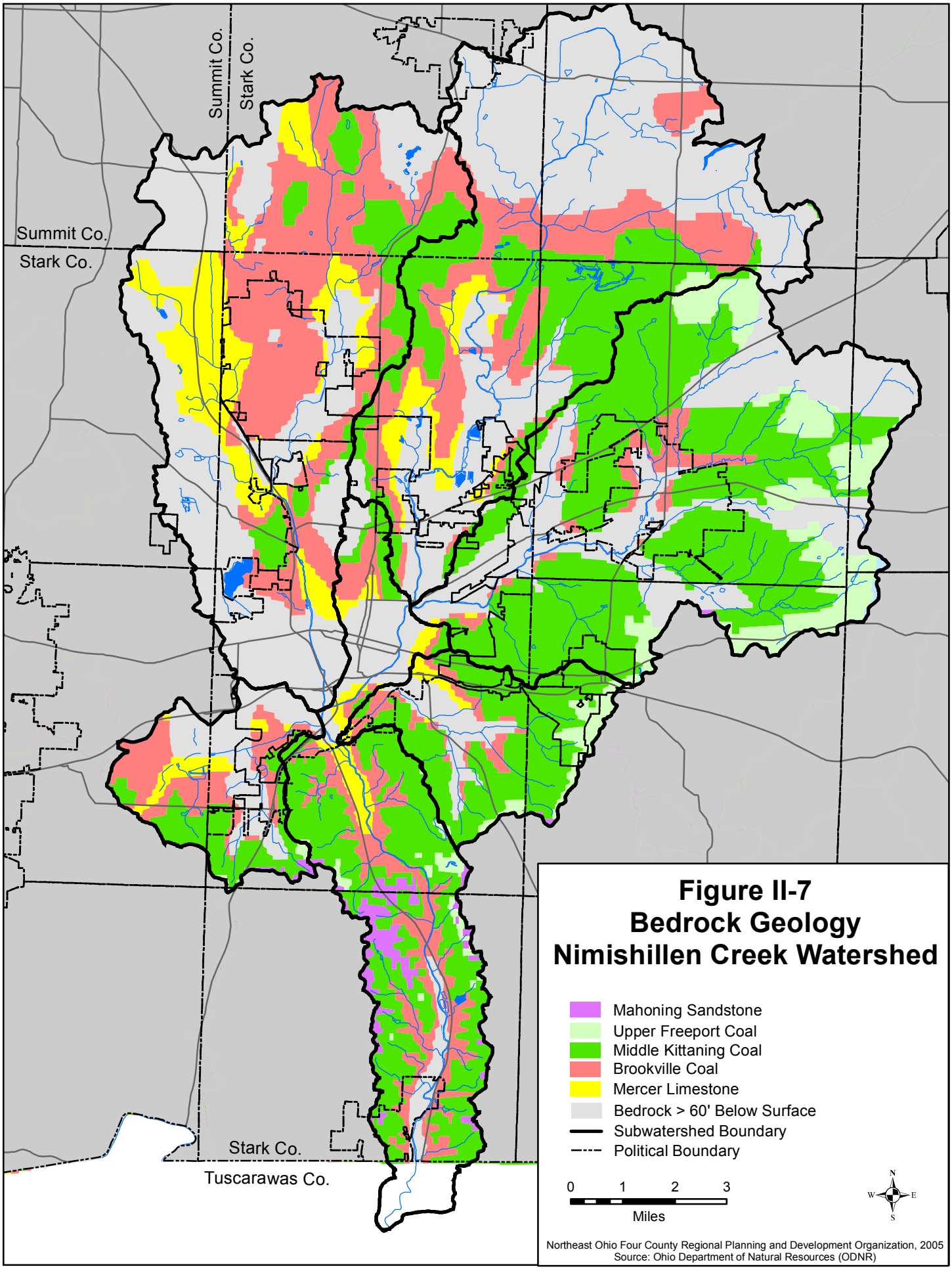
The various Wisconsin glaciers advanced into the Nimishillen Creek Watershed area in two different lobes, melding nearly in the center of the watershed. The Killbuck lobe covered the western part of the glaciated watershed, while the Grand River lobe covered the eastern part. Because the two lobes did not advance at the same pace, there is a zone of overlap and outwash in an interlobate area that extends from Canton northward to Lake Township (Stark County Soil Survey, 1971).

Bedrock Geology

The Nimishillen Creek Watershed is underlain by bedrock from the Pennsylvanian era and the formations mainly consist of sandstone, siltstone, shale, coal, and limestone formed from sediments deposited sometime between 286 and 320 million years ago (Stark County Soil Survey, 1971). Figure II-7 shows the eight different bedrock types in the watershed.

The northern glaciated portion of the watershed has a diverse mix of Middle Kittaning Coal, Brookville Coal, and Mercer Limestone as the dominate bedrock types. Vast areas of bedrock are buried by glacial deposits of more than 60 feet, primarily along valleys of Nimishillen Creek and its major tributaries. In addition, the headwater areas of the Middle Branch of Nimishillen Creek also have bedrock buried by over 60 feet of glacial deposits.

The bedrock composition in the southern unglaciated portion of the watershed is dissimilar from the northern section. The dominant bedrock types are Mahoning Sandstone, Middle Kittaning Coal, and Brookville Coal. Thick glacial deposits only reside in a narrow strip along the Mainstem of Nimishillen Creek near the Stark County - Tuscarawas County boundary.


Summit Co.
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Stark Co.
Stark Co.
Tuscarawas Co.
Figure II-7
Bedrock Geology
Nimishillen Creek Watershed
Mahoning Sandstone
Upper Freeport Coal
Middle Kittaning Coal
Brookville Coal
Mercer Limestone
Bedrock > 60' Below Surface
Subwatershed Boundary
Political Boundary
0 1 2 3
Miles
N
W
E
S
Northeast Ohio Four County Regional Planning and Development Organization, 2005
Source: Ohio Department of Natural Resources (ODNR)

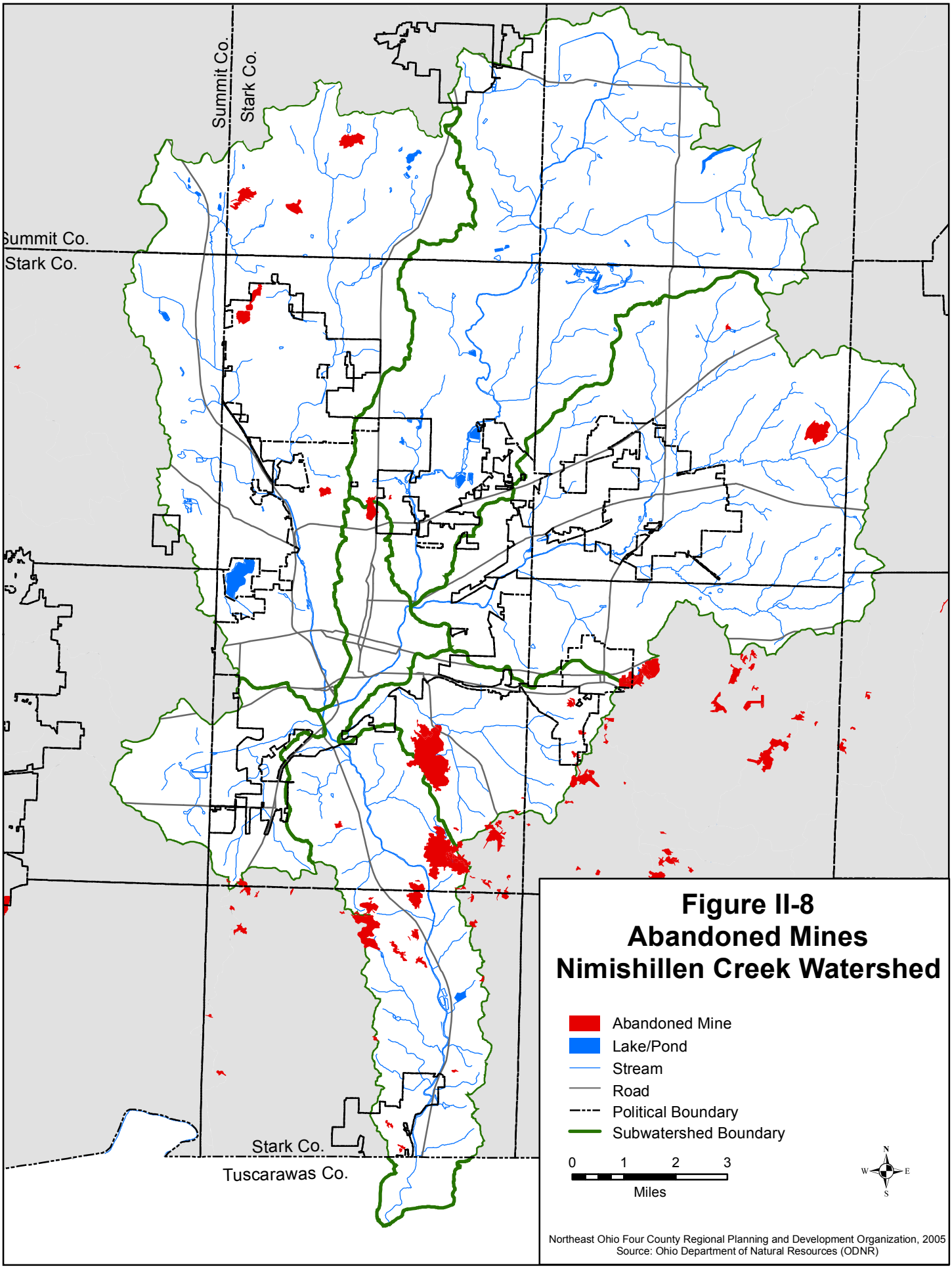
Mineral Resources

Coal was and continues to be an important resource for development and manufacturing in Ohio and the Nimishillen Creek region. Coal from the Brookville and Kittaning bedrock has previously been mined from locations in the Nimishillen Creek Watershed. The peak for coal mining occurred from the late 1880s to the 1930s. According to the ODNR Division of Mineral Resources Management, at least 38 local underground mines, primarily in the unglaciated regions of the watershed, were in operation during this time producing coal to meet the industrial needs of Northeast Ohio. Figure II-8 shows the location of the abandoned mines in the watershed. However, these mines had all been abandoned by the end of the 1930s as coal deposits became more difficult to mine and the more profitable surface mining technique became the standard for coal mining in Ohio. Unfortunately standards for abandoning mining operations did not exist prior to 1972 resulting in acid water polluted with heavy metals discharging directly into Nimishillen Creek and its tributaries. This problem is known as acid mine drainage (AMD). See Section IV, Water Quality Issues, for more information on the known abandoned mines in the watershed.

Also according to the ODNR Division of Mineral Resources Management, there are eight "active" mines in the Nimishillen Creek Watershed. Three of the mines produce coal and are located in Sandy Township (Tuscarawas County) and Pike Township (Stark County) and all are located in the Mainstem subwatershed. Combined they produced 33,000 tons of coal in 2004. The remaining five mines are sand, gravel, and clay producing over 815,747 tons. Two of the mines are located in Jackson Township, two are in Plain Township, and the final one is located within Canton Township. One of the mines is in the Hurford subwatershed, two in the Middle Branch subwatershed, and two are in the West Branch subwatershed. The largest sand and gravel mine is operated by Central Allied Enterprises, Inc. and produced 777,908 tons in 2004 (ODNR, 2004).

Soils

Soils play a integral role in the overall quality of Nimishillen Creek. The type of soil determines, in part, the vegetation cover, farming practices, rainfall infiltration, pollution runoff rates, erosion, and sedimentation (Ohio EPA, 1997). Varying soil characteristics can also affect development by limiting areas suitable for building or for the installation of home sewage treatment systems (See Section VI: HSTS Plan). Nimishillen Creek has nine major soils associations each with unique characteristics and properties: Fitchville-Sebring, Chili-Wheeling-Shoals, Ravenna-Canfield, Canfield-Wooster, Carlisle-Willette-Linwood, Wadsworth-Rittman, Loudonville-Wooster, Latham-Keene, and Muskingum-Gilpin-Dekalb. Below is a brief description of each of these soil types.


Summit Co.
Stark Co.
Summit Co.
Stark Co.
Stark Co.
Tuscarawas Co.
Figure II-8
Abandoned Mines
Nimishillen Creek Watershed
Abandoned Mine
Lake/Pond
Stream
Road
Political Boundary
Subwatershed Boundary
0 1 2 3
Miles
N
W E
S
Northeast Ohio Four County Regional Planning and Development Organization, 2005
Source: Ohio Department of Natural Resources (ODNR)

Fitchville-Sebring Soil Association:
The Fitchville-Sebring soils are found on near level area or old glacial lake beds and are generally lower than the surrounding topography. These areas are scattered throughout the watershed, but are mainly found in the headwater areas of the Middle and West Branches of Nimishillen Creek and along the middle portion of Sherrick Run. These soils are generally somewhat poorly drained soils with a loamy subsoil. Poor drainage is the main limitation for both farming and development. Undrained areas with this association are valuable as habitat for wetland wildlife.

Chili-Wheeling Association:
The Chili-Wheeling soil deposits are irregularly shaped surrounding Canton and extending northward primarily along the West and Middle Branches. The soils occupy sloping and steep hills in Lake, Plain, and Jackson Townships. The Chili and Wheeling soils were formed primarily in glacial outwash areas characterized by silty material underlain by gravely outwash. These soils are well drained. However, the Shoals soils formed in more recent alluvium and are somewhat poorly drained. The soils in this association are well suited for general farming and dairying, and they have few limitations for development. Erosion of these soils is a hazard in the more sloping areas, and flooding is a concern with Shoals soils. Lastly, groundwater contamination from failing HSTSs is a concern, especially in high density housing areas, because of the high permeability of the soils.

Ravenna-Canfield Association:
The soils in this association occupy large undulation to rolling areas in Marlboro, Nimishillen, and Tuscarawas Townships in the East and West Branches of Nimishillen Creek. Topography, like similar glacial till areas, is nearly level. The Ravenna soil types are less sloping than the Canfield soils and are somewhat poorly drained. Conversely, Canfield soils are moderately well drained. The subsoils for this association have a dense, compact subsoil that restricts the movement of water and the growth of roots. These soils reside in the less populated areas of the Nimishillen Creek Watershed and are primarily used for general farming and pastures. Wetness from the poor subsoils is the main limiting factor for these soils. Artificial drainage is usually needed for good crop growth and dry building foundations and basements. Erosion is also a concern with these soils in cultivated areas and/or construction sites. Lastly, poor permeability can limit the effectiveness of tradition HSTS leach fields.

Canfield-Wooster Association:
The Canfield-Wooster soils occur in various formations throughout the glaciated northern portion of the watershed. The soils were formed in deep glacial till and are moderately to well-drained soils. The Canfield soils, like mentioned previously, have a dense, compact subsoil that limits the movement of water and plant roots. The Wooster soils do not have compacted subsoils and are

generally higher and steeper than the Canfield soils. This association is used for both farming and development in the watershed. Erosion is the primary hazard with these soils, but seasonal wetness in the spring can delay usage of the land. For non-agriculture uses, soils are limited by moderately slow permeability and, in some areas, by steep slopes. For buildings, Canfield soils need artificial drainage to insure dry foundations and basements. The compact subsoils of the Canfield soils can also limit the function of a HSTS leach field.

Carlisle-Willette-Linwood Association:
The soils of the Carlisle-Willette-Linwood Association occur in scattered, nearly level and depressional areas in Lake, Plain, Jackson, and Canton Townships. The association consists of muck soils that are underlain by mineral soil material at various depths. Naturally these are wetlands because of the very poorly drained organic soils. Poor drainage is the main limitation to farming because the muck tends to oxidize and subside when the water tabled is lowered. When dry, all areas of these soils can be damaged or destroyed by fire; as well as, being susceptible to soil blowing. Farming these soils requires intensive management that includes artificial drainage and control of the water table. The soils have severe development limitations because the muck is unstable and often subsides.

Wadsworth-Rittman Association:
In the Nimishillen Creek Watershed, the Wadsworth-Rittman soils occur only in the headwater of the Middle Branch in Marlboro Township. These soils were formed in clay loam or silty clay loam glacial till and have a compact layer in the subsoil that restricts the infiltration of water. The Wadsworth soils are mainly level and are somewhat poorly drained. The Rittman soils are sloping and moderately well drained. Both soil types naturally have a seasonally high water table. Farming and pasturing are the primary uses of this land, and artificial drainage is needed on the Wadsworth soil for good crop production. Erosion from farming or construction is a hazard for Rittman soils. Development of these soils is severely limited due to the seasonally high water table. Home sewage treatment systems with filter beds will also not function properly even during dry periods.

Loudonville-Wooster Association:
This association occurs in widely separate areas mainly in the southern half of the Nimishillen Creek Watershed. In most areas the glacial till is less than four feet thick over residuum from shale and sandstone. Loudonville soils are formed in glacial till 20 to 40 inches thick over bedrock. These soils are well drained on sloping to very steep sloping land. The Wooster soils formed in glacial till greater than 40 inches thick and are well drained and contain a fragipan. Much of the land with these soils is used for pasture, but can be used for general farming, dairying, or growing fruit. In many areas these soils are so steep that erosion is a severe hazard if cultivated or developed. Rapid runoff is also common with these

soils. However, many areas have scenic values because of these unique characteristics.

Latham-Keene Association:
The soils of the Latham-Keene Association occupies scattered areas in the south-central, unglaciated portion of the Nimishillen Creek Watershed. Sloping to steep topography is commonly associated with these soil types. Latham soils developed in place from weathered shale and are well drained but have a low permeable subsoil. Keene soils also formed in place from weathered shale and a thin layer of siltstone bedrock. Keene soils are generally not as steep as Latham soils and are moderately well drained, but permeability is moderately slow in the upper part or the subsoil and slow in the lower part. Most of these area are forested, but some acreage have been strip mined for coal and shale. Erosion is a hazard because of the steep slopes and rapid runoff from these soil areas. Dense development is limited due to the steep slopes, but some areas have been used for single family homes. However, even developing homestead sites is limited because the poor soil permeability is not suitable for HSTSs.

Muskingum-Gilpin-Dekalb Association:
This soil association occurs in the unglaciated, sloping to steep areas in the southern portions of the Nimishillen Creek Watershed. The Muskingum soils formed in the residuum from siltstone, sandstone, and shale. The Gilpin soils formed in the residuum from thin beds of siltstone, shale, and sandstone, and the Dekalb soils originated in the residuum from sandstone and thin beds of siltstone. All of these soil types are well drained, low in natural fertility, and droughty. Large areas of this association have been strip mined for coal. Row crops are grown in very few areas, but general farming and fruit production can be accomplished in these soils. The less sloping areas can also be used for pasture lands. Because runoff is very rapid on these soils, intense erosion control is needed in all cultivated and construction areas. Development is limited due to slopes and, in some areas, by bedrock near the surface.

Biological Features

Rare, Threatened, and Endangered Plant Species

According to the Ohio Department of Natural Resources (ODNR) Division of Natural Areas and Preserves, the Nimishillen Creek Watershed and surrounding areas (Stark County) have six endangered, sixteen threatened, and thirty-two potentially threatened plant species (ODNR-DNAP, 2001). There are currently no plant species that are presumed locally extirpated. A complete list of these plants listed on the Ohio Natural Heritage Data Base for Stark County can be found in Appendix D. Also, none of the plants in the watershed found on the State of Ohio's threatened and endangered species list are currently included on the federal threatened and endangered species list.

Several factors account for the list of threatened and endangered plant species in the Nimishillen Creek Watershed. Some of the plants require specialized habitats such as bogs or fens, which naturally limit a plant's abundance. While other species range has been limited by current and past land use practices that have turned areas such as native forest, wetlands, and grasslands into farms, houses, and businesses. Also the invasion of non-native plant species (see below) can also reduce habitat. In order to increase the numbers of a rare plant species, the habitat in which it thrives must be increased in any watershed.

Invasive, Non-Native Species

An inventory of invasive, non-native exotic species has not been conducted for Stark County, Summit County, or the Nimishillen Creek Watershed. However, the types of invasive species and the ensuing problems created are equivalent to other areas in Northeast Ohio.

Fortunately, the Stark County Park District has recently begun tracking and removing invasive plant species in their parks. Invasive species they have documented are Japanese knotweed (*Polygonum cuspidatum)*, garlic mustard (*Alliaria petiolata)*, multiflora rose (*Roda multiflora*), purple loosestrife (*Lythrum salicaria*), privet (*Ligustrum spp.)*, amur honeysuckles (*Lonicera maackii*), Canada thistle (*Cirsium arvense*), phragmites (*Phragmites austrails*), crown vetch (*Coronilla varia*), Queen Ann's lace (*Daucus carota*), and reed canary grass (*Phalaris arundinacea*).

Invasive plants can cause severe economic, recreational, or environmental harm if left uncontrolled. Nearly all invasive species are non-native to the watershed thereby lacking natural predators or controls which results in rapid reproduction and dispersion. Because of these traits, invasive plants force out native plants often creating monocultures of the invasive plant. Wildlife is often affected by plant invasions because many animals depend on a variety of native plants for food and cover. In Ohio, invasive plants are now considered the second largest threat to biodiversity and endangered species, only behind habitat loss (Windus, 2003).

Controlling invasive plant species is often a time, labor, and/or resource-intensive process. Attacking invasive plants during the early stages of establishment is generally the best strategy because once well established, multiple control strategies with follow-up treatment are often needed. Specific control measures will vary depending on the targeted plant, but will fall into one of three control categories: biological (natural enemies), mechanical (cutting, digging, etc.), or chemical (herbicides).

Wildlife

An extensive survey of wildlife has not been completed for the Nimishillen Creek Watershed. However, various organizations and agencies have conducted surveys of certain wildlife segments providing a general picture of animal diversity found in

the watershed. Specifically, the Stark County Parks Department conducts bird, amphibian, and reptile surveys, while the Ohio EPA has extensively sampled fish and macroinvertebrates. Generally the wildlife is typical of similar areas in Northeast Ohio. The list below is a condensed list of the most common wildlife in the watershed as gathered from the surveys and general field observations:

Fish:
Largemouth Bass
Smallmouth Bass
Rock Bass
White and Black Crappie
Yellow, Brown, and Black Bullhead
Common Carp
Bluegill Sunfish
Green Sunfish
Pumpkinseed Sunfish
Yellow Perch
White Sucker
Northern Hog Sucker
Creek Chub
Blacknose Dace
Striped Shiner
Bluntnose Minnow
Central Stoneroller
Johnny Darter

Mammals:
White-Tailed Deer
Beaver
Red Fox
Muskrats
Ground Hogs
Mink
Raccoons
Coyotes
Least Weasels
Long Tail Weasels
Eastern Chipmunk
Squirrels (Fox, Grey, Flying, Black)
Eastern Cottontail Rabbit
Striped Skunk
Voles
Deer Mice
Greenside Darter
Rainbow Darter
Mottled Sculpin

Amphibians:
American Toad
Bull Frog
Green Frog
Grey Tree Frog
Spring Peeper
W. Chorus Frog
Wood Frog
Four-Toed Salamander
Tiger Salamander

Waterfowl:
Canada Goose
Mallard Duck
Wood Duck
Big Brown and Little Brown Bats

Raptors/Birds:
Bald Eagle
Broad-Winged Hawk
Coopers Hawk
Red-Tailed Hawk
Sharp-Shinned Hawk
Great Blue Heron
Osprey

Reptiles:
Eastern Garter Snake
Eastern Box Turtle
Spotted Turtle
Snapping Turtle
Northern Brown Snake
Water Snake

Water Resources

Climate and Precipitation

Weather conditions in Northeast Ohio throughout most of the year are generally mild, but can be extreme in the winter. The region in which the Nimishillen Creek resides averages approximately 37 inches of precipitation each year. May through September are generally the wettest months averaging better than 3.4 inches per month. January and February typically have the least amount of precipitation averaging less than 2.6 inches. However, extreme variations in precipitation can occur for any month, any given year (Oelker, 2005). Average monthly temperatures range from a low of 33^{o}F in January to 82^{o}F in July.

Surface Water

The Nimishillen Creek Watershed covers 188 square miles in Stark, Summit and Tuscarawas Counties of Northeast Ohio. The Mainstem has a length of 24.5 miles and flows into Sandy Creek to the south. The five major tributaries to Nimishillen Creek are Hurford Run, Sherrick Run (also called Sherrie Run), West Branch, Middle Branch, and East Branch. Sherrick Run has a length of 6.8 miles and drains an area of just over 11.2 square miles. Hurford Run's length is 4.95 miles with a drainage area of approximately 8 square miles. The Middle Branch is the longest of the tributaries flowing 16.6 miles and covering over 95.2 square miles. East Branch length is 10.4 miles with an area of 43.56 square miles. And finally the West Branch flows for 9 miles and drains 46.5 square miles.

Lake resources in the Nimishillen Creek Watershed are limited. According to the Ohio Department of Natural Resources' *Ohio Lake Inventory*, there are only sixteen waterbodies greater than five acres in size in the entire Nimishillen Creek Watershed. Of that total, ten are ten acres or less in size and are primarily man made impoundments as a result of mining activities or recreational enhancements like fishing ponds. The only public lake is the twelve acre Petros Lake located on Stark County Metro Parks property in the Hurford Run Subwatershed. Meyers Lake has the largest surface area of 134 acres and is located between the Cities of Canton and Massillon in the West Branch Subwatershed.

Appendix E contains information on lakes greater than 5 acres listed in the *Ohio Lake Inventory*. However, this should not be considered a comprehensive list of waterbodies since the inventory was completed in 1980 and there are additional lakes greater than five acres that have been created over the past 26 years. Conversely, some of the waterbodies listed in the inventory may have been filled in and no longer exist, especially in mineral resource areas like mines or gravel pits. In general, lakes may provide localized water quality, wildlife, and/or recreational benefits in their immediate vicinities, but the influence on the overall surface water quality, wildlife, and recreational opportunities in the Nimishillen Creek Watershed is minimal.

Flow Regime

The United States Geological Survey (USGS) operates two stream gauges along Nimishillen Creek to measure the Creek's height and flow volume (discharge). Figure II-9 shows the gauge locations, and listed below is a summary information from the USGS about these gauging stations.

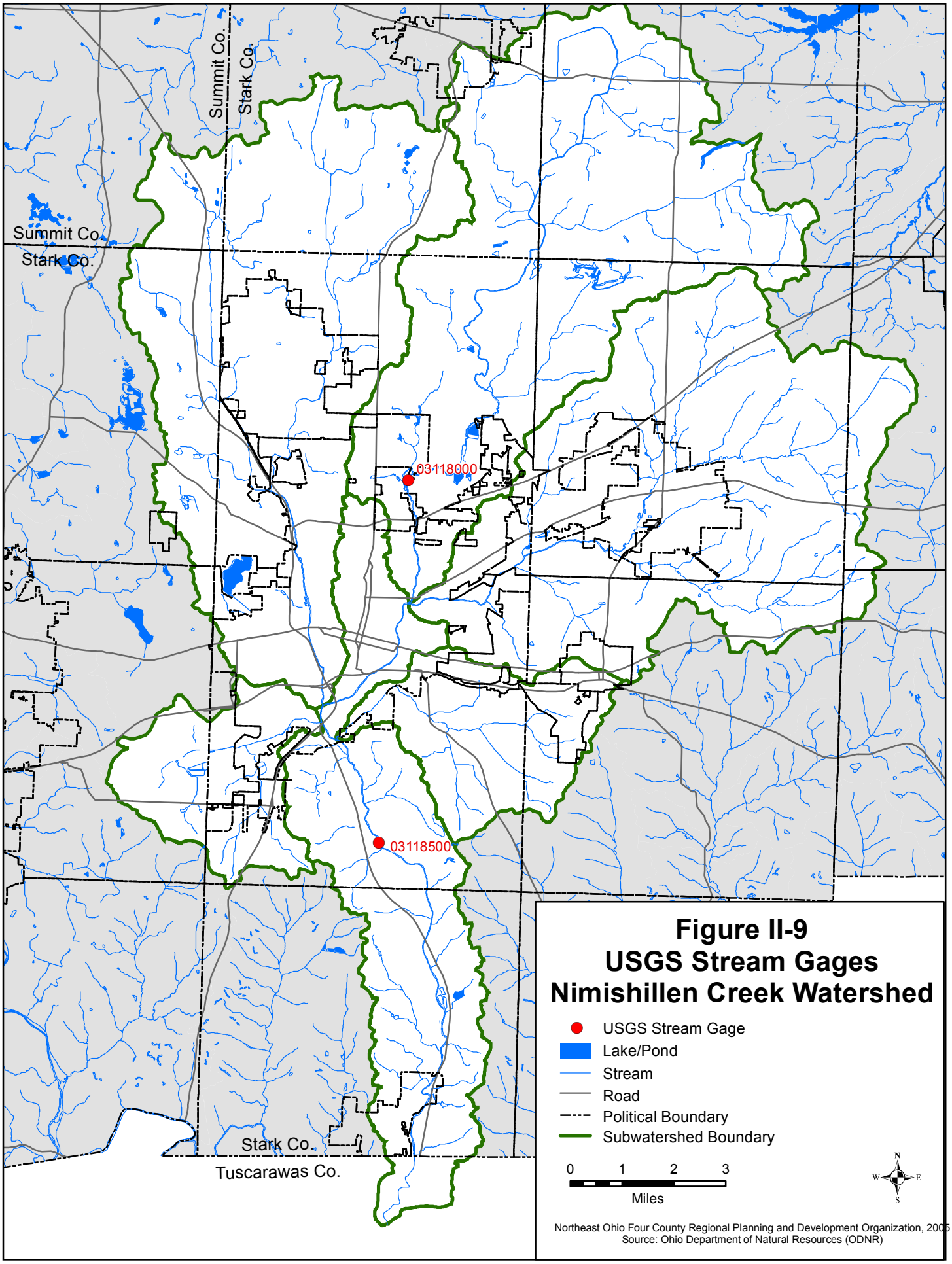
Gauge Identification: 03118000 - Middle Branch Nimishillen Creek, Canton, OH
Location: Lat 40°50'29", Long 81°21'14", on the downstream end of right bridge abutment on Martindale Road, 0.8 mile upstream from Rt. 62 bridge over Middle Branch Nimishillen Creek, and 2.4 miles upstream from the mouth.
Drainage Area: 43.1 mi^2
Period of Record: September 1941 to Current Year
Annual Mean Flow Range: 16.4 ft^3/sec (1944) to 70.5 ft^3/sec (1996)
Peak Flow: 2,470 ft^3/sec (Jan. 22, 1959)
Comments: Station operated in cooperation with the City of Canton

Gauge Identification: 03118500 - Nimishillen Creek at North Industry, OH
Location: Lat 40°44'03", Long 81°21'08", on left bank upstream abutment of Baum Rd. bridge, 400 feet northeast of Ridge St., and 2.1 miles downstream from Sherrick Run.
Drainage Area: 175 mi^2
Period of Record: October 1921 to Current Year
Annual Mean Flow Range: 86.9 ft^3/sec (1931) to 355 ft^3/sec (1990)
Peak Flow: 8,600 ft^3/sec
Comments: Station operated in cooperation with the Ohio Department of Natural Resources - Division of Water and the U.S. Army Corps of Engineers

Floodplain Areas

Floodplains are land areas along Nimishillen Creek that are subject to recurring water inundation during high water flows. Events that trigger flooding of these areas are typically heavy rain storms and/or snow melt. Flooding is a natural process and can be beneficial to both the creek and adjacent lands. Specifically, floodplains act as natural water retention basins slowing down and holding flood waters. Floodplains reduce the force and volume of water transported downstream resulting in less erosion and flooding. A floodplain is functioning properly when the deposition of soil and mineral particles occurs in flooded areas which results in less sediment, nutrients, and pollutants being transported downstream. An ancillary benefit from this deposition is that floodplains are often fertile agriculture lands.

Nimishillen Creek's floodplain areas vary in both size and frequency of inundation. Like many streams in Ohio, the floodplain of Nimishillen Creek has been altered over the years by human actions, primarily urban/suburban development and agriculture. The reduction in floodplain land from encroachment in conjunction with sections of


Summit Co.
Stark Co.
Summit Co.
Stark Co.
03118000
03118500
Stark Co.
Tuscarawas Co.
Figure II-9
USGS Stream Gages
Nimishillen Creek Watershed
USGS Stream Gage
Lake/Pond
Stream
Road
Political Boundary
Subwatershed Boundary
0 1 2 3
Miles
N
W
E
S
Northeast Ohio Four County Regional Planning and Development Organization, 2005
Source: Ohio Department of Natural Resources (ODNR)

the Nimishillen Creek being straightened, wetlands filled, and open land covered with buildings and pavement has resulted in more water reaching Nimishillen Creek at a faster rate and in greater volumes. Over time the floodplain areas of the creek change in response to these and other actions.

Mapping of the floodplain areas is the responsibility of the Federal Emergency Management Agency (FEMA) and is primarily for insurance purposes. Figure II-10 shows the 100-year floodplain areas in Nimishillen Creek as determined by FEMA. The term "100-year floodplain" is used to express the probability of a given area to flood any given year, and not the occurrence interval between major floods. A 100-year floodplain simply means that the area has a one percent chance of flooding in any given year, while a 50-year floodplain has a two percent chance of flooding. The extent of floodplain areas fluctuate to reflect changes within the basin. For example, if a floodplain is filled (developed) upstream, the footprint of downstream floodplains will likely increase to hold the increase volume of water.

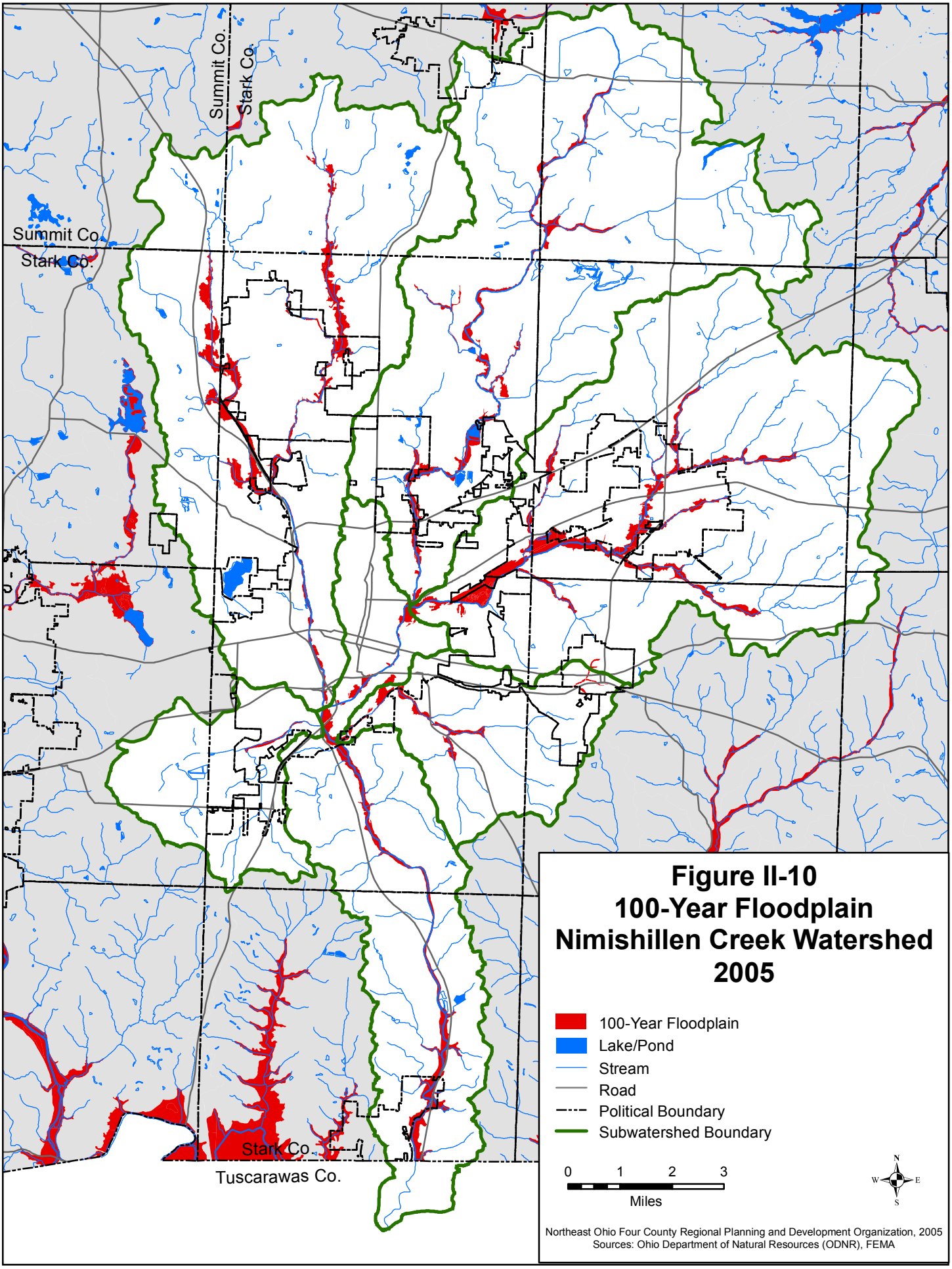
Figure II-10 was created using the current FEMA floodplain map; however, the map is currently being updated and digitized by FEMA. For the new flooding maps, the 100-year floodplain areas are anticipated to increase in size to reflect increased flood volumes from development within the watershed.

Extensive flooding occurred within the Nimishillen Creek Watershed in 2003 and 2004. Some areas significantly impacted by these floods include the cities of Louisville, Canton, North Canton, Jackson Township, and Canton Township. Damage primarily affected houses and businesses built within the current 100-year floodplain. Although the focus of this study is water quality, flooding and water quality issues should also be considered for projects or action when appropriate.

Water Quality Improvement Efforts

Water quality improvement efforts in the watershed have largely been limited to existing programs administered through various agencies. Some examples of these typical efforts include the Stark Soil and Water Conservation District (SWCD) monitoring construction site runoff, the Natural Resources Conservation Service (NRCS) working with the agricultural community to implement various agricultural best management practices, and the Stark County Health Department investigating failing HSTSs.

Some improvement efforts that are unique to the watershed include the City of Canton constructing a storm water treatment wetland adjacent to the Middle Branch. Modest testing of the wetland's efficiency at removing pollutants has shown a reduction in sediment and nutrients from storm water runoff entering the Middle Branch. Also, the Nimishillen Creek Watershed Partners hold an annual creek clean-up each fall to remove trash and tires from various sections of Nimishillen Creek. The Stark County Health Department holds an Environmental Expo to promote, in part, the health of local water resources. The City of Canton created the


Summit Co.
Stark Co.
Summit Co.
Stark Co.
Stark Co.
Tuscarawas Co.
Figure II-10
100-Year Floodplain
Nimishillen Creek Watershed
2005
100-Year Floodplain
Lake/Pond
Stream
Road
Political Boundary
Subwatershed Boundary
0 1 2 3
Miles
N
W
E
S
Northeast Ohio Four County Regional Planning and Development Organization, 2005
Sources: Ohio Department of Natural Resources (ODNR), FEMA

Fairhope Nature preserve along a tributary to the East Branch in 2011. Lastly, the Stark County Parks District has been purchasing riparian habitat along various sections of Nimishillen Creek for habitat preservation and community recreation. They have a long-term goal of establishing a recreational trail along the Nimishillen Creek corridor.

These current efforts show the interest and commitment from local stakeholders to improve their local water resources. Future programs and activities like the TMDL study and NPDES Storm Water Phase 2 (see below) will call on the stakeholders to implement and support additional improvement efforts. This Action Plan is an initial attempt to focus both on-going and future efforts on water quality improvements.

Storm Water

NPDES Storm Water Phase 2 Communities

In an effort to preserve, protect, and improve water resources throughout the nation from polluted storm water runoff (drainage), the United States Environmental Protection Agency (USEPA) in 2003 mandated that most urban areas develop a program to manage their community's runoff. This regulatory mechanism is called the National Pollutant Discharge Elimination System (NPDES) Storm Water Program Phase 2 and is authorized by the 1987 Water Quality Act (WQA). By 2008, all affected communities must develop and implement at least six minimum control measures to control polluted storm water runoff. Those control measures are:

1. Public Education and Outreach Program
2. Public Involvement and Participation
3. Elimination of Illicit (Illegal) Discharges
4. Construction Site Storm Water Ordinance
5. Post Construction Storm Water Ordinance
6. Pollution Prevention and Good Housekeeping

The following communities in the Nimishillen Creek Watershed are designated as NPDES Phase II communities:

- **Counties**: Stark and Summit
- **Cities**: Canton, Green, Louisville, and North Canton
- **Villages**: East Canton, Hartville, Hills and Dales, and Meyers Lake
- **Townships**: Canton, Jackson, Lake, Marlboro, Nimishillen, Osnaburg, Perry, Pike, and Plain

All of the above communities except the City of Green, Village of Hills and Dales, and Marlboro Township submitted individual applications for their NPDES Phase 2 permit from the Ohio EPA. Marlboro Township and Hills and Dales received waivers from the Ohio EPA and do not have to participate in the Phase 2 Program. The City of Green is a co-permittee in the *Summit County Countywide*

Storm Water Management Program Phase 2 Permit application. For more information about NPDES Phase II in the Watershed, refer to the above plans available from the Ohio EPA's Division of Surface Water or any of the permitted communities.

Stark County Drainage Task Force

The Stark County Drainage Task Force is a coalition of elected officials, water resource professionals, and citizens that was formed in the fall of 2003 in response to extensive flooding that occurred in Stark County that year. The Task Force is directed by a Steering Committee comprised of representatives from every township, village, and city in the county, local environmental professionals (SWCD, County Engineer, NEFCO, non-profit organizations, etc.), and citizens. Their initial goals are:

1. Categorize drainage problems and create a list of short-term and long-term projects in both municipal and township areas.
2. Review current municipal and county regulations, address jurisdiction issues, and create uniformity of regulations throughout Stark County.
3. Create opportunities for public input throughout the planning process and explain to the public the pros and cons of various solutions.
4. Educate Stark County citizens about watersheds and increase awareness of proper environmental/water management.
5. Identify possible funding options and create criteria which promotes equitable resolution of drainage problems.

To accomplish these goals, four subcommittees were formed: problem identification, education, regulations, and business plan. The Task Force's subcommittees in 2004 and 2005 mapped all known problem flooding areas, created a website, held public meetings, reviewed current regulations (subdivision, floodplain, etc.), and worked to secure money for a diagnostic study for the County. As a result of these efforts, Stark County was appropriated one million dollars by Congress through the U.S. Army Corps of Engineers for a detailed engineering study of drainage issues. However, the study has not yet begun as the funding requires a 50 percent or one million dollar match in order to proceed. Efforts to secure this match have not yet been successful.

The Task Force intends to improve both water quantity and quality issues when addressing flooding. Open space preservation, riparian protection/restoration, wetland mitigation, and water quality detention ponds are all proposed methods of dealing with drainage issues in the Stark County and the Nimishillen Creek Watershed.

Wetlands

Wetlands have been described as the kidneys of a watershed because of the functions that they perform in the hydrologic and chemical cycles. They function as

the downstream receivers of wastes from both natural and human sources. Wetlands can cleanse polluted waters, prevent floods, protect shorelines, and recharge groundwater. They also provide unique and important habitat for plants and animals (Mitsch, 1993). Unfortunately, the benefits of wetlands have not always been appreciated by mankind. Over the years they have been drained, ditched, and filled for agriculture and development. Mass wetland destruction began in the mid-1800s and continued nearly unchecked until the mid-1970s when wetlands began receiving legal protection by the United States and state governments.

In Ohio, wetland area has declined by an estimated 90 percent over the last 200 years. Wetlands currently cover 1.8 percent of the State covering approximately 483,000 acres (Dahl, 1990). No study has been done for the Nimishillen Creek Watershed to determine historic wetland loss, but it is believed to be equal to or greater than the percentage of wetland loss throughout the State. This observation is based on the extensive urban/suburban development in the Canton region and the extensive agricultural activity in the headwater sections of the East and Middle Branches.

The Ohio Department of Natural Resources and Natural Resources Conservation Service maintains the Ohio Wetlands Inventory database. This inventory was conducted using digital satellite data and other digital data to attain an estimate of wetland areas in Ohio. Figure II-11 shows the wetland areas in the watershed as determined by the Ohio Wetland Inventory. The inventory provides a general picture of wetland areas in the watershed. The largest contiguous wetlands are farmed and wooded wetlands in northern Marlboro Township and south of Hartville. The farmed wetlands in Marlboro and Lake Townships are primarily in muck soils. Woods on hydric (wetland) soils appear to be the most common wetland type in the entire watershed, primarily located along stream banks. The West Branch contains the greatest number of shrub/scrub wetlands while Middle Branch has the largest shallow marsh wetland.

However, information displayed on Figure II-11 should be viewed with caution since the data for the Ohio Wetland Inventory was collected between 1985 and 1987. Changes have likely occurred to a number of these wetland areas, especially in the Plain, Jackson, and Lake Township areas due to pressures of suburban sprawl. In addition, the wetland areas were not field checked in the Nimishillen Creek Watershed and areas represented as wetlands in the inventory may never have been wetlands. Conversely, there are likely wetland areas in the watershed that did not show up on the inventory due to the either the method of data collection used or wetland restoration efforts occurring after the survey was completed.

The Stark County Parks Department is in the preliminary stages of conducting a countywide wetland survey for the purposes of protecting and restoring wetland areas. Their end goal is to establish wetland mitigation banks with the county and watershed. This and similar wetland identification projects need to be supported in

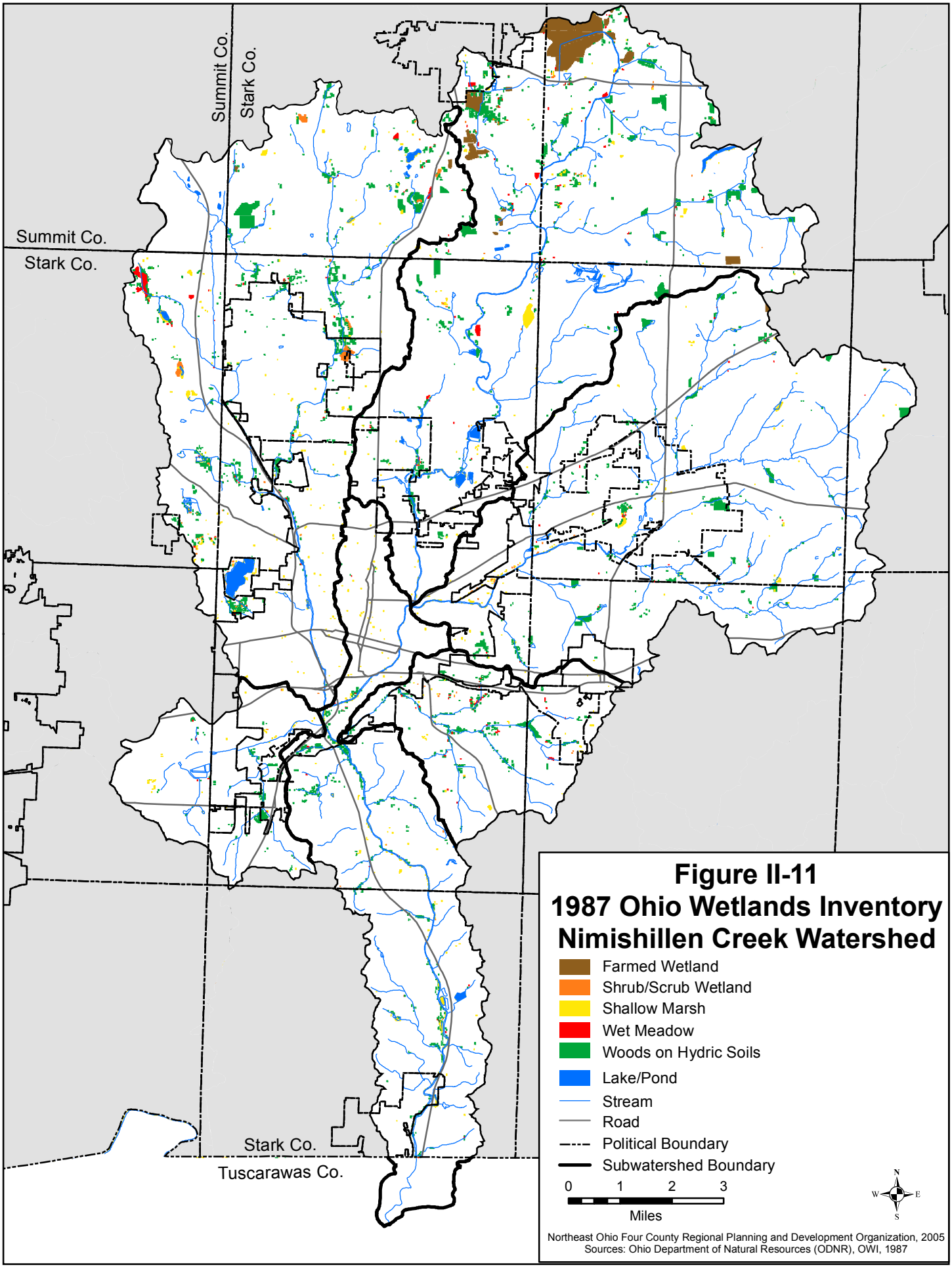

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Figure II-11
1987 Ohio Wetlands Inventory
Nimishillen Creek Watershed
Farmed Wetland
Shrub/Scrub Wetland
Shallow Marsh
Wet Meadow
Woods on Hydric Soils
Lake/Pond
Stream
Road
Political Boundary
Subwatershed Boundary
0 1 2 3
Miles
N
W
E
S
Northeast Ohio Four County Regional Planning and Development Organization, 2005
Sources: Ohio Department of Natural Resources (ODNR), OWI, 1987

order to attain a clear picture of the wetland status within the watershed. The benefits of an accurate wetland inventory can lead to better wetland mitigation options, targeted wetland restorations, and enhanced protection of existing wetlands.

Ground Water

Water Suppliers

Four cities or villages, Canton, North Canton, Louisville, and East Sparta, obtain their municipal water supply from wellfields located within the Nimishillen Creek Watershed. East Canton and Hartville do not have a municipal water system and draw their drinking water from private wells. All of the above water supply areas are within areas serviced by sewers. The City of Canton also receives drinking water from wellfields outside of the Nimishillen Creek Watershed in the Sandy Creek Watershed.

Most of the remaining homes in the watershed rely on individual wells for their drinking water and are located in areas dependant on home sewage treatment systems. These areas include portions of Jackson, Lake, Marlboro, Plain, Nimishillen, Canton, Osnaburg, and Pike Townships.

Ground Water Pollution Potential

In 1991, the Ohio Department of Natural Resources Division of Water completed the mapping of the pollution potential of ground water resources in Stark County. The mapping program used by ODNR is called DRASTIC method and it identifies areas that are vulnerable to contamination. The program takes into account characteristics of an area including depth to water, net recharge of the ground water, aquifer media, soil types, and topography to determine a numeric value indicating the potential pollution risk to ground water resources. The higher the DRASTIC values calculated by ODNR, the greater the vulnerability to contamination. Figure II-12 shows the findings of this analysis.

In general, the ground water pollution potential is higher in the northern portion of the Nimishillen Creek Watershed. This is generally due to reduced topography and the glacial deposits underlying much of the northern portion of the watershed. The highest values are located in Canton, North Canton, Louisville, Nimishillen Township, and Plain Township along Nimishillen Creek and its East, Middle, and West Branches. In the southern portion of the watershed including the Sherrick Run and Mainstem subwatersheds, the highest pollution potential areas are located in the valleys created by the streams. The pollution potential is limited in other areas of these subwatershed due to the steep slopes.

ODNR's *Ground Water Pollution Potential of Stark County, Ohio*, study is useful in developing protection strategies for a large area. It can be used to help prioritize ground water monitoring or clean-up efforts by stakeholders in the county. However, it is not designed to take the place of site investigations for

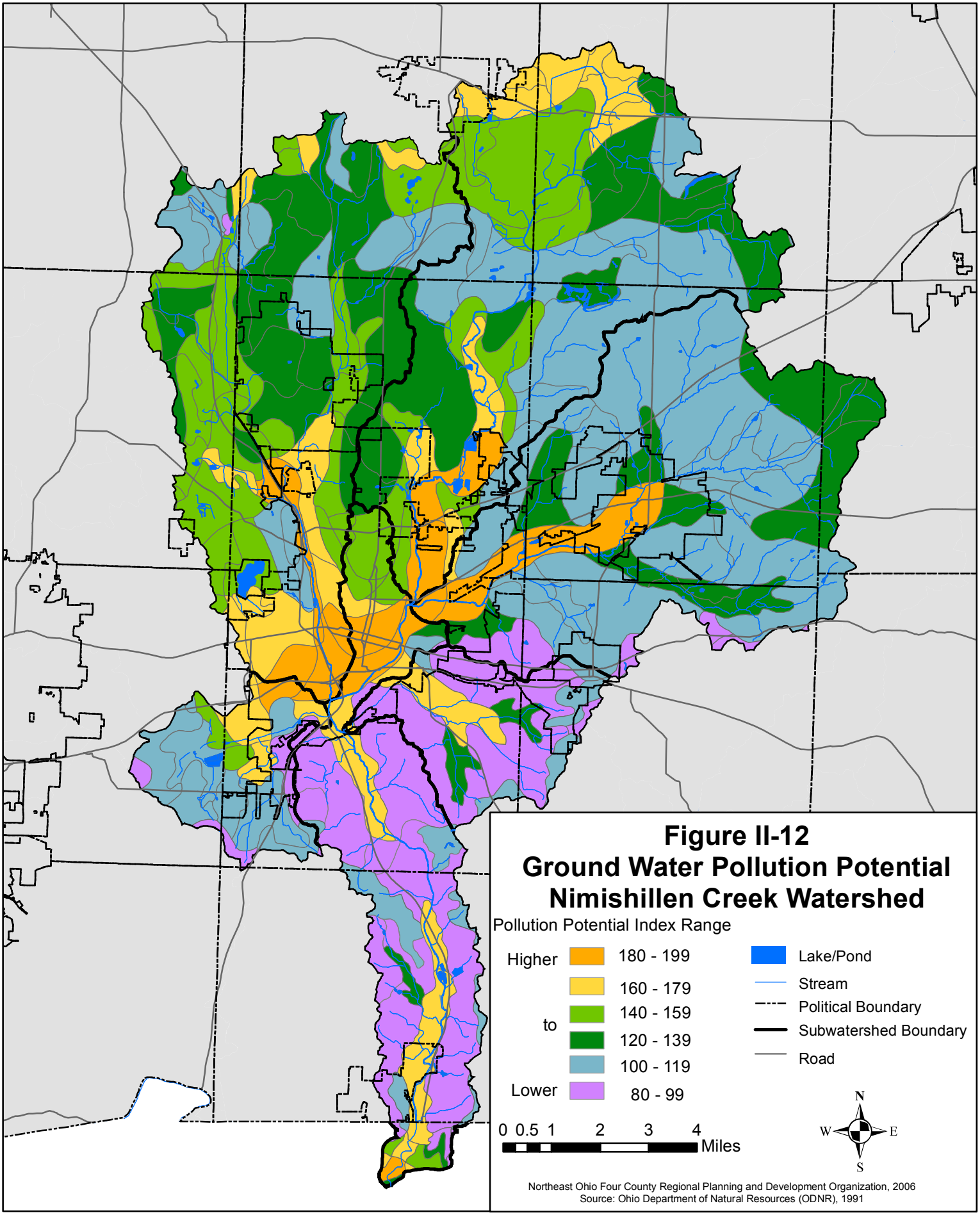


Figure II-12
Ground Water Pollution Potential
Nimishillen Creek Watershed
Pollution Potential Index Range
Higher
to
Lower
180 - 199
160 - 179
140 - 159
120 - 139
100 - 119
80 - 99
Lake/Pond
Stream
Political Boundary
Subwatershed Boundary
Road
0 0.5 1 2 3 4
Miles
N
W
E
S
Northeast Ohio Four County Regional Planning and Development Organization, 2006
Source: Ohio Department of Natural Resources (ODNR), 1991

specific projects. The results of the study should not be applied to areas less that 100 acres (Williams, 1991).

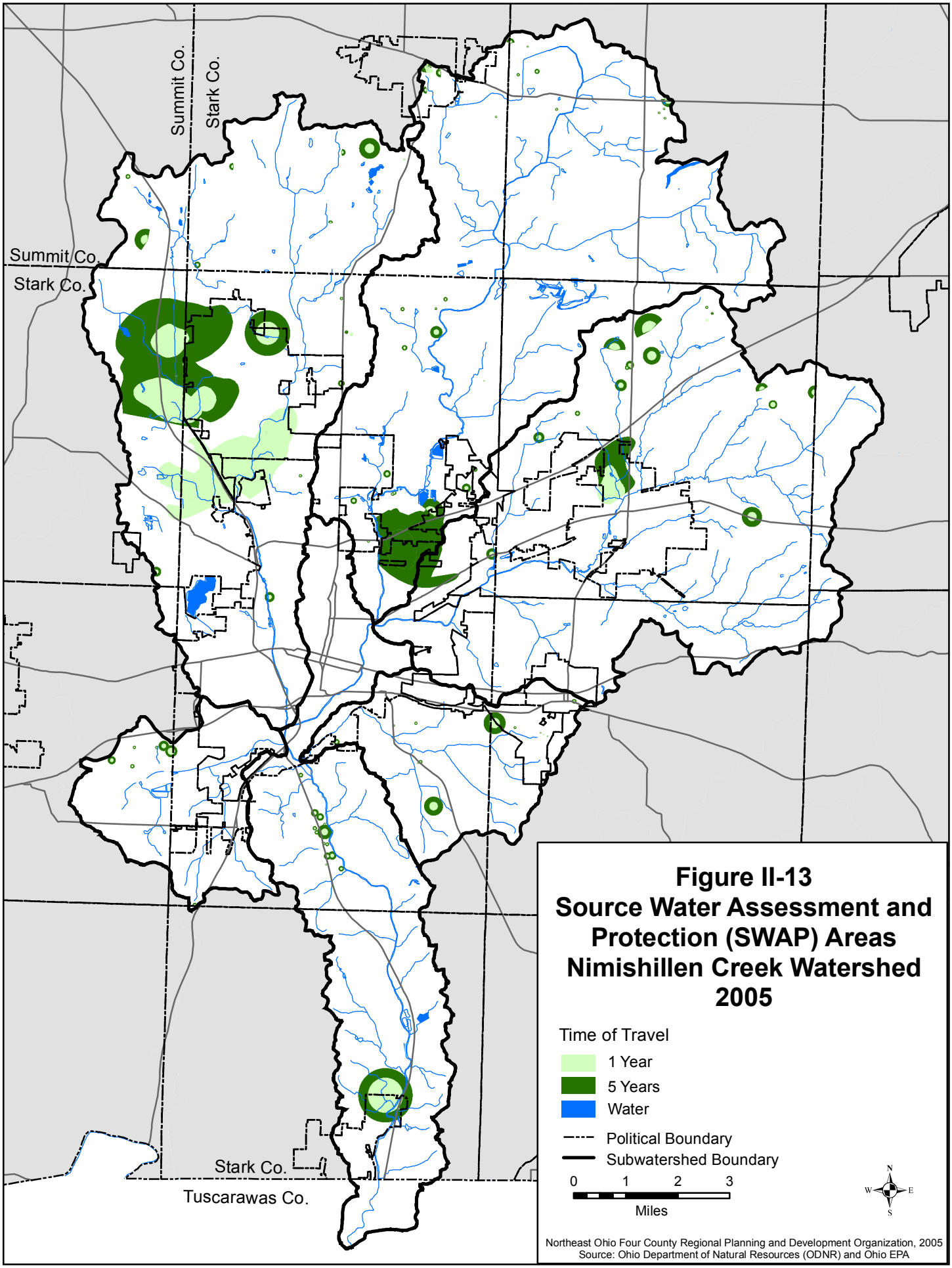
SWAP Program

Ohio's Source Water Assessment and Protection (SWAP) Program is designed to protect ground and surface water resources that are used for public drinking water from contamination. There are two phases in the SWAP Program: assessment and protection. The Ohio EPA completed the assessment phase for all public drinking water systems in the State. The assessment includes a determination of the protection areas, identifying potential contamination sources in the area, and determining the susceptibility of the drinking water to contamination. How long it takes, or the time-of-travel, for water to reach a well used for public drinking water is also determined in the assessment phase. The time-or-travel is typically delineated for up to 5 years. Figure II-13 shows the time-of-travel boundaries for public drinking water systems in the watershed. Land within these areas should be carefully managed to prevent contamination of a drinking water system.

To aid in protection, the Ohio EPA recommends that owners and operators of public water systems complete the second phase of the SWAP Program by developing and implementing a local drinking water source protection plan. The protection plan is locally designed and the content is dependent on the size and type of water systems. All the drinking water systems in the Nimishillen Creek Watershed are from groundwater wells, and typical drinking water protection plans for groundwater sources include public education guidance, water system concerns, contingency plans, and strategies to reduce contamination risks. Completion and implementation of a protection plan is not required by the Ohio EPA, but is highly recommended to ensure an abundant supply of safe drinking water. All public water supply wells in the watershed have a completed assessment analysis, but none have completed a source water protection plan.

Land Use

Characterization of a watershed's land use/land cover can lend a better understanding of potential threats to water quality. A study of the Nimishillen Creek's land use/land cover was achieved by combining 1977 digital land use data with 1994 digital satellite land cover data resulting in a generalized categorization of land use/land cover types. Results of the study revealed that the watershed is comprised of various types of land use/land cover. The most substantial form of land use in the watershed is agricultural/open and urban areas. Potential products of agricultural storm water runoff from fields included animal waste, nutrients, and sediment. Urban areas are also found in the watershed. These areas have the potential to be sources of nutrients, bacteria and other pollutants. Sections of undeveloped land remains in the form of wooded, shrub/scrub, non forested wetland and open area. These areas may help alleviate the impacts from storm water runoff from urbanized areas.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Tuscarawas Co.
Figure II-13
Source Water Assessment and Protection (SWAP) Areas
Nimishillen Creek Watershed
2005
Time of Travel
1 Year
5 Years
Water
Political Boundary
Subwatershed Boundary
0 1 2 3
Miles
N
W
E
S
Northeast Ohio Four County Regional Planning and Development Organization, 2005
Source: Ohio Department of Natural Resources (ODNR) and Ohio EPA

Land Cover

Understanding land uses within the watershed can offer clues as to the types of nonpoint source (NPS) pollutants, subwatersheds at high risk of NPS pollution, and appropriate best management practices (BMPs) to address the problems. The watershed constitutes a total area of approximately 117,826 acres. The majority of the watershed is located in Stark County (98.5%), with a minor portion in Summit and Tuscarawas Counties (1.5%).

The land use/land cover categories for the study area include: 1) Agriculture (cropland, pasture, and orchards)/Open Urban Area (parks, golf courses, lawns, and open grassy areas); 2) Industrial (heavy and light industrial operations); 3) Urban (residential areas, roads, shopping centers, warehouses, office buildings, educational, religious and health care facilities, and parking lots); 4) Non-Forested Wetlands (wetlands identified from the 1994 Thematic Mapper data as well as from the Ohio Wetland Inventory); 5) Barren (strip mines, quarries, sand and gravel pits, and beaches); 6) Wooded (deciduous and coniferous forest land)/Shrub/Scrub (young, sparse, woody vegetation); and 7) Water (lakes, ponds and streams).

The land use/land cover for the watershed is illustrated in Figure II-14. Table II-4 presents the acreage and percentage of land use/land cover in the watershed.

Table II-4:
Land Use/Land Cover by Subwatershed for the Nimishillen Creek Watershed

Land Use/Cover	Total Area		Subwatersheds							
			1, 5, and 6		2		3		4	
	acres	(%)	acres	(%)	acres	(%)	acres	(%)	acres	(%)
Ag/Open	52,716	44.7	9,457	32.9	9,605	32.1	16,965	56.8	16,689	56.9
Industrial	2,924	2.5	1,430	5.0	416	1.4	218	0.7	860	2.9
Urban	34,852	29.6	8,751	30.4	14,018	46.9	6,086	20.4	5,997	20.5
Non-Forested Wetland	1,203	1.0	97	0.3	246	0.8	805	2.7	55	0.2
Barren	42	0.0	28	0.1	2	0.0	5	0.0	7	0.0
Wooded	25,106	21.3	8,815	30.6	5,362	17.9	5,402	18.1	5,527	18.9
Shrub/Scrub	556	0.5	178	0.6	87	0.3	139	0.5	152	0.5
Open Water	427	0.4	19	0.1	159	0.5	228	0.8	21	0.1
Total Area	**117,826**		**28,775**		**29,895**		**29,848**		**29,308**	

Source: Department of Natural Resources, Division of Real Estate and Land Management, 1977 and 1994.

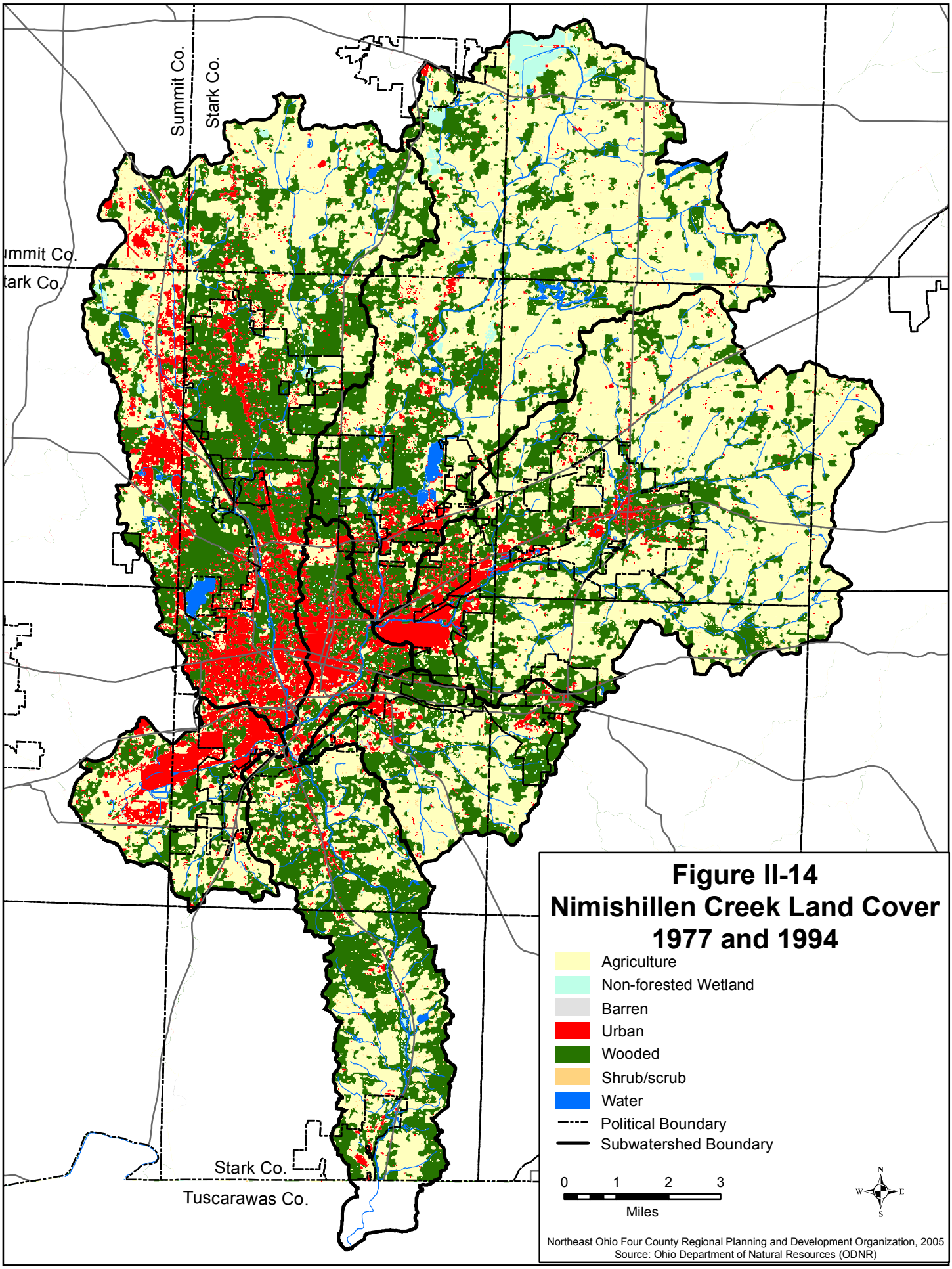
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Figure II-14
Nimishillen Creek Land Cover
1977 and 1994
Agriculture
Non-forested Wetland
Barren
Urban
Wooded
Shrub/scrub
Water
Political Boundary
Subwatershed Boundary
0 1 2 3
Miles
N
W E
S
Northeast Ohio Four County Regional Planning and Development Organization, 2005
Source: Ohio Department of Natural Resources (ODNR)

Table II-4 reveals that the predominate land use in the watershed is agricultural/open land (44.7%). Other significant forms of land use/land cover consist of urban (29.6%) and wooded (21.3%).As residential development continues, the demand for clean and safe water is on the rise. Residential areas have the potential to be sources of nutrients and bacteria, particularly if located in unsewered areas with poor soils for home sewage treatment systems (HSTSs). Nutrients and bacteria can originate from failed HSTSs, while other pollutants can arise as the result of lawn fertilizers, pesticides and general household wastes. As development proceeds, the level of imperviousness and storm water drainage increases. The impacts of storm water runoff from urbanized areas can destabilize streams and ditches. Streams respond to increased flows by eroding (usually along stream banks), transporting and depositing sediment downstream. Increased sediment and attached nutrients may well exacerbate other pollutant impacts, i.e. reducing a stream's ability to assimilate pollution.

Significant portions of wooded, shrub/scrub and open areas are located throughout the watershed (Figure II-14). For example, vast tracts of wooded and shrub/scrub areas are located in the southern and eastern portions of Subwatershed 1, in Pike and Osnaburg Townships, along the Nimishillen Mainstem and Sherrick Run; scattered in the northern portion of Subwatershed 3; and eastern section of Subwatershed 4. The presence of these natural areas probably moderates the impact of runoff from many of the land uses throughout the watershed. These natural areas act as buffers and filters to moderate water flow and reduce erosion and the transport of pollutants downstream.

Status and Trends

The general trend in land usage in the Nimishillen Creek Watershed is nearly identical to land use trends in Stark County. Specifically, the watershed's population is moving towards an uneven suburban growth distribution coupled with increasing abandonment of urban areas and a decrease in rural areas. Areas receiving the bulk of the suburban boom are Plain, Lake, and Jackson Townships in the West and Middle Branches of Nimishillen Creek. Water quality and other environmental degradations are a concern in these developing suburban areas. Also, suburban areas generally lack the open space and park land associated with rural and urban areas, respectively (Stark County RPC, 2005).

The trend of watershed residents moving to suburban areas is reflected in the new single family housing permits issued within Stark County for 2005 and 2006. According to the Stark County Building Industry Association (BIA), the county had 1,031 single family housing permits issued in 2005. The Nimishillen Creek Watershed suburban communities of Jackson Township, Plain Township, and the City of Louisville were all in the top 4 of permits issued with 230, 98, and 63, respectively. The traditional urban centers of Canton and North Canton in 2005 had 49 and 19 single family house permits issued, respectively. Through July of 2006, these housing trends have continued with Jackson Township (108 permits) and

Plain Township (48 permits) having issued the most single family housing permits in Stark County (Stark BIA, 2006).

Impervious Surfaces

Impervious areas in the watershed are those areas where vegetation has been replaced by nearly impermeable surfaces such as roads, sidewalks, parking lots, and roof tops. As the level of impervious cover increases it prevents the infiltration of water into the soil. This can reduce ground water recharge, exacerbate runoff and streambank erosion, and impact the natural aquatic community. Research indicates that stream degradation occurs at levels of imperviousness as low as 10% (Ohio EPA, 1997). Impervious areas can also be the source of a magnitude of pollutants, since gasoline, oil, and chemical spills are likely to occur on impervious surfaces, such as: trucking docks and yards, gasoline stations, and roads. The location of urbanized areas, as well as roads, in the watershed indicate where a high degree of impervious surfaces are found.

Road and bridge construction and maintenance provides an indication of which areas in the watershed are increasing impervious area. Rapidly developing suburban areas are generally going to need more road construction and maintenance projects as the expanding population overwhelms the existing road infrastructure. In addition to the water quality concerns from impervious areas listed above, road construction can also increase sediment loads of nearby streams from construction site erosion and runoff. Road and bridge construction can alter a stream's physical characteristics by building culverts, relocating the stream channel, armoring of the stream banks, and other common construction practices.

Table II-5 shows all the future road and bridge construction and maintenance projects in the Nimishillen Creek Watershed through 2008. Over half of the future projects are located in the quickly developing Plain, Lake, and Jackson Townships. In addition to Stark County road and bridge projects, the Ohio Department of Transportation is working through 2008 to improve and widen the Interstate 77 from Ohio Route 30 to the City of Akron. Interstate 77 runs adjacent to and crosses the West Branch of Nimishillen Creek throughout much of these construction areas.

Table II-5: Future Road and Bridge Construction and Maintenance Projects in the Nimishillen Creek Watershed			
Project Name	**Type of Construction and Maintenance**	**Subwatershed - Municipality/Township**	**Start Date**
Paris - Meese Intersection	Road	East Branch - Nimishillen Twp.	2006
Georgetown	Bridge	East Branch - Osnaburg Twp.	2006
Trump - Georgetown Intersection	Road	East Branch - Canton Twp.	2006
Beck Street	Bridge	East Branch - Nimishillen Twp.	2007
Broadway Street	Bridge	East Branch - Nimishillen Two.	2007
Columbus - Paris Intersection	Road	East Branch - Nimishillen Twp.	2007
Miday Ave.	Bridge	East Branch - Nimishillen Twp.	2007
Easton Street. - Paris Intersection	Road	East Branch - Nimishillen Twp.	2008
30th St. - Harrisburg Intersection	Road	Middle Branch - Plain Twp.	2006
55th Street	Bridge	Middle Branch - Plain Twp.	2007
Middlebranch - State Intersection	Road	Middle Branch - Lake Twp.	2007
Werner Church Street	Bridge	Middle Branch - Plain Twp.	2007
Market - Mt. Pleasant Intersection	Road	Middle Branch - Lake Twp.	2008
Portage Street Widening	Road	West Branch - Jackson Twp.	2004
Applegrove - Frank - Strausser	Road	West Branch - Jackson Twp.	2005
12th Street	Bridge	West Branch - Perry Twp.	2006
20th Street - Lakeside Intersection	Road	West Branch - Plain Twp.	2007
Everhard - Whipple Intersection	Road	West Branch - Plain Twp.	2008
Applegrove Widening	Road	West Branch - Jackson Twp.	2008
Ridge Ave.	Bridge	Mainstem - Canton Twp.	2006
Source: Ohio Public Works Commission. *Stark County - Five Year Capital Improvement Plan/Maintenance of Effort.* 2003.			

Protected Lands

Protected lands within the Nimishillen Creek Watershed can generally be divided into two categories: agricultural best management programs and recreational parks. As noted above there are a number of parks within the Nimishillen Creek Watershed. Although primarily used for recreation, the parks provide environmental benefits including floodplain preservation, wildlife habitat, and riparian habitat protection.

Agricultural best management programs offered through the United States Department of Agriculture also protects lands through the Conservation Reserve Program or CRP. The CRP is a voluntary program where agricultural land owners receive rental payments and cost-share assistance to establish long-term cover crops to protect eligible lands. Contracts with land owners are for 10 to 15 years. Stark County has 334.3 acres enrolled in the CRP. The total acreage for land enrolled within the Nimishillen Creek Watershed was requested, but not provided in time for inclusion in this plan.

Additional protected lands include agricultural easement, land owned by Earth Action Partnership, and additional land owned by Stark Parks that have yet to be developed into active parks or trails. These lands are summarized in Table II-6. This section will be updated to include new lands that come under protection and/or existing protected lands not included in this original plan.

Table II-6: Known Protected Lands in the Nimishillen Creek Watershed

Entity	Property Name - Location	Size (acres)	Type of Protection	Subwatershed
Stark Parks	Aultman Property - Martindale Road	14.7	Ownership	Middle Branch
Stark Parks	Boettler Barn - Werner Church Rd. & Boettler	5.9	Ownership	Middle Branch
Stark Parks & North Canton	Hoover Connector Trail - Hoover Park	Not Given	Ownership	West Branch
Stark Parks	Linder - 55th St. & Harmont	8.7	Ownership	Middle Branch
Stark Parks	Nickel Plate Trail - Georgetown Road	39.8	Ownership	East Branch
Stark Parks	Plain Center Trail and Wetland - Plain Center Rd. & 55th St.	26.8	Ownership	Middle Branch
Stark Parks	Reno Drive	7.5	Ownership	East Branch
Stark Parks	Sanctuary - Applegrove Rd.	2.3	Ownership	East Branch
The Wilderness Center	State Street & Market Ave.	99.5	Agricultural Easement	Middle Branch

Agriculture

Agricultural data for Nimishillen Creek has not been separated from information provided by various agencies for Stark, Summit, and Tuscarawas Counties. However, the majority of the agricultural lands and activities occur in subwatersheds 2 and 3 which are entirely located in Stark County. Therefore, agricultural information for the Nimishillen Creek Watershed is assumed to be similar to agricultural data provided for Stark County.

According to the *2003 Ohio Department of Agriculture Annual Report and Statistics* Stark County has a total of 1,330 farms with the average size of 109 acres. The total land in farms for the entire county is 145,000 acres which translates into a commercial grain capacity of 483,000 bushels. Since 1990, their has been 13,000 acre reduction in the amount of farm land in Stark County.

Crop Type

Table II-7 contains a summary of crops produced in Stark County. The county ranks high in the State for production of oats and hay and near the middle for corn, grain, soybean, and wheat.

Table II-7: 2010 Crop Production for Stark County, Ohio

2003 Crop	Acres Harvested	Yield	Production	State Rank
Corn and Grain (bushels)	25,100	148.8	3,735,000	47
Soybean (bushels)	27,900	44.5	1,241,000	55
Wheat (bushels)	-	-	-	-
All Hay (tons)	15,100	-	43,100	--

Source: 2010 Ohio Department of Agriculture Annual Report and Statistics

Tillage

Many crop producers in Stark County have adopted conservation tillage techniques. Conservation tillage, or “no-till”, is when farmers use specialized equipment to plant their field(s) without turning the soil and exposing the topsoil. Conservation tillage has become a popular practice since the early 1990s because it can produce the same or greater yields for a farmer while lowering production costs, eliminating plowing/discing/cultivating, improving soil moisture, reducing soil compaction, increasing organic matter, and reducing insect and disease problems. Local water resources benefit from no-till practices because they can reduce soil erosion by up to 90 percent. Also, conservation tillage increases infiltration rates resulting in less runoff. Reduction in erosion and runoff from fields reduces the sediment, chemicals, and nutrients entering a stream or lake. Below is a summary of tillage practices in Stark County.

As Table II-8 indicates, over 78 percent of the active crop lands in Stark County are utilizing a conservation tillage practice. The majority of the conservation tillage is no-till, the most environmentally beneficial type. However, nearly a quarter (22 percent) of acreage in corn production still uses conventional tillage (residue <30%).

Table II-8: Summary of Tillage Statistics in Stark County, Ohio							
Crop Type	Overall Acres	Conservation Tillage > 30% Residue			Conservation Tillage Total	Other Tillage Systems	
		No-Till	Ridge-Till	Mulch-Till		15-30% Residue	0-15% Residue
Corn	29,900	19,435	0	3,887	23,332	3,289	3,289
Small Grain	8,900	6,410	0	0	6,410	2,145	345
Soybeans	23,000	19,550	0	0	19,550	1,500	1,950
Forage Crops	2,000	500	0	0	500	0	1,500
Total	**63,800**	**45,895**	**0**	**3,887**	**49,782**	**6,934**	**7,084**
Source: Conservation Technology Information Center - 2004 Summaries for Stark County, Ohio							

Rotations

In general, crop rotating increases crop yield by improving the soil, reduces weeds and insects, and is instrumental in a successful conservation tillage program. It is well documented that yields increase if a crop rotation procedure is followed. Increased yields are often accomplished with less fertilizers and insecticides than using a continuous one crop plan.

According to the Stark County Soil and Water Conservation District, crop rotations in the Nimishillen Creek Watershed and Stark County are similar to the rest of Ohio's counties. Grain farmers often use a rotation of corn, soybeans, and wheat. Dairy producers' rotation is typically a corn silage followed by a hay and wheat crop. Beef producers usually use a corn, hay, and pasture rotation.

Irrigation

Irrigation is used during dry periods to ensure the continued health of a crop and to protect crops from cold weather. Well watered crops have increased size and weight and a reduction in defects. Ohio is a water-rich state that has historically received enough precipitation to satisfy growers' needs limiting the need for irrigation. A survey conducted in 1989 found less than 40,000 acres were irrigated in Ohio. However, advances in irrigation knowledge coupled with periods of drought over the last 20 years has likely increase the total acres irrigated statewide since 1989 (Brown, 1991). Specifically, vegetables and fruits need a steady supply of water throughout their development for high yields and good quality. Moisture shortage at critical times during development can greatly limit growth and yields.

The Ohio Farm Bureau Federation (OFBF) recently conducted a state-wide survey to better assess irrigation in the state. There were seven responses from farmers in Stark County covering 1050 acres of vegetable crops, 66 acres of fruit crops, and 2 acres of horticultural crops produced under irrigation. Six out of seven respondents use irrigation for crop production. Irrigation water sources are wells (71 percent), ponds (14 percent), and lakes (14 percent). None of the producers draw water directly from Nimishillen Creek. The survey also shows that only 29 percent of the respondents use soil moisture devices to determine when to irrigate crops, depending more on visual condition of crop (86 percent) and feel of the soil (43 percent). All of the survey respondents indicated they irrigate in June, July, and August, 80 percent irrigate in September and October, and 60 percent in April (Antosch, 2006).

There are several potential impacts to local water resource from irrigation. Excessive irrigation can result in polluted runoff with concentrated nutrients, sediments, pesticides, and other chemicals reaching surface water resources. Using wells to supply irrigation waters could lead to the lower of the local water table and the pollution of the groundwater through leachate from irrigated fields.

The largest farm that uses irrigation in the Nimishillen Creek Watershed is K. W. Zellers & Sons, Inc. producing vegetables for commercial sale on 600 farmable acres of muck soils in Marlboro Township. They draw their irrigation water from wells that are regularly tested for total coliform, heavy metals, nitrates, and nitrites. Ground water from K. W. Zellers & Sons, Inc. wells have never tested above the standards for these parameters as established by Food and Drug Administration and the Ohio Department of Health.

Zellers & Sons also have a extensive drainage system to complement their irrigation practices. Field tile drains water to sumps which is then pumped into ditches that empty into Swartz Ditch in the Middle Branch Subwatershed. The water in these ditches is also regularly tested for nitrates, nitrites, and phosphorus before discharging into Swartz Ditch. Nitrate and nitrite levels have never exceeded 10 mg/l, Ohio's maximum contamination levels for public drinking water standards, and are often below detection limits. Phosphorus readings range between below detection limits to 0.3 mg/l. Lastly, Zellers & Sons can control the water levels in both their drainage tile system and nine acre pond through water control structures. This allows the farm to absorb or retain over 10 inches of precipitation without an increased discharge to Swartz Ditch (Lukens, 2006)

Livestock Inventory and Grazing

Stark County ranks as one of the top 10 for inventory of cattle, calves, and mild cows. Table II-9 summarizes the livestock inventory for the county.

Table II-9: 2010 Livestock Inventory for Stark County, Ohio		
2003 Livestock	**Number**	**State Rank**
All Cattle and Calves	26,000	11
Milk Cows	9,400	6
All Hogs and Pigs	6,400	47
All Sheep and Lambs	1,700	22
Source: 2010 Ohio Department of Agriculture Annual Report and Statistics		

A grazing survey for the Watershed has not been completed. However, the U.S. Department of Agriculture's Natural Resources Conservation Service (NRCS) District Technician for Stark County judges that the majority of the grazing in the Nimishillen Creek Watershed occurs south of Nimishillen Creek Township due to the unglaciated topography. Beef cattle constitute the majority of the grazing animals in this area. Dairy operations in the watershed are located north of Osnaburg Township in the glaciated portions of the watershed. The NRCS District Conservationist estimates that 10 to 15 percent of the watershed is grazed (Bayham, 2006).

Agriculture and Economy

According the Ohio Farm Bureau Federation, agriculture contributes $2.3 billion in output and employees 32,800 people in Stark County. Table II-10 shows the total value cash receipts from marketing of farm commodities from Stark County farms in 2002.

Table II-10: 2002 Cash Receipts from Marketing of Farm Commodities in Stark County, Ohio	
Commodity	**Value**
Dairy and Milk	$29,511,000
Poultry and Other Livestock	$68,967,000
Cattle and Calves	$7,208,000
Corn	$11,594,000
Soybean	$10,513,000
Oats and Hay	$1,632,000
Hogs and Pigs	$1,197,000
Wheat	$2,270,000
Other Crops	$11,898,000
Total	**$144,791,000**
Average Per Farm	**$112,241**
Source: 2010 Ohio Department of Agriculture Annual Report and Statistics	

Socioeconomics

Demographics

Over 95 percent of the Nimishillen Creek Watershed is located in Stark County. The total population of Stark County is 378,098, with 90 percent of the population white and 7 percent black. The largest age group represented is the 35-44 year olds which comprises over 15 percent of the county's population. The City of Canton is the largest populated entity with 80,806 residents. Other city's and village's populations within the watershed are North Canton (16,369), Louisville (8,904), Hartville (2,174), East Canton (1,629), Hills and Dales (216), and Meyers Lake (480) (U.S. Census, 2000).

Table II-11 shows the population trend in Stark County since the 1860 U.S. Census. Overall population growth has been modest since 1980 with a 2.8 percent increase from 1990 to 2000. The principal trends in population have been suburbanization, changing household composition, and increases in aging and minorities among residents (Stark County RPC, 2005). The latest U.S. Census information show a decrease of county population in 2010 to 375,586 or decrease of 2,512 people since 2000.

Table II-11: Stark County's Decennial Population Since 1860

1860	42,987	**1940**	234,887
1870	52,508	**1950**	283,194
1880	64,031	**1960**	340,345
1890	84,170	**1970**	372,210
1900	94,747	**1980**	378,823
1910	122,987	**1990**	367,585
1920	177,218	**2000**	378,098
1930	221,784	**2010**	375,586

Source: 2010 U.S. Bureau of the Census

Economics

Based on information from the Stark County Regional Planning Commission, Stark County's total labor force is 175,401 and total employment equals 204,702. The commercial sector employs 35,739, industrial employment is 43,599, the service industry has 96,315 workers, and all other employers provide 29,049 jobs in the county. Stark County's 2003 unemployment rate was 6.7 percent, which ranked 41st highest of the 88 Ohio counties.

A significant trend in Stark County is suburbanization. Jobs have followed population shifts to the suburbs, especially in the commercial and retail sectors. In

1970, there was a balance between jobs located in the City of Canton and the rest of Stark County. Since then Canton and other cities have lost jobs while other areas have become major employment centers like Plain Township, Jackson Township, and North Canton. Other employment trends show growth of service jobs at the expense of traditional manufacturing employment (Stark County RPC, 2005).

There is also an increase in commuting times as jobs become more decentralized from suburbanization. Daily vehicle miles traveled by people from urban areas has increased over 66 percent (4,295 to 6,480 miles) from 1990 to 2000. Daily miles traveled by rural residents has slightly decreased from 1,843 miles in 1990 to 1,663 miles in 2000 (Stark County RPC, 2005).

Physical Attributes

Riparian Corridor Study

NEFCO completed a riparian corridor survey as part of its *Comprehensive Watershed Management Plan - Phase I* in 2000. The purpose of this Nimishillen Creek Riparian Habitat Inventory is to evaluate the condition of the riparian corridor along the Nimishillen Creek Mainstem, Sherrick Run, Hurford Run (Nimishillen Creek Subwatershed); West Branch Nimishillen Creek, West Branch Tributary-1 (West Branch Subwatershed); Middle Branch Nimishillen Creek, Swartz Ditch (Middle Branch Subwatershed); and East Branch Nimishillen Creek, East Branch Tributary-1 and East Branch Tributary-2, as they existed in March 1997.

The riparian inventory report was completed by using 1997 aerial photos of the watershed to investigate riparian habitat along the Nimishillen Creek mainstem and major tributaries. The criteria used to evaluate the riparian habitat were developed from the Ohio EPA Qualitative Habitat Index (QHEI). Each streambank was analyzed for both riparian width and quality, then scored numerically. See the *Comprehensive Watershed Management Plan - Phase I* for more information on the methodology used.

The study was conducted under the belief that riparian corridors are important components of the environment, and that such natural areas are subject to adverse impacts caused by commercial and residential development, which is exacerbated by habitat and hydraulic modifications. The integrity of the riparian corridor habitat is a key component of a watershed because an intact corridor helps the stream resist erosion and protects water quality from influxes of pollutants, sediment and overland runoff.

Based on the results of the riparian habitat evaluation for the watershed, NEFCO has been able to conclude that residential and commercial development as well as agricultural practices has fragmented much of the riparian habitat (Figure II-15). Numerous segments indicate a loss of riparian habitat through habitat modification caused by channelization, streambank alteration, stream burial, removal of riparian vegetation and an increase in impervious surface areas. Such impacts contribute to

the instability of riparian corridor ecosystems and raise serious concerns regarding water quality issues by increasing the amount of storm water runoff, streambank erosion, sedimentation, loss of shading, and the inability to serve as filter areas to trap sediment.

Table II-12 indicates that the following streams received average riparian habitat scores from highest to lowest: for the "High" category: no average stream scores were above 5.0; "Moderate": Nimishillen Creek Mainstem - 4.76; Sherrick Run - 4.54; East Branch Nimishillen Creek - 3.09, East Branch Tributary 2 - 2.98, West Branch Tributary 1 - 2.86, West Branch Nimishillen Creek - 2.85; "Low" category: Swartz Ditch - 1.87, and Hurford Run - 1.58. Additionally, each subwatershed received an average riparian habitat score, of which the Mainstem Subwatershed received the highest score of 4.76, follow by Sherrick Run Subwatershed, East Branch Subwatershed, West Branch Subwatershed, Middle Branch Subwatershed, and Hurford Run Subwatershed with scores of 4.54, 3.80, 2.86, 2.48, and 1.58, respectively.

Table II-12: Nimishillen Creek Watershed
Percentage of Low, Moderate and High Quality Riparian Habitat

Stream Name	Subwatershed	Average Riparian* Habitat Score	Ranking based on Average Riparian Habitat Score	Subwatershed Average Riparian Habitat Score	Ranking based on Subwatershed Average Riparian Habitat Scores
Nimishillen Creek (Mainstem)	Mainstem	4.76	1	4.76	1
Sherrick Run	Sherrick Run	4.54	2	4.54	2
Hurford Run	Hurford Run	1.58	10	1.58	6
West Branch Nimishillen Creek	W. Branch	2.85	8	2.86	4
West Branch Trib. 1		2.86	7		
Middle Branch Nimishillen Creek	M. Branch	3.09	5	2.48	5
Swartz Ditch		1.87	9		
East Branch Nimishillen Creek	E. Branch	4.39	3	3.80	3
East Branch Trib. 1		4.03	4		
East Branch Trib. 2		2.98	6		

Habitat Scores: > 5 = "High"; 2 - 5 = "Moderate"; <2 = "Low"
* Calculated by dividing the total points by the total number of stream segments.
Source: C*omprehensive Watershed Management Plan - Phase 1.* NEFCO, 2000.

Tables and additional information about the riparian habitat can be found in the Riparian Corridor Study, as part of the *Nimishillen Creek Comprehensive Watershed Management Plan - Phase I*. This information can be used to target severely altered riparian segments, streams or subwatersheds for remediation activities or target areas with intact riparian habitat for protection/preservation efforts.

Ohio EPA's Habitat Restorability Rating

The Ohio EPA in its 2000 Ohio Water Resource Inventory ranked stream segments based on their likelihood of having their aquatic life use restored to a condition comparable to reference conditions in each ecoregion. The major factors used to determine the restorability of a stream segment included habitat quality, watershed conditions, stream gradient, and aquatic life use designations. Stream segments were then categorized from least restoration potential, or "Essentially None"; to most restoration potential, or "Extremely High". The results of this effort by the Ohio EPA are summarized in Table II-13.

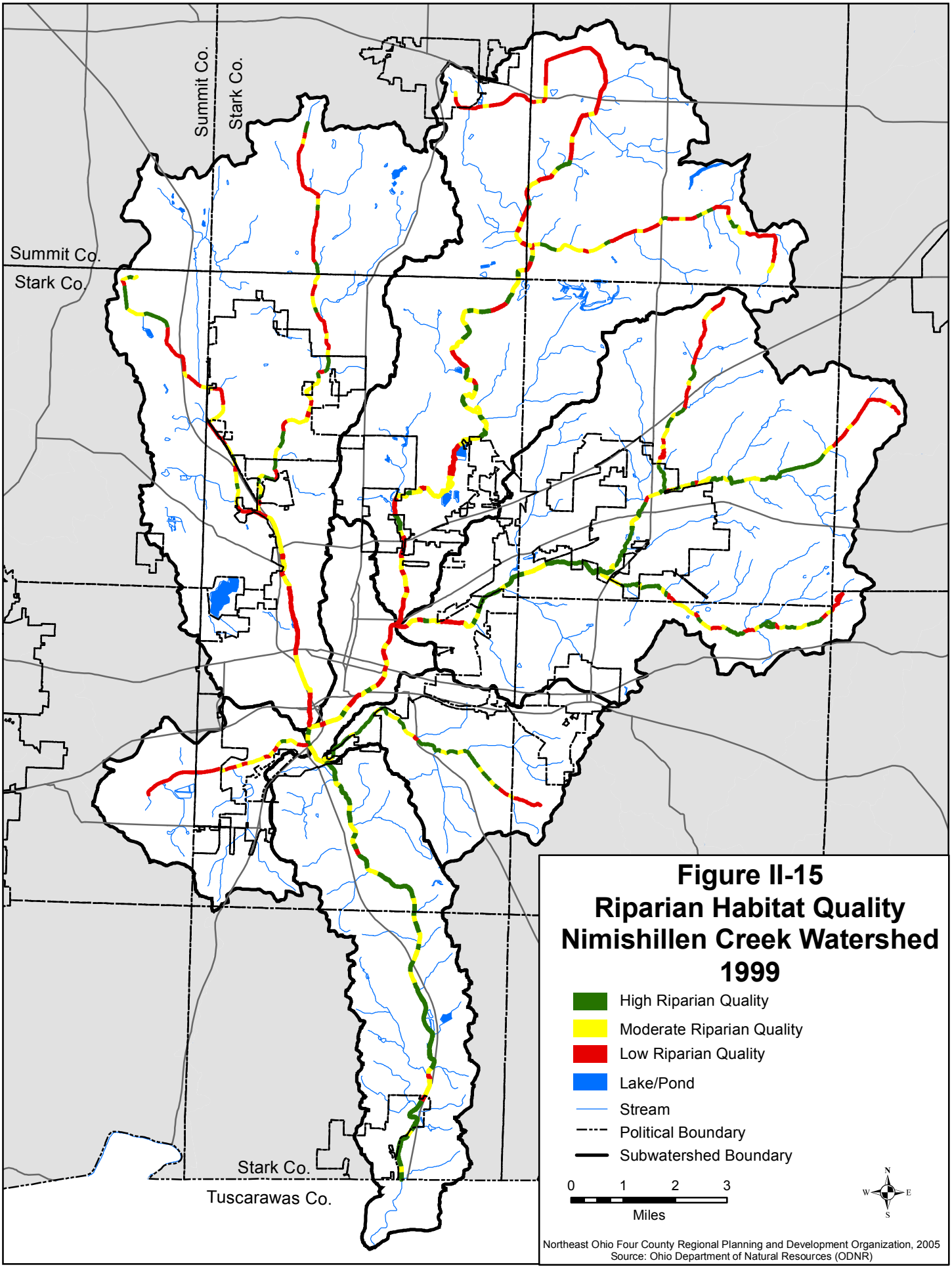

Summit Co.
Stark Co.
Summit Co.
Stark Co.
Stark Co.
Tuscarawas Co.
Figure II-15
Riparian Habitat Quality
Nimishillen Creek Watershed
1999
High Riparian Quality
Moderate Riparian Quality
Low Riparian Quality
Lake/Pond
Stream
Political Boundary
Subwatershed Boundary
0 1 2 3
Miles
N
W
E
S
Northeast Ohio Four County Regional Planning and Development Organization, 2005
Source: Ohio Department of Natural Resources (ODNR)

Table II-13: Ohio EPA Restorability Rating Factor for Aquatic Life Based on Stream Habitat Quality Index for Nimishillen Creek

Creek Segment (Upper/Lower River Mile)	Segment Mean QHEI	Mean Gradient (feet/mile)	Drainage Area (square miles)	Restorability Rating*	Ohio EPA Confidence
Nimishillen Creek Mainstem (14.70/0.00)	73.80	8.9	150.05	High	High
Hurford Run (4.95/0.00)	41.64	23.4	6.34	Essentially None	High
- Domer Ditch (3.21/0.00)	58.10	17.9	2.34	Moderate - High	High
Sherrick Run (6.80/0.00)	53.17	16.6	5.40	Essentially None	High
- Osnaburg Ditch (1.50/0.00)	40.50	34.87	1.00	Essentially None	High
West Branch Nimishillen Creek (9.00/0.00)	51.81	8.0	38.75	Moderate - High	High
- McDowell Ditch (6.27/0.00)	34.00	8.4	10.00	Essentially None	High
- Hoover Ditch (1.23/0.00)	48.00	11.6	1.50	Essentially None	High
- Zimber Ditch (4.46/0.00)	47.31	13.2	6.38	Essentially None	High
Middle Branch Nimishillen Creek (16.60/0.00)	54.67	4.4	31.50	Moderate - High	High
- Swartz Ditch (8.10/0.00)	35.17	3.0	8.67	Essentially None	High
- Guiley/Hartfield Ditch (4.00/0.00)	34.33	10.36	1.87	Essentially None	High
East Branch Nimishillen Creek (10.40/0.00)	66.83	85	148.50	High	High
- Tributary to East Branch (3.98/0.00)	44.00	16.2	3.00	Low	Moderate

Source: 2000 Ohio Resource Inventory, Appendix E
QHEI = Qualitative Habitat Evaluation Index
* Essentially None: Limited Resource Water (LRW) or Modified Warm Water Habitat (MWH)
Low: Mean QHEI > 30 and $\leq$ 45; Mean Gradient Score < 7
Moderate - High: Mean QHEI $\geq$ 60 and < 75; Mean Gradient $\leq$ 4
High: Mean QHEI $\geq$ 60 and < 75; Mean Gradient > 4

The Qualitative Habitat Evaluation Index (QHEI) is the methodology used by the Ohio EPA to assess habitat conditions in Ohio's waterways. The evaluation of habitat is important because it is one of the primary factors affecting the biological integrity of streams (Karr, 1983). QHEI factors that greatly affect a stream's biological composition include recent channelization, silt/muck substrates, non-sparse cover, and shallow depths. QHEI scores at the segment level will reflect these factors.

Riparian Miles with Permanent Protection

Currently there are no protected areas within the Nimishillen Creek Watershed with the specific rationale of preserving or restoring riparian habitat. That is, no conservation easements or land purchases have been completed with the sole intent of protecting riparian areas. However, there are significant portions of the riparian corridor that are protected parkland. Figure II-3 and Table II-2 summarize the parks located adjacent to Nimishillen Creek and its tributaries.

Riparian protection is a priority in the watershed given the multiple functions it provides from storing flood waters to reducing pollution entering the creek. Ideally, high quality habitat such as forested riparian areas and intact riparian corridors in sections of the watershed facing development (e.g. Plain and Lake Townships) should be investigated first for protection. Coupling riparian protection with existing or future recreational or flooding prevention projects will likely result in the greatest success.

Dams

According to the ODNR Division of Water record, there is only one low head dam along Nimishillen Creek and its tributaries. This is located along the Middle Branch near Martindale Park (RM 3.5). There are likely other low head dams along Nimishillen Creek that have not been reported to ODNR. Overall, dam removal is not a priority for water quality improvement in this watershed.

Gradient

Stream gradient can indirectly indicate how quickly a stream segment can recreate needed habitat features over time. With all else equal, the steeper the gradient of a stream, the more power the stream possess allowing it to more quickly recover from perturbations such as flooding or sedimentation. Based upon observed relationships between stream gradient and fish sampling by the Ohio EPA, a gradient of 6 ft./mile of watershed less than 20 square miles, or 2 feet per mile for watersheds between 20-200 square miles is needed to achieve a normal Warm Water Habitat fish community

Table II-14 shows the average stream gradients and percent of slope for Nimishillen Creek and it major tributaries. Typically, a stream with a steep gradient has more energy available for stream flow. This increases its capacity to headwardly erode and transport sediment loads and debris downstream. The stream gradient

diminishes as it approaches the convergence with the mainstem or higher order stream.

Table II-14: Nimishillen Creek Watershed
Average Stream Gradient and Percent of Slope

Stream Name	Average Stream Gradient	Percent of Slope
	height/length = avg. stream gradient	vertical distance/horizontal distance x 100 = % of slope
Nimishillen Creek Mainstem*	107'/13.5 mi = 7.93 ft/mi	107'/72,280' x 100 = .15%
Sherrick Run	141'/5.70 mi = 24.74 ft/mi	141'/30,096' x 100 = .47%
Hurford Run	54'/3.50 mi = 15.43 ft/mi	54'/18,480' x 100 = .29%
West Branch Nimishillen Creek	148'/14.10 mi = 10.5 ft/mi	148'/74,448' x 100 = .20%
West Branch Trib. -1	124'/6.70 mi = 18.51 ft/mi	124'/35,376' x 100 = .35%
Middle Branch Nimishillen Creek	212'/17.80 mi = 11.91 ft/mi	212'/93,984' x 100 = .22%
Swartz Ditch	38'/8.9 mi = 4.27 ft/mi	38'/47,400' x 100 = .08%
East Branch Nimishillen Creek	178'/13.50 mi = 13.19 ft/mi	178'/71,280' x 100 = .25%
East Branch Trib. -1	168'/6.20 mi = 27.10 ft/mi	168'/32,736' x 100 = .51%
East Branch Trib. -2	141'/4.45 mi = 31.69 ft/mi	141'/23,496' x 100 = .60%

*Any Stream Gradient to the Stark/Tuscarawas County Line
Source: Nimishillen Creek Comprehensive Watershed Management Plan - Phase I

Channelization and Other Modifications

Portions of Nimishillen Creek and its tributaries have been modified for various reasons over the last several decades. Maps dating back to the early 1900s show heavy channelization in agricultural areas to improve drainage in “swamp” lands and increase the available acreage for crops along the West and Middle Branches. According to the Stark County Engineer’s records, the first Stark County “dedicated” ditch was completed in 1867 with the last finished in 1948. A total of 77 “dedicated” ditches created over this span were located in the Nimishillen Creek watershed. The Middle Branch and West Branch subwatersheds contain the majority of these ditches with 33 and 29, respectively. Hurford Run has six “dedicated” ditches, while Sherrick Run has contains five. The Mainstem of Nimishillen Creek (three ditches) and East Branch (one ditch) were the least impacted by this 81 years of ditching projects. Table II-15 has a summary of largest ditches in the watershed. Appendix E has a complete list of Stark County “dedicated” ditches within the Nimishillen Creek watershed.

In 1957, the State revised the Ohio County Ditch Law establishing a framework for creating (petitioning) and maintaining ditches at the county level. Since all major ditching in the watershed occurred prior to the creation of these laws, maintenance by Stark County was not required and often ignored. Consequently, many of these ditches no longer provide the drainage function they were intended due to sedimentation and debris located in the channel. Without maintenance, some of the smaller "dedicated" ditches reverted back to a natural creek shape. Ditches that are still providing drainage to farmland have by-in-large been maintained by the private sector.

Table II-15: Large Ditches in the Nimishillen Creek Watershed

Ditch Name	Subwatershed	Length (miles)	Drainage Area (mi^2)
Domer	Hurford Run	3.21	2.34
Gailey - Hartfield	Middle Branch	4.00	1.87
Hoover	West Branch	1.23	1.50
McDowell	West Branch	6.27	10.00
Osnaburg	Sherrick Run	1.50	1.00
Swartz	Middle Branch	8.10	8.67
Zimber	West Branch	4.46	6.38
	Totals =	**28.77**	**31.76**

Source: 2000 Ohio Resource Inventory, Appendix E

Also, many of these areas that were ditched over 50 years ago have been converted from agriculture to urban/suburban areas. This has resulted in localized flooding of homes and businesses in areas drained by these aging drainage systems. In response to these events, the Stark County Commissioners and Engineer have recently established a ditch maintenance program to help alleviate some of these drainage problems. A long term goal of the Stark County Drainage Task Force is to develop a comprehensive county drainage plan to address water quantity and quality problems which will include these ditched areas (see above).

Eroded Banks

No quantitative data have been collected documenting bank erosion along Nimishillen Creek and its primary tributaries. However, observations of stream bank conditions have been documented to some extent during NEFCO macroinvertebrate surveys in 2000, 2002, and 2004. In general, areas that lacked riparian habitat vegetation and/or had grassed banks, were areas commonly cited as having some bank erosion problems. Also, Sherrick Run was noted as having some bank erosion problems, but this is likely the result of the steep gradient and topography of the

basin. For more details on observations from these studies, please refer to NEFCO's *Nimishillen Creek Macroinvertebrate Surveys.*

Presumably there are many sections of the creek outside of the macroinvertebrate sampling stations detailed above that have bank erosion problems. Channelized or ditched areas, especially without regular maintenance, will gradually seek a more natural serpentine or meandering footprint resulting inevitably in bank erosion. Agricultural areas, and in particular livestock operations, are likely to have bank erosion occurring if certain best management practices such as exclusion fencing are not being used. An eroded bank survey is not planned for the watershed, but could be included in future projects. Examining stream banks in agricultural areas and along ditched sections of the creek would be a logical starting point.

Floodplain Connectivity

A study of Nimishillen Creek and its tributaries' connection with the floodplain has not been completed. However, the Stark County Drainage Task Force is working with the U.S. Army Corps of Engineers to conduct an engineering study of the areas that will likely document this attribute. The Nimishillen Creek Watershed Partners will promote the inclusion of floodplain connective analysis for headwater and other smaller streams in the U.S. Army Corps study. The study should be started in 2007.

Riparian Levees

An extensive levee system has not been constructed along Nimishillen Creek. It is possible that localized levees have been placed over the years to prevent flood waters from inundating specific locations, but none have been documented. This section will be updated should such levees be discovered. Also, the Nimishillen Creek Watershed Partners will request the inclusion of a riparian levees inventory as part of the upcoming U.S. Army Corps of Engineers engineering study in Stark County.

Entrenched Miles, Bankfull Discharge, and Stream Power

An analysis of the length and severity of entrenched portions of Nimishillen Creek has not been attempted. Information regarding entrenchment will be collected when appropriate and/or needed.

However, an estimate can be made regarding the amount of water, or discharge, at certain sections of the Middle and East Branches of Nimishillen Creek. The United States Geological Survey (USGS) developed a method to estimate bankfull discharges along rural streams that lack dams. Bankfull is the height of the stream where water first begins to overflow its natural banks onto the active floodplain. Bankfull discharge is the amount of water that would fill the main channel to an elevation equal to the active floodplain and is important because flows near bankfull stage do much of the work in moving sediment and forming the shape of the channel. Under normal conditions, a bankfull discharge occurs about once every one to two years (Sherwood, 2005).

Using the USGS method, bankfull discharges were estimated for seven Nimishillen Creek segments in the Middle Branch and East Branch Subwatersheds. The method was developed to apply to rural areas that were unregulated; therefore, the West Branch, Mainstem, Sherrick Run, and Hurford were not considered because the subwatersheds are located in predominately urban, suburban, and/or industrial areas. Four of the selected reaches were in the Middle Branch while the remaining three stream segments studied were located in the East Branch Subwatershed (Figure II-16). Table II-16 contains the bankfull discharge values as determined using equation #15 in the USGS report (Sherwood, 2005). Drainage area, main-channel slope, and main channel elevation index were calculated by NEFCO staff using geographic information systems (GIS) mapping. The results show that the three lowest bankfull discharges were in the Middle Branch and the two highest were for segments in the East Branch.

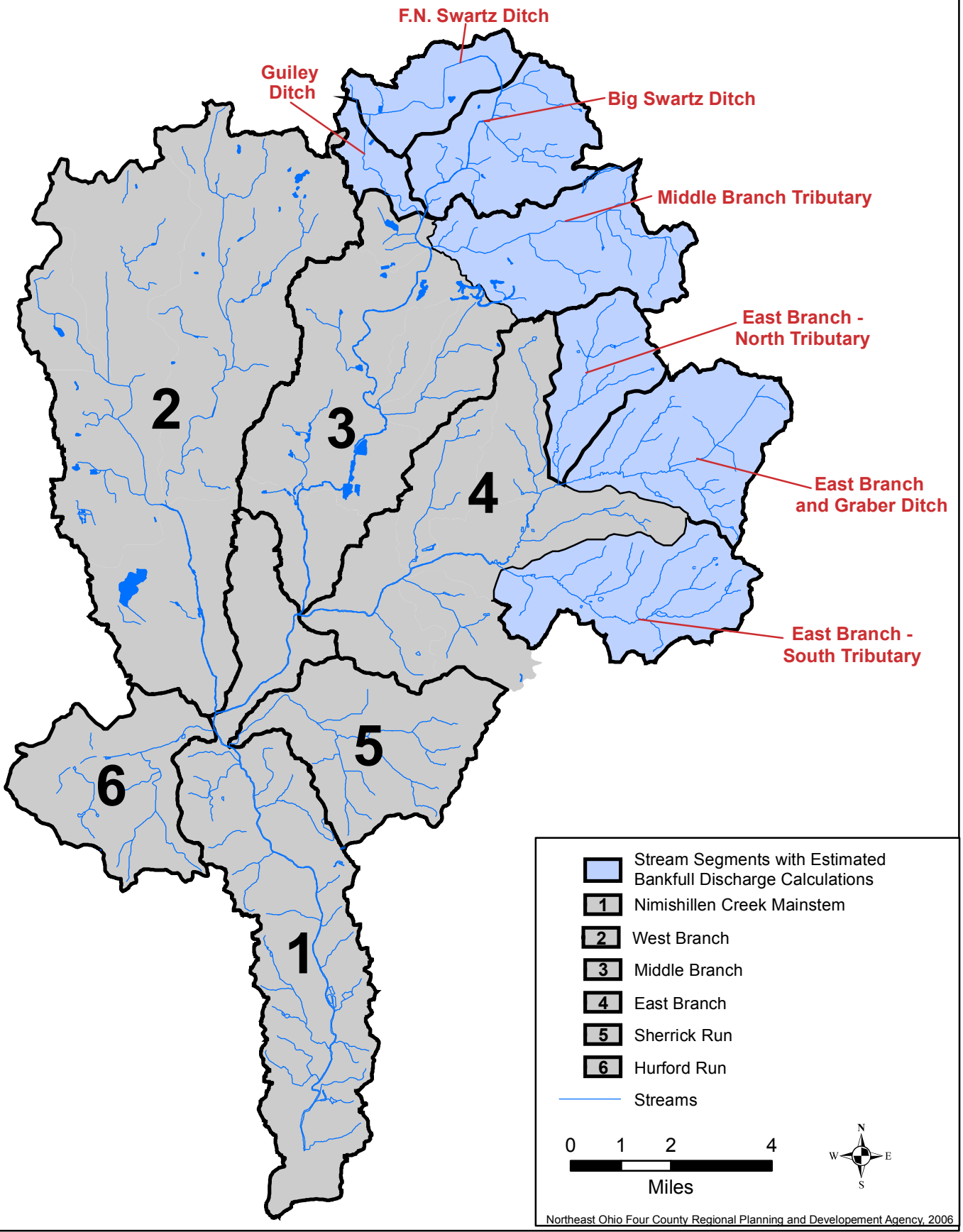
Table II-16: Estimated Bankfull Discharge for Selected Nimishillen Creek Segments

Segment Name	Subwatershed	Drainage Area (mi^2)	Main-Channel Slope (ft./mile)	Main Channel Elevation Index (ft.)	Bankfull Discharge ($ft.^3$/sec.)	Bankfull Discharge (gal./sec.)
F.N. Swartz Ditch	Middle Branch	4.32	4.25	1127	42.00	314.18
Big Swartz Ditch	Middle Branch	7.81	11.68	1124	147.98	1,106.97
Guiley Ditch	Middle Branch	1.87	10.36	1130	34.78	260.32
Middle Branch Trib.	Middle Branch	6.69	21.35	1144	268.62	2,009.42
East Branch and Graber Ditch	East Branch	9.19	27.51	1151	301.77	2,257.39
North Tributary	East Branch	5.15	33.17	1166	195.02	1,458.85
South Tributary	East Branch	9.42	30.12	1135	333.97	2,498.27

Sources: NEFCO; Sherwood, 2005
mi^2 = square mile; ft. = foot; ft^3 = cubic foot; gal. = gallon; sec. = second

As mentioned above, bankfull discharge is an important measurement because streams typically have the most energy to transport sediment and develop channel features during this stage. However, a better indicator of a stream's ability to move sediments is unit stream power. Unit stream power is the rate of potential energy

Figure II-16
Nimishillen Creek Stream Segments with Estimated Bankfull Discharge Calculations 2006



expenditure per unit weight of water at bankfull stage. The higher the unit stream power the more energy the flowing water has at the bankfull stage to move sediments and develop channel characteristics like riffles, runs, meanders, and pools. The Ohio Department of Natural Resource developed equations to estimate unit stream power. Using the bankfull discharge determined in Table II-16 and bank widths as determined by a regional curve, unit stream power calculations were completed for each of the seven Nimishillen Creek segments (Table II-17).

Table II-17: Estimated Unit Stream Power for Selected Nimishillen Creek Segments

Segment Name	Subwatershed	Bankfull Discharge[1] ($ft.^3/sec.$)	Stream Power[2] (lbs./sec.)	Bankfull Width[2] (ft.)	Unit Stream Power[2] (lbs./sec./ft.)
F.N. Swartz Ditch	Middle Branch	42.00	2	31	0.07
Big Swartz Ditch	Middle Branch	147.98	21	39	0.54
Guiley Ditch	Middle Branch	34.78	4	22	0.20
Middle Branch Trib.	Middle Branch	268.62	70	43	1.63
East Branch and Graber Ditch	East Branch	301.77	101	42	2.41
North Tributary	East Branch	195.02	78	33	2.38
South Tributary	East Branch	333.97	122	72	2.89

Sources: [1] Sherwood, 2005; [2] Mecklenburg, 2006
ft^3 = cubic foot; sec. = second; lbs. = pound; ft. = foot

A unit stream power of 0.7 lbs./sec./ft. is considered very low, while a value of 2.4 lbs./sec./ft. is a high value (Mecklenburg, 2006). Three of the four Middle Branch segments are below the very low threshold, all three East Branch sites are at or above the high value, and the Middle Branch Tributary is between these two groups at 1.63 lbs./sec./ft.

The bankfull discharge and unit stream power values are rough estimates to be used for general planning purposes. These findings can be further refined and improved with field measurements of many of the parameters found in the Table II-16 and Table II-17, particularly bankfull discharge and bankfull width. The development of a regional curve for bankfull widths specific to the Nimishillen Creek Watershed would greatly improve the accuracy of future estimated power calculations for different stream segments.

Despite the margin of error associated with this assessment, the results clearly show a significant difference in both bankfull discharge and unit stream power for the Middle Branch's F.N. Swartz Ditch, Big Swartz Ditch, and Guiley Ditch and the rest

of the studied stream sections. The three ditches have extremely low unit stream power values which indicate a lack of ability for these sections to naturally restore features and functions needed for a healthy stream. These ditches simply do not have enough power to transport and sort the sediment load in order to restore natural features like riffles, pools, and meanders. Restoration of these channelized areas would require stakeholders to actively build these features into the stream using natural channel design principles at a significant cost. But given the low slope, bankfull discharge, and unit stream power of these three segments, the success of any stream restoration project is questionable. Because of the high costs and an uncertain outcome based on the information above, stream restoration in these three watershed should rank behind other water resource protection actions like wetlands restoration and protection.

Fortunately the other four stream segments analyzed above do show potential for stream restoration projects. The Middle Branch Tributary (1.63 lbs./sec./ft), East Branch - North Tributary (2.38 lbs./sec./ft.), East Branch/Graber Ditch (2.41 lbs./sec./ft.), and East Branch - South Tributary (2.89 lbs./sec./ft.) have enough energy to transport the sediment needed to restore natural features. These sections of Nimishillen Creek are good candidates for either active or passive stream restoration techniques. Active restoration, as described above, normally involves going into a stream and manually restoring features and functions using natural channel design techniques. Active restoration is an option and would likely be successful in quickly restoring natural features and functions to a stream segment. However, costs can be prohibitive with active restoration methods and typically result in only small stream sections being restored.

A more cost effective option for restoration in these four Nimishillen Creek segments is passive restoration techniques. Generally this involves providing the disturbed or degraded stream segments the needed conditions to recover on their own. For streams that are entrenched or ditched, passive restoration entails restoring the active floodplain at or below the bankfull discharge stage, commonly referred to as a two stage ditch design. For stream channels with sufficient energy for sediment transport, near bankfull discharges over time will develop natural channel features in the newly constructed active floodplain. Other than restoring the floodplain to approximately five times the width of the bankfull width, little in-stream work is required since natural processes during near bankfull stages complete the restoration work. Passive restoration is less costly than active natural channel design restoration, but the results are not as immediate as it will take several months or years for a restored stream section to fully develop all of its features and functions. However, the lower cost potentially will result in more linear feet of Nimishillen Creek being restored.

Recreation

There are numerous recreational opportunities in and around Nimishillen Creek and its tributaries. As shown in Table II-2, there are numerous parks directly adjacent to

Nimishillen Creek with various recreational amenities such as hiking trails, basketball courts, baseball fields, fitness circuit, tennis courts, skating park, picnic areas, and playgrounds. Fishing and nature watching can also be enjoyed in these parks. The lower portions of the Nimishillen Creek Mainstem offers adequate water depth for canoeing. Local liveries offer a variety of options for those interested in planning canoe trips. Other local attractions near Nimishillen Creek are the Pro Football Hall of Fame, Canton Garden Center, John F. Kennedy Memorial Fountain, and the McKinley National Memorial.

Park districts and other recreation advocates are important partners in protection and restoration of the Nimishillen Creek corridor. Continued enhancement of recreational opportunities along the creek will increase stakeholder awareness of the value of this local resource. The Stark County Park District long range plans include purchasing land along Nimishillen Creek for increased recreational opportunities for watershed residence. Contact any of the park districts listed in Table II-2 for more information about recreation opportunities in the watershed.

Cultural Resources

Historical Information

Almost the entire Nimishillen Creek Watershed rests in Stark County, with small portions in Summit and Tuscarawas County. The first inhabitants of this are thought to be the Mound Builders present during the stone ages. Little is known between the time of the Mound Builders and Native Americans, but by the mid-1770s there were seven major tribes of Native Americans in Ohio. Stark County held several important cross trails, with the two most famous being the Great Trail and the Muskingum Trail.

The first European explorers to enter the area were the French in the 1660s who laid claim to the entire region. The first English explorers visited between 1730 and 1740. The English and the United States fought the French for control of the area for several years, and it was not until the war of 1812, that the United States' control of the region was affirmed. The Northwest Territory was created by the Continental Congress in 1787 and the passage of the Land Ordinance Act of 1785 authorized the sale of land in Ohio. In 1803, Ohio became the first state admitted from the Northwest Territory.

Stark County was created in 1808 and was named after Revolutionary War General John Stark, though he never actually visited the county. It originally had 22 townships and included all but one of the townships (Sandy) that is part of the Nimishillen Creek Watershed. In 1805, Canton was the first town to be established in the Nimishillen Creek Watershed, and became a city in 1854. In 1834, Stark County lost three southeast townships to Carroll County and two northeast townships to Summit County, including Green Township which contains a portion of the watershed, leaving the County with its present 17 townships.

The start of the industrial revolution after the Civil War brought about change to the Nimishillen Creek basin. The areas around Canton and North Canton became industrial centers and the work force changed from agrarian to industrial jobs. The area emerged from this era as one of the America's industrial leaders. However, agricultural areas in the watershed remained very productive and helped support booming communities throughout northeast Ohio.

Today, Canton and North Canton remain primarily industrial, with the areas to the north and east largely agricultural. Industries still located within the watershed include the Timken Company, the Hoover Company, the Belden Brick Company, and Diebold. The watershed is also home to rich agricultural areas that provide dairy products, poultry, vegetables and produce to various communities in the region.

In recent years, employment in the industrial sector has been in decline. The Nimishillen Creek Watershed like many areas with industrial areas is undergoing a transition to a retail and service-based economy. This is resulting in increased suburbanization and urban sprawl primarily along Interstate 77 in the West Branch subwatershed.

Historical Sites

According to the Stark County - Ohio Bicentennial Committee, there are 35 sites in the Nimishillen Creek Watershed on the National Register of Historical Places. Nearly all of these sites are located in the City of Canton. None of the sites listed are directly related to Nimishillen Creek or its tributaries. There are no historic dams, locks, or other creek related structures that are listed as historical sites in the watershed. For more information on these historical sites, please refer to the *Stark County Historic Sites Map* published by the Stark County - Ohio Bicentennial Committee.

Nimishillen and Sandy Canal

The Ohio and Erie Canal was built in the 1820s and 1830s connecting Lake Erie to the Ohio River. In Stark County, the Canal followed the Tuscarawas River and went through Massillon and other areas to the west of the Nimishillen Creek Watershed. The Canal increased local commerce by providing reliable transportation to move various products and people to and from the larger eastern cities and markets. Towns all along the Canal prospered from all the benefits this new transportation system provided.

Having been bypassed by the initial canal construction, community leaders from Canton and surrounding areas began plans in the 1830s to construct the Nimishillen and Sandy Canal to tie into the Ohio and Erie Canal. This canal was planned to follow a 12 mile route from Canton south to Sandyville along Nimishillen Creek. Work began on the Canal in 1835, and a small portion of the waterway was

completed. However, the project was quickly abandoned primarily due to an insufficient water supply for the canal. Also, a trip by boat from Canton to Massillon, which were less than eight miles apart, would have been a 30 mile journey going through three different canal systems. Lastly, an economic "slowdown" hit the area in 1837 reducing the resources available to fund canal construction. Remnants of the incomplete Nimishillen and Sandy Canal can seen in East Sparta near the corner of Walnut Street and Willow Avenue (Loomis, 1994).

III. Water Resource Quality

Designated Uses for Ohio Surface Water Resources

The Ohio EPA is required by the Federal Clean Water Act to develop water quality standards in order to protect, maintain, and improve surface water in the state. Consequently, the agency created standards in two designated categories: Aquatic Life Uses and Non-Aquatic Life Uses. Aquatic Life Use designations vary depending upon where the segment is located in the state and the demonstrated potential of that section of a stream. Non-Aquatic Life Use designations are used to determine a stream's ability as a viable water supply and for recreation.

Aquatic Life Use Designations

An aquatic life use designation is assigned to a stream or river based on the potential aquatic biological community that can realistically be sustained given the biological, physical, and chemical attributes of the waterway. Ohio's aquatic life use designations are:

Exceptional Warm Water Habitat (EWH): A designation given to waterbodies with the most productive environment. These streams support unusual and exceptional assemblages of aquatic organisms, which are characterized by a high diversity of species, particularly those that are highly intolerant and/or rare, threatened, or endangered. This use represents a protection goal for water resource management efforts dealing with Ohio's best water resources.

Warmwater Habitat (WWH): A designation given to streams and rivers with a typical warmwater assemblage of aquatic organisms. It is the principal restoration goal for the majority of water resource management efforts in Ohio. Criteria vary by ecoregion and site type.

Modified Warmwater Habitat (MWH): This designation applies to streams with extensive and irretrievable physical habitat modifications, and where the biological criteria for warmwater habitat is not attainable. The activities contributing to the modified warmwater habitat designation have been sanctioned and permitted by state or federal law. The representative aquatic assemblages are generally composed of species that are tolerant to low dissolved oxygen, silt, nutrient enrichment and poor habitat quality. The three primary types of modification are acid mine drainage runoff, heavily channelized streams, and extensively impounded rivers.

Limited Resource Water (LRW): Designation applies to small streams in watersheds of less than 3 square miles and other waterbodies which have been irretrievably altered to the extent that no appreciable assemblage of aquatic life can be supported. Limiting factors often include acid mine drainage, drainage

way maintenance, or other specified conditions. No biological criteria has been established for LRW streams.

Coldwater Habitat (CWH): These are designated waters that support assemblages of coldwater organisms and/or those that are stocked with salmonids with the intent of providing a fishery on a year round basis. No specific biological criteria has been established for this use designation.

Seasonal Salmonid Habitat (SSH): A designation used for waters that are capable of supporting the passage of salmoinids from October to May and large enough to support recreational fishing. This designation is only in effect from October to May each year.

As documented in Chapter 3745-1-24 in the Ohio Administrative Code, Nimishillen Creek and its tributaries have the aquatic life habitat designations of warmwater habitat (WWH), modified warmwater habitat (MWH), and limited resource water (LRW). No segment in the Nimishillen Creek Watershed was designated as exceptional warmwater habitat (EWH), seasonal salmonid habitat (SSH), or coldwater habitat (CWH). Aquatic Life Use designations for various segments of Nimishillen Creek are summarized in Table III-1.

Most of the segments in the Nimishillen Creek Watershed are designated as WWH. However, there are significant segments in the watershed that are classified as MWH. These are all the result of past ditching efforts, primarily occurring in the Middle and West Branches, to improve agricultural drainage. Some channelization has also occurred along Hurford Run and Sherrick Run. Lastly, three stream segments located in Hurford Run, Sherrick Run, and Hoover Ditch are designated as LRW. This means that the fish and invertebrate communities are severely limited by irreversible habitat conditions.

Table III-1: Aquatic Life Use Designations for Nimishillen Creek and Tributaries				
Nimishillen Creek Segment	**WWH**	**MWH**	**LRW**	**Comments**
Nimishillen Creek Mainstem - all segments	X			
Hurford Run: Headwaters to River Mile (RM) 1.71 (Domer Ditch)			X	Small Drainage Way Maintenance
Hurford Run: RM 1.71 (Domer Ditch) to RM 0.8 (Harrison Ave.)		X		Channel Modifications
Hurford Run: RM 0.8 to mouth	X			
Hurford Run: Domer Ditch	X			
Sherrick Run: Headwaters to RM 5.2 (Osnaburg Ditch)			X	Small Drainage Way Maintenance
Sherrick Run: RM 5.2 to Mouth	X			
Sherrick Run: Osnaburg Ditch		X		Channel Modifications
West Branch: McDowell Ditch: Headwaters to RM 2.3 (Zimber Ditch)		X		Channel Modifications
West Branch: McDowell Ditch: RM 2.3 to Mouth		X		Channel Modifications
West Branch: Zimber Ditch: Headwaters to RM 1.2 (Rettig Ditch)	X			
West Branch: Zimber Ditch: RM 1.2 to Mouth		X		Channel Modifications
West Branch: Hoover Ditch			X	Small Drainage Way Maintenance
West Branch: All Other Segments	X			
Middle Branch: Swartz Ditch		X		Channel Modifications
Middle Branch: Guiley Ditch		X		Channel Modifications
Middle Branch: All Other Segments	X			
East Branch: All Segments	X			
RM = River Mile; WWH = Warmwater Habitat; MWH = Modified Warmwater Habitat; LRW = Limited Resource Water Source: Ohio Administrative Code, Chapter 3745-1-24				

Non-Aquatic Life Use Designation - Water Supply

Ohio has three categories for surface water supply: public water supply (PWS), agricultural water supply (AWS), and industrial water supply (IWS). The water

supply use designations for Nimishillen Creek are summarized in Table III-2. Currently no surface water in the Nimishillen Creek Watershed is used as a potable drinking water source. Agricultural water supply is defined as surface water that is used, or potentially used, for watering livestock or irrigation. Nearly all but a few segments of the creek have this use designation. Lastly, IWS is surface water that can be used for industrial purposes. All stream segments in the Nimishillen Creek Watershed are classified as being suitable for this use. For more information about Nimishillen Creek's water supply use designations, refer to the Ohio Administrative Code, Chapter 3745-1-24.

Table III-2: Water Supply Use Designation for Nimishillen Creek and Tributaries

Nimishillen Creek Segment	PWS	AWS	IWS
Nimishillen Creek Mainstem - all segments		X	X
Hurford Run - all segments		X	X
Sherrick Run - all segments		X	X
West Branch - McDowell Ditch: headwaters to RM 2.3 (Zimber Ditch)		X	X
West Branch - McDowell Ditch: RM 2.3 to mouth			X
West Branch - Zimber Ditch: headwaters to RM 0.8 (North Canton Ditch)		X	X
West Branch - Zimber Ditch: RM 0.8 to mouth			X
West Branch - Hoover Ditch			X
West Branch - all other segments		X	X
Middle Branch- all segments		X	X
East Branch - RM 6.0 to mouth			X
East Branch - all other segments		X	X

RM = River Mile; PWS = Public Water Supply; AWS = Agricultural Water Supply; IWS = Industrial Waters Supply
Source: Ohio Administrative Code, Chapter 3745-1-24

Non-Aquatic Life Use Designation - Recreation

The Ohio EPA designates waterbodies based on recreational activities that can occur. The three designations used are bathing waters (BW), primary contact recreation (PCR), and secondary contact recreation (SCR). Bathing waters include swimming beaches with lifeguards and/or bath houses. No areas within the Nimishillen Creek Watershed fall under this classification. Therefore, all creek segments fall in either the PCR or SCR designation. One or more of the following characteristics must be met to receive the primary contact recreation designation: water depth allows for full body immersion; creek segment in close proximity to residential areas; or the water present and intermediate potential exposure to

bacteria. Characteristics to qualify as a SCR designated creek segment are water depth precludes full body immersion, not near residential areas, and low potential to bacteria exposure. Table III-3 summaries the recreation activities designations for Nimishillen Creek and tributaries as reported in the Ohio Administrative Code, Chapter 3745-1-24.

Table III-3: Recreation Use Designation for Nimishillen Creek and Tributaries

Nimishillen Creek Segment	Use Designation
Nimishillen Creek Mainstem - all segments	PCR
Hurford Run - all segments	PCR
Hurford Run - Domer Ditch	SCR
Sherrick Run - all segments	SCR
West Branch - McDowell Ditch	SCR
West Branch - Zimber Ditch	SCR
West Branch - North Canton Ditch`	SCR
West Branch - all other segments	PCR
Middle Branch - Swartz Ditch	SCR
Middle Branch - Guiley Ditch	SCR
Middle Branch - all other segments	PCR
East Branch - all segments	PCR

PCR = primary contact recreation; SCR = secondary contact recreation
Source: Ohio Administrative Code, Chapter 3745-1-24

Non-Aquatic Life Use Designation - State Resource Waters

State Resource Waters (SRW) are surface waters that lie within national, state, and local park systems, wetland, and wildlife refuges, areas, and preserves and are designated in Ohio's Water Quality Standards. According to the Chapter 3745-1 of the Ohio Administrative Code (OAC), no section of Nimishillen Creek is classified as a SRW. Although still used, the SRW designation is being phased out and replaced by four different categories to describe "high quality waters" (OAC, 3745-1-05). Currently there is no information designating any segment within the Nimishillen Creek Watershed as "high quality waters".

Biological Criteria

The Ohio EPA adopted biological criteria into the Ohio Water Quality Standards in 1990. Specifically, two fish and one macroinvertebrate indices are used to determine if a specific stream segment is reaching its aquatic life use designation (Table III-1).

These indices are:

IBI - Index of Biological Integrity

The Index of Biological Integrity (IBI) is a measure of fish species diversity and species populations. The index is a number that reflects total native species composition, indicator species composition, pollutant tolerant and intolerant species composition, and fish condition. The higher the calculated score, the healthier the stream system with the highest score being 60 (Ohio EPA, 1997).

ICI - Invertebrate Community Index

The Invertebrate Community Index (ICI) is based on measurements of the macroinvertebrate communities living in a given stream or river. It is a useful evaluation tool of a stream health because: (1) there are a wide variety of pollution tolerant macroinvertebrate taxa; and (2) there are a number of macroinvertebrate types which are known to be intolerant to pollution. The ICI is also on a scale of 0 to 60 with higher scores reflecting healthier macroinvertebrate communities and therefore more diverse communities (Ohio EPA, 1997).

MIwb - Modified Index of Well Being

The Modified Index of Well Being (MIwb) filters out 13 pollutant tolerant fish species and includes fish mass in the final analysis. Using both the IBI and MIwb can give a clear picture of the health of the fish and biological community along a section of stream. Also, by comparing the fish mass versus fish abundance, the Ohio EPA may be able to determine which pollution source is impacting the biological community more than others (Ohio EPA, 1997).

To be in full attainment, all three of these indices must meet standards from regional reference sites reflecting natural or least impacted habitats in each ecoregion. If only one or two of the indices is met, then a stream segment is in partial attainment. If none of the standards are meet then the waterbody is considered to be in non-attainment.

Aquatic Life Use Attainment Status of Nimishillen Creek

Ohio has five ecoregion that have distinct assemblages of biological communities (Figure III-1). Aquatic life use standards for streams in each ecoregion are based on reference sites that reflect natural or optimal conditions. As shown in Table III-1, Nimishillen Creek has been assigned three different aquatic life use designations: Warmwater Habitat (WWH), Modified Warmwater Habitat (MWH), and Limited Resource Water (LWR). For the Nimishillen Creek to be in attainment, each designated use listed in Table III-1 must meet IBI, ICI, and MIwb standards based on reference streams in the Erie-Ontario Lake Plain (EOLP) or West Allegheny Plateau (WAP) ecoregions. The southern sections of the Nimishillen Creek Mainstem reside in the WAP ecoregion, while all other subwatersheds utilize EOLP ecoregion standards (Figure III-1). Water quality standards are generally higher for segments located in the WAP than in the EOLP. Table III-4 summaries biocriteria standards for each aquatic life use designation for each ecoregion.

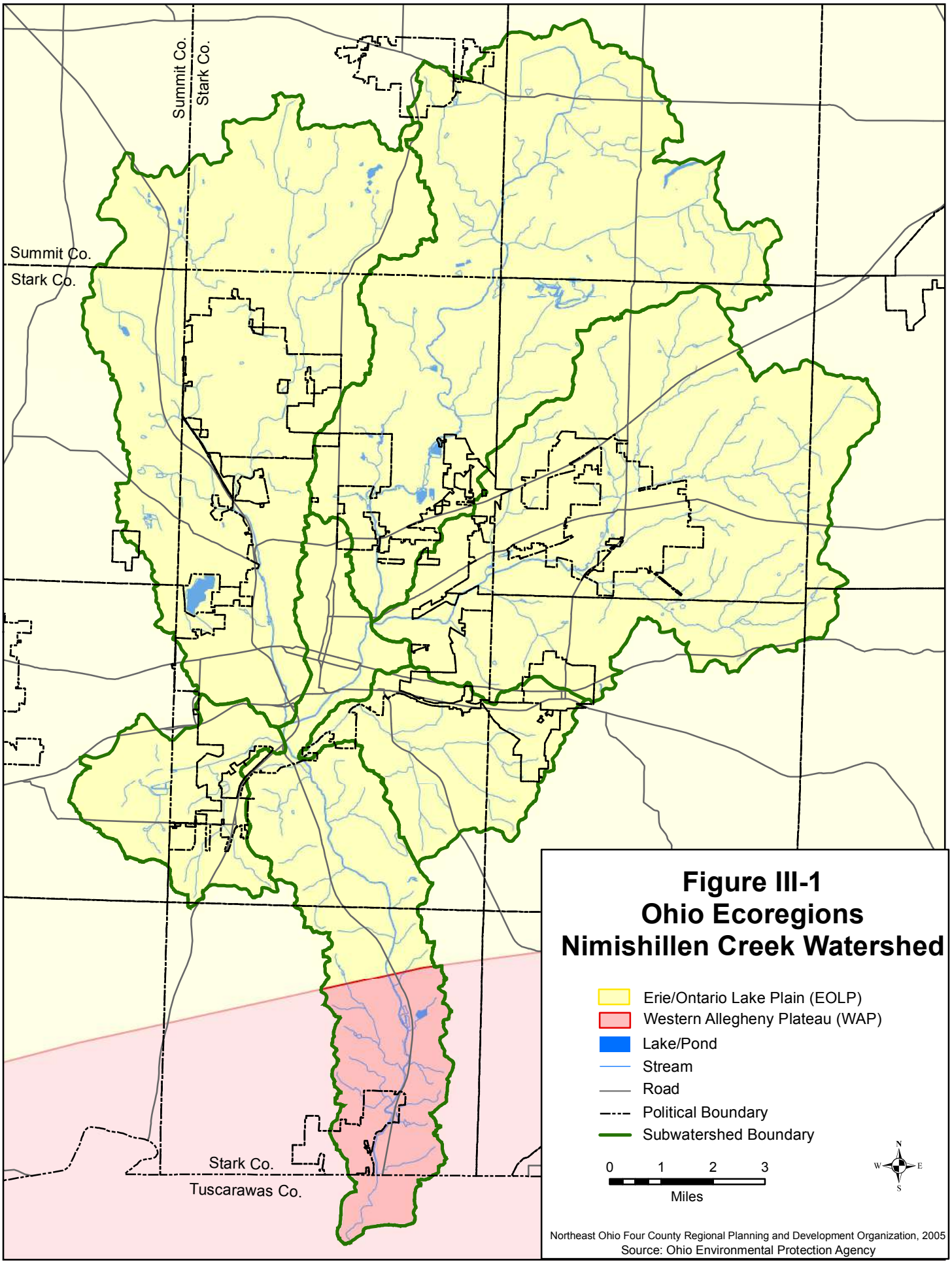
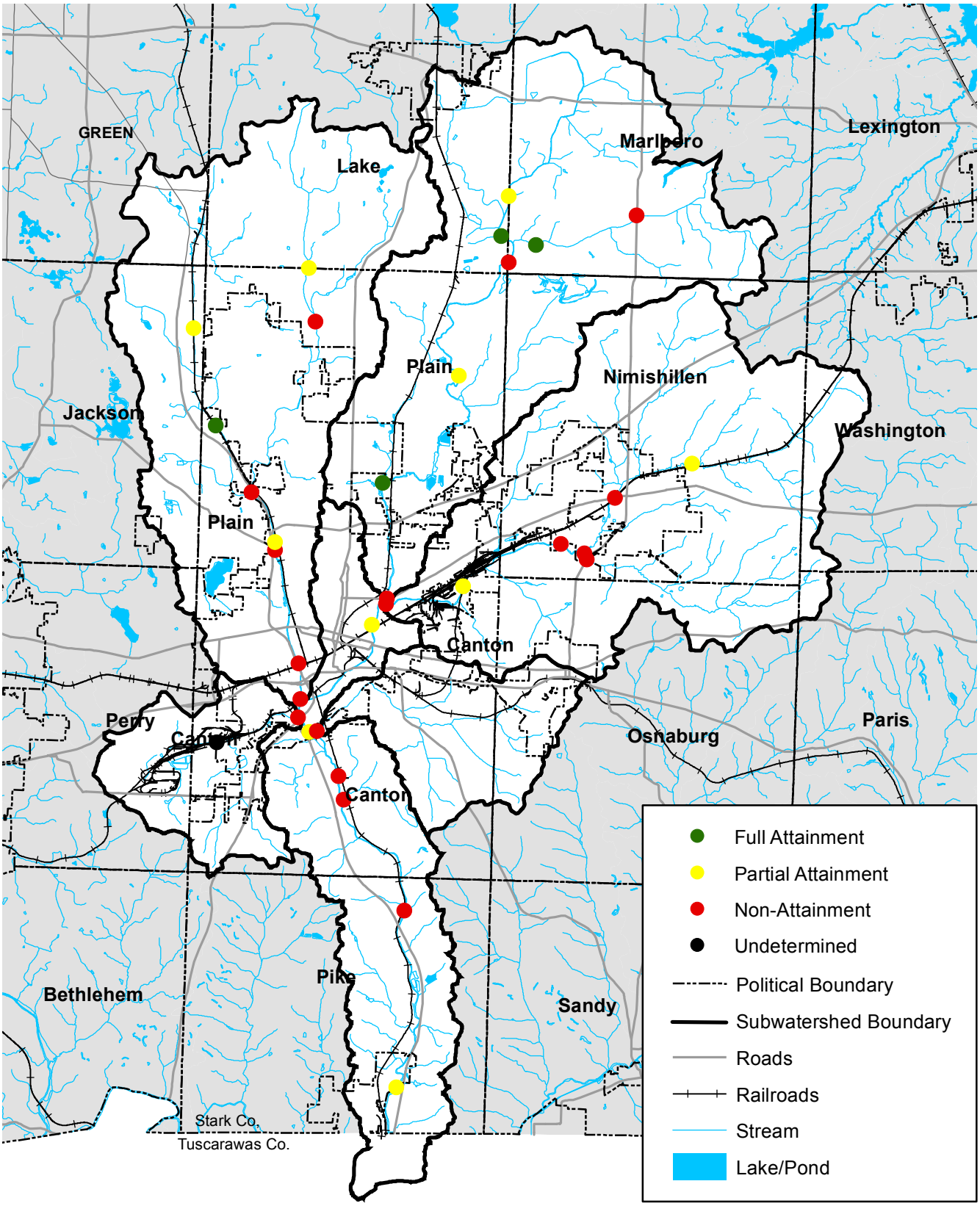

Summit Co.
Stark Co.
Summit Co.
Stark Co.
Stark Co.
Tuscarawas Co.
Figure III-1
Ohio Ecoregions
Nimishillen Creek Watershed
Erie/Ontario Lake Plain (EOLP)
Western Allegheny Plateau (WAP)
Lake/Pond
Stream
Road
Political Boundary
Subwatershed Boundary
0 1 2 3
Miles
N
W
E
S
Northeast Ohio Four County Regional Planning and Development Organization, 2005
Source: Ohio Environmental Protection Agency

Table III-4: Ecoregion Biocriteria for the Erie/Ontario Lake Plain (EOLP) and the Western Allegheny Plateau (WAP)		
Aquatic Life Use Designation	**EOLP**	**WAP**
EWH	IBI - Headwaters = 50 IBI - Wading = 50 IBI - Boat = 48 MIwb - Wading = 9.4 MIwb - Boat = 9.6 ICI = 46	IBI - Headwaters = 50 IBI - Wading = 50 IBI - Boat = 48 MIwb - Wading = 9.4 MIwb - Boat = 9.6 ICI = 46
WWH	IBI - Headwaters = 40 IBI - Wading = 38 IBI - Boat = 40 MIwb - Wading = 7.9 MIwb - Boat = 8.7 ICI = 34	IBI - Headwaters = 44 IBI - Wading = 44 IBI - Boat = 40 MIwb - Wading = 8.4 MIwb - Boat = 8.6 ICI = 36
MWH	IBI - Headwaters = 24 IBI - Wading = 24 IBI - Boat = 24 MIwb - Wading = 6.2 MIwb - Boat = 5.8 ICI = 22	IBI - Headwaters = 24 IBI - Wading = 50 IBI - Boat = 24 MIwb - Wading = 6.2 MIwb - Boat = 5.8 ICI = 22
LWR	IBI - Headwaters = 18 IBI - Wading = 18 IBI - Boat = 18 MIwb - Wading = 4.0 MIwb - Boat = 4.0 ICI = 6	IBI - Headwaters = 18 IBI - Wading = 18 IBI - Boat = 18 MIwb - Wading = ?? MIwb - Boat = ?? ICI = 8
EWH = Exceptional Warmwater Habitat; WWH = Warmwater Habitat; MWH = Modified Warmwater Habitat; LWR = Limited Resource Water; IBI = Index of Biotic Integrity; MIwb = Modified Index of Well Being; ICI = Invertebrate Community Index Source: *The Role of Biological Criteria in Water Quality Monitoring, Assessment, and Regulation*. Ohio EPA, 1995.		

In the Nimishillen Creek TMDL report, 32 sites in the Nimishillen Creek watershed given scores for biocriteria. Only 12.5 percent of the sites assessed in Nimishillen Creek were in full attainment (all three indices meeting ecoregion standards), 31.25 percent were in partial attainment (one or two of the indices meeting ecoregion standards), and the remaining 36.25 percent of the sites were in non-attainment (no indices meeting ecoregion standards). Figure III-2 shows the attainment status of the assessed portions of Nimishillen Creek. Table III-5 summarizes the Ohio EPA's results for aquatic life uses in the watershed.

Figure III-2: Aquatic Life Use Attainment Status

2009 Nimishillen Creek TMDL Report



Northeast Ohio Four County Regional Planning and Development Organization, 2011.
Source: Nimishillen Creek TMDL, 2009.

Table III-5: Summary of Designated Aquatic Life Uses and Attainment Status for Nimishillen Creek and Tributaries

Creek Segment (HUC Number)	Location - (Lower/Upper River Mile)	Use Designation	Attainment Status	Biological Criteria Scores		
				IBI	MIwb	ICI
Nimishillen Creek Mainstem (05040001 05 05 & 05040001 05 06)	Farber Rd. - (2.7)	WWH	Partial	34*	6.5*	34
	Howenstien Rd. – (6.7/6.7)	WWH	Non	32*	5.4*	38
	Faircrest Rd. - (9.2/9.6)	WWH	Non	31*	6.5*	26*
	Upstream of Canton WWTP – (9.9)	WWH	Non	32*	6.9*	--
	Upstream of Sherrick Run - (11.1)	WWH	Partial	30*	6.1*	38
	Eighth St. - (14.2/14.3)	WWH	Partial	40	7.1*	38
Sherrick Run (05040001 05 05)	Allen Ave. - (0.1)	WWH	Non	34*	--	Poor*
Hurford Run (05040001 05 05)	At Mouth - (0.1)	WWH	Non	24*	--	Poor*
	Downstream Ashland Oil - (1.8)	LRW	--	Very Poor*	--	--
West Branch (05040001 05 03)	Market St. - (0.1)	WWH	Non	36	5.8*	Fair*
	Upstream Gregory Galvanizing - (0.4/0.3)	WWH	Non	31*	6.7*	Fair*
	Downstream Fulton Rd. - (3.2)	WWH	Non	22*	5.1*	--
	Upstream Fulton Rd. - (3.5/3.4)	WWH	Partial	32*	6.6*	40
	Upstream McDowell Ditch - (4.6/4.7)	WWH	Non	28*	--	Fair*
	Applegrove St. - (9.3/9.0)	WWH	Non	26*	--	Fair*
	Mr. Pleasant St. - (10.5/10.4)	WWH	Partial	40	--	Fair*
McDowell Ditch (05040001 05 03)	Everhard Rd. - (1.9/1.8)	MWH	Full	24	--	High
Zimber Ditch (05040001 05 03)	Applegrove St. – (2.4)	WWH	Partial	40	--	Low

Table III-5: Summary of Designated Aquatic Life Uses and Attainment Status for Nimishillen Creek and Tributaries (continued)

Creek Segment (HUC Number)	Location - (Lower/Upper River Mile)	Use Designation	Attainment Status	Biological Criteria Scores		
				IBI	MIwb	ICI
Middle Branch (05040001 05 01 & 05040001 05 04)	12th Street - (0.1/0.2)	WWH	Non	32*	6.7*	Fair*
	Martindale Park - (2.7/2.6)	WWH	Full	36	8.0	34
	Easton St. - (6.8)	WWH	Partial	30*	6.3*	38
	State St. - (10.4)	WWH	Non	28*	5.6*	42
	Immel Ave. - (11.4)	WWH	Full	40	--	--
	State Route 44 - (13.6)	WWH	Non	24*	--	Poor*
Swartz Ditch (05040001 05 01)	Tyro St. - (0.2)	MWH	Full	24	--	40
	Nimishillen Church Rd. - (1.2)	MWH	Partial	26	--	Poor*
East Branch (05040001 05 02)	Cook Park - (0.1)	WWH	Non	34*	6.2*	Fair*
	Harmont Ave. - (1.9)	WWH	Partial	30*	5.9*	40
	Beck Rd. - (4.2)	WWH	Non	28*	5.2*	44
	Upstream Louisville WWTP - (5.9)	WWH	Non	26*	4.8*	48
	State Route 153 - (6.4)	WWH	Non	22*	--	38
	Meese Rd. - (8.6)	WWH	Partial	28*	--	50
Tributary to East Branch (05040001 05 02)	State Route 44 - (0.3)	WWH	Non	28*	--	Fair*

* Indicates significant departure for applicable biocriteria (>4 IBI or ICI units, or >0.5 MIwb units).
___ Underlined scores are in the Poor or Very Poor range.
Source: Nimishillen Creek TMDL, Ohio EPA, 2009.

Reported major causes and sources of water quality impairments from the Ohio EPA' TMDL report includes flow alteration, wastewater treatment plant discharges, metals, ammonia, nutrients, crop production, habitat alteration, siltation, organic enrichment and home sewage treatment (septic) systems (Ohio EPA, 2009). See Section III for more information on specific water quality data (Ohio EPA 305b Report).

QHEI - Qualitative Habitat Evaluation Index

In addition to surveying the biology of a specific stream segment, the Ohio EPA also examines the in-stream and bank-side (riparian) habitat. This survey is called the Qualitative Habitat Evaluation Index (QHEI) and is designed to provide measures of habitat that normally correspond to physical features that affect biological communities in a stream. Physical features used in this index include composition of the substrate, type and magnitude of cover, condition of the riparian habitat, the quality of the pool and riffles areas, and channel dimensions (Rankin, 1989). Scores can range between 12 and 100 with higher scores equating to better habitat conditions. However, unlike the above indices the **QHEI is not used to determine aquatic life use attainment status for streams**. However, it has been shown that there is a strong relationship between QHEI scores and aquatic life use scores. Table III-6 shows the relationship between the QHEI and aquatic life use.

Table III-6: Relationship between Ohio's Aquatic Life Uses and the QHEI

Aquatic Life Use	Habitat Characteristics
Exceptional Warmwater Habitat (EWH)	QHEI Scores > 70-75 Excellent Habitat Heterogeneity
Warmwater Habitat (WWH)	QHEI Scores > 60 Good to Fair Habitat Heterogeneity
Modified Warmwater Habitat (MWH)	QHEI Scores < 45 Poor Habitat Heterogeneity
Limited Resource Water (LRW)	QHEI Scores < 20-30 Habitat Limited Sites, Usually < 3 mi^2 Drainage Area

Source: Ohio EPA, "The Use of the Qualitative Habitat Evaluation Index for Use Attainability Studies in Streams and River in Ohio" by Edward Rankin.

The Warmwater Habitat use designation QHEI target is 60. In addition, since habitat is strongly correlated with the IBI biocriteria, the QHEI provides a target and format to evaluate how habitat issues and impairments affect attainment of the aquatic use designations. Degraded habitat has been identified as a contributing cause of nonattainment in several stream segments within the Nimishillen Creek basin (Ohio EPA, 2009). Table III-7 provides the QHEI scores for sites assessed as part of the TMDL report.

Table III-7: Summary of Qualitative Habitat Evaluation Index (QHEI) Scores for Nimishillen Creek and Tributaries

Creek Segment (HUC Number)	Location - (Lower/Upper River Mile)	Use Designation	QHEI Score
Nimishillen Creek Mainstem (05040001 05 05 & 05040001 05 06)	Farber Rd. - (2.7)	WWH	75
	Howenstien Rd. - (6.7/6.7)	WWH	78
	Faircrest Rd. - (9.2/9.6)	WWH	77
	Upstream of Canton WWTP - (9.9)	WWH	79.5
	Upstream of Sherrick Run - (11.1)	WWH	68.5
	Eighth St. - (14.2/14.3)	WWH	71.5
Sherrick Run (05040001 05 05)	Allen Ave. - (0.1)	WWH	78.5
Hurford Run (05040001 05 05)	At Mouth - (0.1)	WWH	69
	Downstream Ashland Oil - (1.8)	LRW	--
West Branch (05040001 05 03)	Market St. - (0.1)	WWH	69
	Upstream Gregory Galvanizing - (0.4/0.3)	WWH	74
	Downstream Fulton Rd. - (3.2)	WWH	42
	Upstream Fulton Rd. - (3.5/3.4)	WWH	77
	Upstream McDowell Ditch - (4.6/4.7)	WWH	58.5
	Applegrove St. - (9.3/9.0)	WWH	47
	Mr. Pleasant St. - (10.5/10.4)	WWH	60.5
McDowell Ditch (05040001 05 03)	Everhard Rd. - (1.9/1.8)	MWH	--
Zimber Ditch (05040001 05 03)	Applegrove St. - (2.4)	WWH	60
Middle Branch (05040001 05 01 & 05040001 05 04)	12th Street - (0.1/0.2)	WWH	64.5
	Martindale Park - (2.7/2.6)	WWH	73.5
	Easton St. - (6.8)	WWH	56
	State St. - (10.4)	WWH	52
	Immel Ave. - (11.4)	WWH	59
	State Route 44 - (13.6)	WWH	28
Swartz Ditch (05040001 05 01)	Tyro St. - (0.2)	MWH	63.5
	Nimishillen Church Rd. - (1.2)	MWH	31.5
East Branch (05040001 05 02)	Cook Park - (0.1)	WWH	60.5
	Harmont Ave. - (1.9)	WWH	79.5
	Beck Rd. - (4.2)	WWH	79
	Upstream Louisville WWTP - (5.9)	WWH	73.5
	State Route 153 - (6.4)	WWH	55
	Meese Rd. - (8.6)	WWH	66
Tributary to East Branch (05040001 05 02)	State Route 44 - (0.3)	WWH	59.5

___ Underlined scores are below the QHEI target score of 60 for WWH streams.
Source: Nimishillen Creek TMDL, Ohio EPA, 2009.

Other Water Quality Studies

Over the years there have been numerous studies and documents from various agencies and organizations that directly or indirectly deal with watershed and water

quality management for Nimishillen Creek. Information from several of these reports and documents have been incorporated into this Plan. Some of these include:

- *Nimishillen Creek Comprehensive Watershed Management (CWMP) Plan - Phase I*, November 2000, by NEFCO. This is the first Phase of NEFCO's watershed study to aid in the protection and restoration of Nimishillen Creek's water quality. The report is essentially a diagnostic study contain detailed information about land use and land cover, potential sources of pollution, a riparian zone analysis, water quality data, and public meeting information.

- *Nimishillen Creek Comprehensive Watershed Management Plan - Phase II*, November 2000, by NEFCO. This is a continuation of NEFCO's watershed planning for Nimishillen Creek. This Phase evaluates the potential of each land use identified in Phase I to impair the Creek's water quality. It also contains data on the water quality based on macroinvertebrate sampling from six stations in the watershed. Lastly, this report contains preliminary information on the formation of the Nimishillen Creek Action Plan.

- *Nimishillen Creek Comprehensive Watershed Management Plan - Phase III*, June 2001, by NEFCO. Phase III of the Nimishillen CWMP contains additional water quality information based on macroinvertebrate sampling at ten sites throughout the watershed. The main section of this report is the Nimishillen Creek Watershed Action Plan and Cost Analysis which is a strategic plan that aims to restore and protect water quality, habitat, wildlife, and recreational/commercial uses of natural resources in the watershed. The Action Plan outlines a series of seven goals and numerous objectives that, if achieved, should lead to a higher level of environmental quality and the preservation of important resources.

- *Nimishillen Creek Comprehensive Watershed Management Plan - Phase IV*, April 2003, by NEFCO. Phase IV is the Home Sewage Treatment System (HSTS) Plan developed by the Stark County Health Department and NEFCO. This Plan identifies likely areas where failing systems are affecting surface water quality, provides guidance for financial assistance to homeowners who need to repair or replace their existing systems, summaries long-term inspection and monitoring goals by the Health Department, and outlines a comprehensive educational and outreach program.

- *Nimishillen Creek Macroinvertebrate Surveys*, 2001, 2003, and 2005, by NEFCO. These surveys were funded by the City of Canton to establish baseline data, characterize Nimishillen Creek's water quality in the Canton area, and monitor significant changes to the biology or habitat at the sampling locations. Sampling was conducted in late summer and early fall at sixteen locations throughout the watershed, but mainly around the confluence of the three primary tributaries near

downtown Canton. Sampling results for each tributary can be found in the subwatershed plans' portion of this report (Section VII).

- The Ohio EPA has conducted water quality surveys in Nimishillen Creek. A summary of surveys conduced from 1992-2002 can be found in *2002 Integrated Water Quality Monitoring and Assessment Report.*

- *Reifsynder Park Constructed Storm Water Wetland - Macroinvertebrate Monitoring Results*, by NEFCO, November 2004. The City of Canton contracted with NEFCO to conduct macroinvertebrate monitoring up stream and downstream of a constructed storm water treatment wetland to monitor any changes in the macroinvertebrate community as a result of the wetland's installation. The results showed that the constructed wetland had little to no effect on the macroinvertebrate community. However, the results do not rule out the likelihood of water quality (chemistry) improvements resulting from the wetland. The macroinvertebrate monitoring results can be found in the Middle Branch Subwatershed Plan in Section VII of this report.

- Sherrick Run Sampling Results. City of Canton, 2003-2004. In 2003 and 2004, staff from the City of Canton's Water Pollution Control Center tested a abandoned mine effluent into Sherrick Run. Data collected included pH, heavy metals, nutrients, and temperatures. The results from the testing indicated heavy metals from the abandoned mine are impacting the water quality and in-stream habitat of Sherrick Run. Detailed results can be found in the Sherrick Run Subwatershed Plan in Section VII of this report.

- *Pollutant Removal Efficiencies of a Constructed Storm Water Treatment Wetland in Canton, Ohio*, Spring 2005, by Jim Eynon as part of the requirement for the Masters of Science in Engineering degree at Youngstown State University. This study's goal was to ascertain the effectiveness of a recently constructed treatment wetland along the Middle Branch for removing pollutants from urban runoff. This was completed by comparing the levels of total suspended solids and nutrients in storm water before and after treatment by the wetland. The study provided initial insight regarding the effectiveness of the constructed wetland. High removal efficiencies were documented for total suspended solids, phosphorus, and nitrogen. However, the study was conducted during three rain events range measuring between 0.05 to 0.54 inches. Additional monitoring is needed throughout the year and during higher flow events to gain a more accurate understanding of the overall effectiveness of the constructed wetland.

IV. Water Quality Issues

Overview of Water Quality Impairments

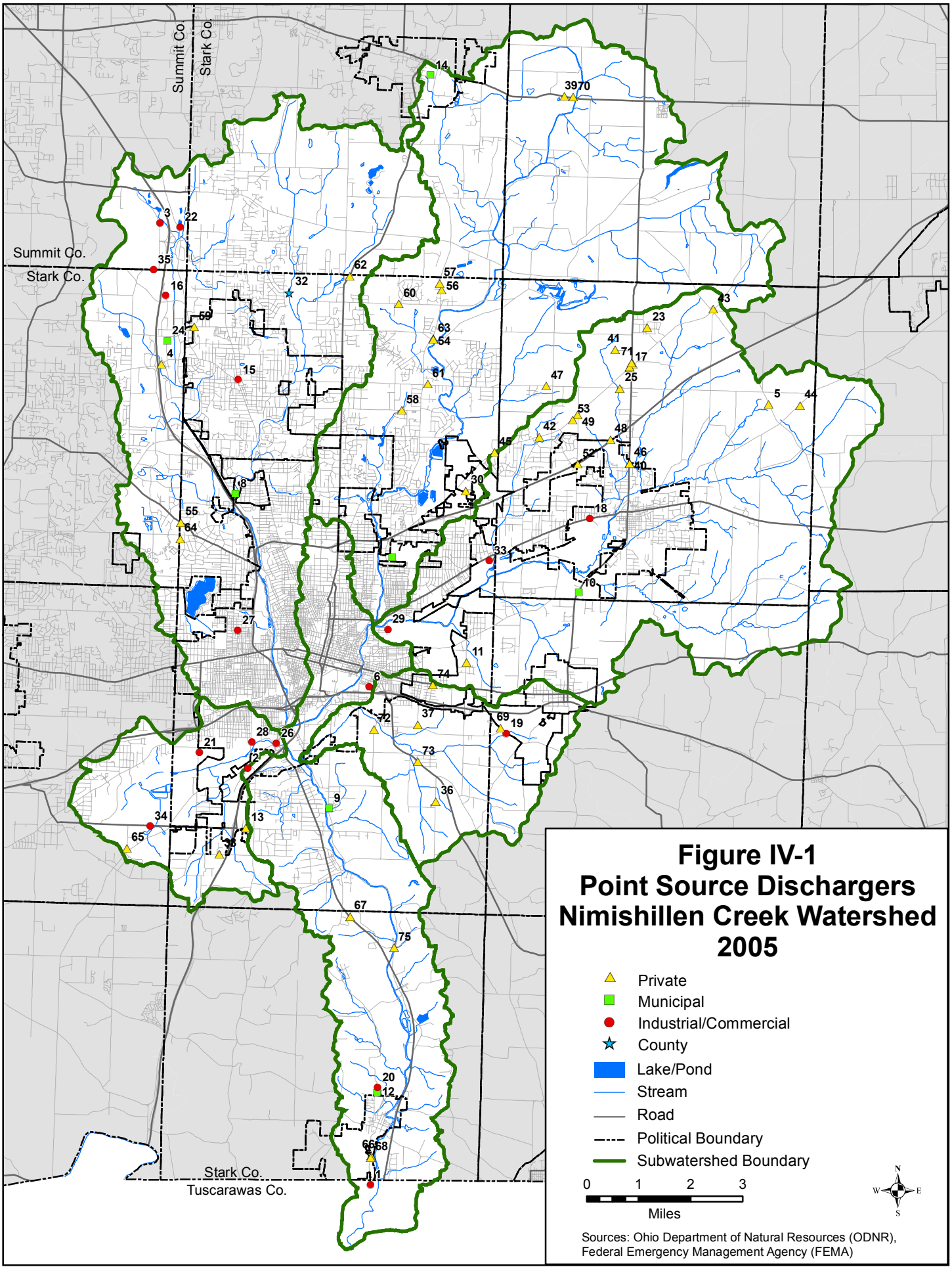
According to NEFCO's *Nimishillen Creek Comprehensive Watershed Management Plan - Phase I*, there are a wide variety of potential pollution sources in the watershed. Pollution sources that can be divided into two categories: Point Source and Nonpoint Source (NPS). Point sources of pollution are those that have a known discharge point, such as a pipe. Nonpoint sources of pollution refers pollution that cannot be tracked back to a single origin or source. Pollution acquired while water drains off of farms, parking lots, yards, and roads are typical examples of NPS pollution.

Point Source Pollution

Figure IV-1 shows the seventy-five permitted point source dischargers in the watershed. These discharges are divided into three categories: municipal, industrial, and private. Municipal discharges are from public water or wastewater treatment plants. There are currently seven municipal dischargers in the watershed. Permitted discharges from industrial plants are generally the byproduct of an industrial process. There are currently eighteen permitted dischargers of this type, and each subwatershed contains at least one industrial discharger. Lastly, private permitted discharges are primarily smaller wastewater treatment systems serving a private residence or business. Fifty of these private discharges are permitted in the Nimishillen Creek Watershed (Figure IV-1). There are also several off-site home sewage treatment systems (HSTSs) in the watershed that should be considered point sources, but are not mapped due to insufficient information. However, locating these off-site HSTSs is currently being addressed as part of the NPDES Storm Water Phase 2 permit being implemented by local entities listed above.

Point sources of pollution have historically been a major cause of water quality degradation in the United States. However, in 1972 the National Pollution Discharge Elimination System (NPDES) was established giving the Ohio EPA the authority to permit or limit what is released into the waterways by point source dischargers. In Stark County, the Ohio EPA monitors all permits that discharge more than 25,000 gallons per day into Nimishillen Creek or its tributaries. The Stark County Health Department regulates discharges less that 25,000 gallons per day that have a NPDES permit. Since inception of the NPDES program, pollution from point source discharges has been greatly reduced and water quality has generally improved. Consequently, this plan will only address point source discharges if they are determined to be illegal, abandoned (mines), and/or the primary factor in preventing a stream segment from meeting state water quality standards.

A new requirement to the NPDES program was added in 2003 to control pollution for storm sewer systems. The NPDES Storm Water Phase 2 permit program was established by the USEPA. It requires nearly all urbanized areas to develop minimum measures to control storm water runoff. Information about this program can be found in Section II of this report. Most communities have until 2008 to fully


Summit Co.
Stark Co.
Summit Co.
Stark Co.
Stark Co.
Tuscarawas Co.
Figure IV-1
Point Source Dischargers
Nimishillen Creek Watershed
2005
Private
Municipal
Industrial/Commercial
County
Lake/Pond
Stream
Road
Political Boundary
Subwatershed Boundary
0 1 2 3
Miles
N
W
E
S
Sources: Ohio Department of Natural Resources (ODNR),
Federal Emergency Management Agency (FEMA)

implement their Phase 2 program, so little information was available for inclusion in this report. Information, activities, and projects resulting from this program will appropriately be added to this report when available.

Section VII of this report contains a summary of point source dischargers for each of the six subwatersheds. Additional information pertaining to point source dischargers can be found in Appendix B.

Nonpoint Source Pollution

Despite the improved water quality resulting from the NPDES permits limiting point source pollution, streams and rivers are still impacted by pollution. Nonpoint source pollution (NPS) or pollution that has no known discharge point is now seen as the primary cause of water quality problems in the United States including Ohio. These pollutants can have harmful effects on drinking water supplies, recreation, fisheries, and other wildlife.

For Nimishillen Creek, the major sources of NPS pollution in the watershed are directly related to land use and human activity. Failing home sewage treatment systems in unsewered areas, agricultural practices, construction sites, petroleum production, impervious areas, and the seasonal spreading of road salt are all examples of potential sources of NPS pollution in the Nimishillen Creek Watershed.

Over half the watershed is unsewered, so there is a very high potential for these areas to be a source of untreated or inadequately treated sewage entering the creek. When home sewage treatment systems fail, untreated sewage containing nutrients and disease-causing organisms can be released into local streams or groundwater. The potential for HSTS failure is especially high when unsewered areas are within urban areas with unsuitable soils for properly functioning treatment systems. See the HSTS Plan in Section VI for more information.

Agricultural areas in the watershed can also be potential sources of nutrients (nitrogen, phosphorus, and potassium), pesticides, herbicides, organic wastes and associated disease-causing organisms. However, the impact of agricultural areas is gradually decreasing as agricultural areas are converted to residential, commercial, or industrial areas. Subwatersheds 3 and 4 will be the most impacted by agricultural activities since they have the most farm land.

Construction sites can contribute sediment loadings to nearby lakes and streams through erosion of disturbed soils during rain events. This is of particular concern in subwatersheds such as the West Branch with a myriad of construction sites due to suburban sprawl. Suburban development also leads to an increase in impervious or hardened areas. All of the parking lots, buildings, roads, and sidewalks are impervious areas that can facilitate the transportation of spilled pollutants and exacerbate runoff and flooding problems. In addition, impervious areas can also reduce groundwater recharge resulting in lower water tables. Subwatersheds 1, 2,

4, and 6 have the most development resulting in the increase of NPS pollution concerns from impervious areas.

Considering these and other dispersed sources of potential pollution, it is apparent that the entire watershed is highly susceptible to the affects of NPS pollution. Each subwatershed will differ on the type and magnitude of NPS pollution impacting water quality. Therefore, actions to reduce the impacts of NPS pollution will differ to some degree from subwatershed to subwatershed. Section VII contains individual action plans for each of the six Nimishillen Creek subwatersheds to address specific NPS issues for that basin.

Potential Contamination Sources

Lacking specific water quality data to categorize nonpoint source pollution problems at the time of this report, NEFCO worked with watershed stakeholders to rate potential pollution sources in the Nimishillen Creek Watershed. NEFCO asked stakeholders to rate the level of impact potential pollution sources has on each subwatershed. NEFCO asked the watershed stakeholders to rank 25 different land uses in the subwatershed based on potential impact to Nimishillen Creek water quality. NEFCO then applied the concepts of the Ohio Comparative Risk Project (OCRP) to the local land use rankings.

The OCRP ranked 45 potential threats to human health, ecosystems, and quality of life in Ohio (Ohio EPA, 1995). The result of these efforts was the production of a list of potential point source and NPS pollution sources for the watershed. Table IV-1 has the ranking for the entire watershed of these pollution sources. The table also provides a rating score for each subwatershed with “1" equaling virtually no threat of impairment from that source to “5" representing a high potential pollution threat. For more information on this methodology or study results, refer to the *Nimishillen Creek Comprehensive Watershed Management Plan - Phase II*. Note that subwatersheds 1, 5, and 6 were treated as a single subwatershed for purpose of this survey.

Results from this planning activity show stakeholders rated industrial areas, failing home sewage treatment systems (HSTS), oil and gas exploration (Figure IV-2), and runoff from agricultural lands and construction sites as having the greatest potential to harm the waters of Nimishillen Creek. Also, subwatershed scores of potential pollution sources can help with identify priority areas for water quality restoration and protections measures.

Spills

Spills is a broad term used to cover a variety of past, current, and future pollution threats to Nimishillen Creek’s water resources. A spill is generally the non-permitted release of liquids that present an ecological and/or health risk to the watershed’s wildlife and residents. Common types of spills include petroleum products (diesel fuel, crude oil, etc.), sewage releases, NPDES permit violations, and fish kills. The causes for the spills range from accidents to illegal dumping to bypassing of a

Table IV-1: Ranking of 25 Land Uses in the Watershed and Land Use Characterization Rating for each Subwatershed

Identified Potential Pollution Source	Subwatershed			
	1, 5, & 6	2	3	4
1. Industrial Land Use Areas	5	3	2	5
2. Off-Lot (Discharging) Home/Semi-Public Sewage Treatment Systems (Septic Tanks)	4	1	4	4
2. Failing On-Lot Home/Semi-Public Sewage Treatment Systems (Septic Tanks)	4	1	4	4
3. Oil and Gas Wells (i.e., Oil and Gas Production and Exploration/Drilling Activity)	5	3	5	4
3. Gasoline Use (Including Storage and Transportation of Gasoline)	5	4	4	4
4. Construction Sites	2	3	3	3
5. Industrial Dischargers	4	1	2	2
6. Agricultural Areas	3	2	3	3
7. Trucking Activity and Related Maintenance (Including Diesel Fuel Use)*	3	4	1	2
8. Oil and Gas Pipelines (i.e., Oil and Gas Transportation)	4	4	2	2
9. Mining Activity*	4	3	1	1
10. Landfills and dumps*	3	1	1	1
11. Nurseries/Greenhouses and Landscaping Operations*	2	2	2	2
11. Golf Courses*	1	3	3	1
12. Impervious Areas (e.g., Rooftops, Roads, Parking Lots, etc.)	4	5	2	2
13. Semi-Public Wastewater Treatment Plants (Package Plants-discharging less than 100,000 gpd)	3	2	3	3
14. Public Wastewater Treatment Plants (Municipal and County POTWs)	3	2	2	3
14. Lawn and Garden/Household Maintenance Activity*	2	4	2	2
14. Excess Nutrients From Natural Sources (e.g., Geese)*	2	2	1	1
15. Salt Storage and Seasonal Spreading of Salt	3	2	2	2
16. Fuel Oil Use (Including Storage and Transportation of Fuel Oil)*	3	2	2	2
17. Polychlorinated Biphenyls (PCBs) Use (Used in Some Electrical Transformers)*	3	1	1	3
Leaking Underground Storage Tanks (information was not available at time of evaluation)**	--	--	--	--
Registered Underground Storage Tanks (information was not available at time of evaluation)**	--	--	--	--
Abandoned Drinking Water Wells (information was not available at time of evaluation)**	--	--	--	–

*Documentation is not available at this time.

**Ranking was not possible.

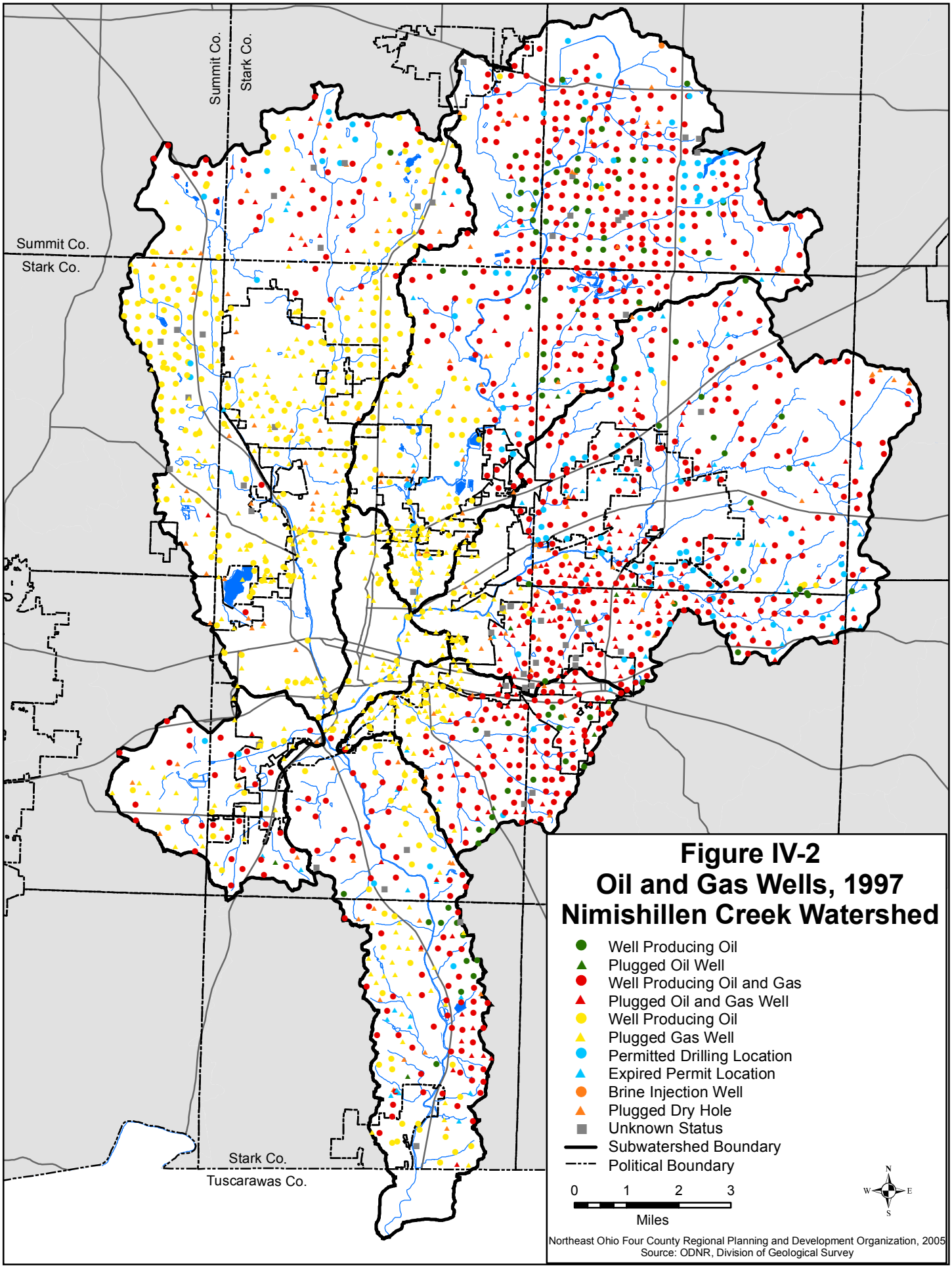
1 = Virtually no potential to impair surface water and/or ground water quality.

2 = Low potential to impair surface water and/or ground water quality.

3 = Moderate to impair surface water and/or ground water quality.

4 = High to impair surface water and/or ground water quality.

5 = Very high to impair surface water and/or ground water quality


Summit Co.
Stark Co.
Summit Co.
Stark Co.
Stark Co.
Tuscarawas Co.
Figure IV-2
Oil and Gas Wells, 1997
Nimishillen Creek Watershed
Well Producing Oil
Plugged Oil Well
Well Producing Oil and Gas
Plugged Oil and Gas Well
Well Producing Oil
Plugged Gas Well
Permitted Drilling Location
Expired Permit Location
Brine Injection Well
Plugged Dry Hole
Unknown Status
Subwatershed Boundary
Political Boundary
0 1 2 3
Miles
N
W E
S
Northeast Ohio Four County Regional Planning and Development Organization, 2005
Source: ODNR, Division of Geological Survey

sewage treatment systems during high volume flows. Unfortunately, a good number of spills occurring in the Nimishillen Creek Watershed and Ohio are often unknown.

The Ohio EPA Division of Emergency and Remedial Responses (DERR) takes the lead on significant spills in Ohio. Since 1990, the DERR has responded to 75 spills in the Nimishillen Creek Watershed, an average of nearly 5 spills per year. This is not surprising since the watershed is partially located in a densely populated urban/suburban area with major highways, manufacturing facilities, an oil refinery, and other businesses.

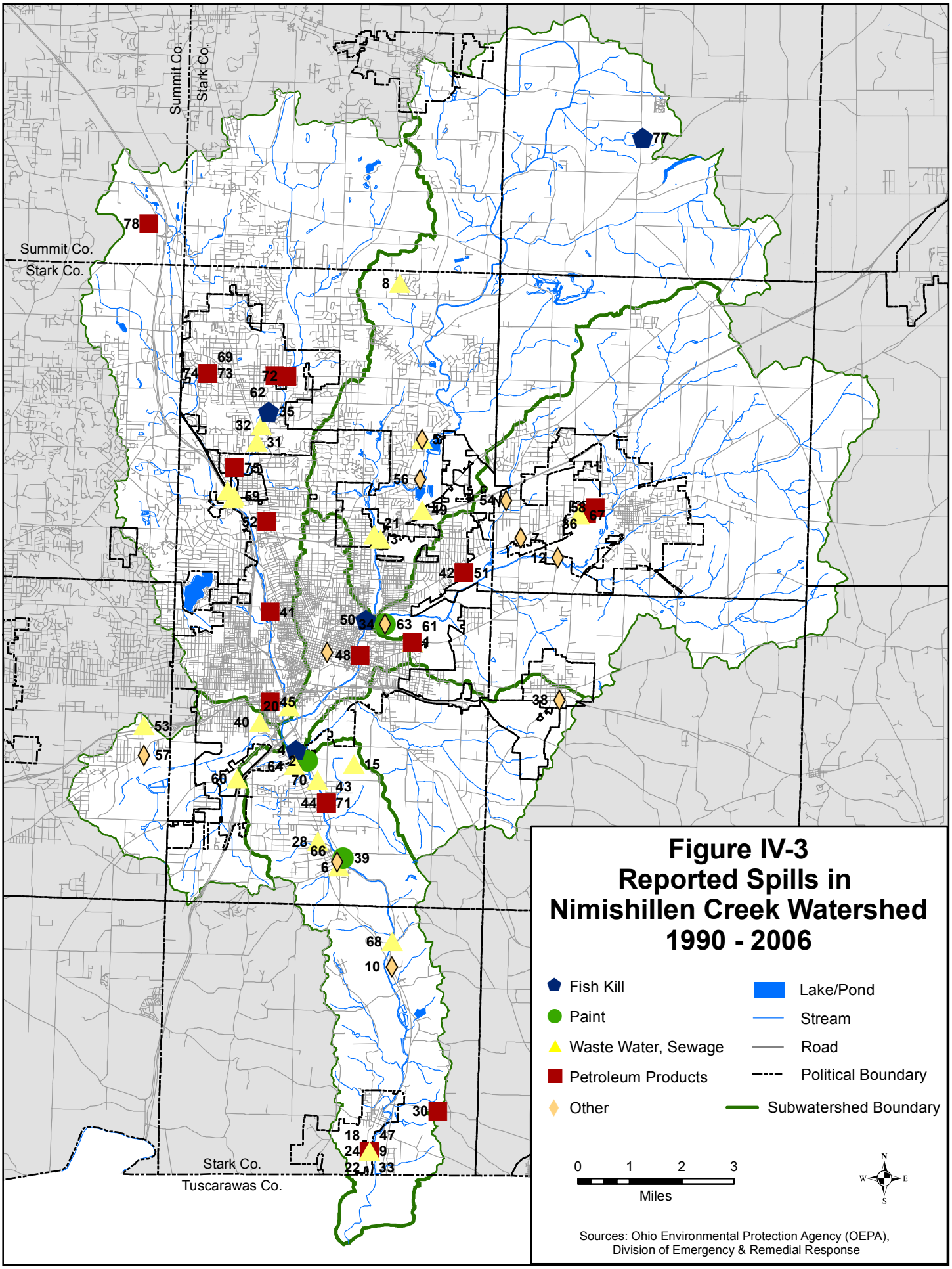
Each of the six subwatersheds has had a spill reported to DERR, with spills occurring more frequently in the subwatersheds with dense population and major highways. The Mainstem, West Branch, East Branch, Middle Branch, Hurford Run, and Sherrick Run Subwatersheds have had respectively 34, 16, 14, 7, 4, and 1 spills reported since 1990. Petroleum based spills are the most common types with 23 on record with DERR. The second and third most common spills are wastewater permit violations and sewage spills with 16 and 15 reported, respectively. There have been four fish kills and three paint spills since 1990. A variety of materials, some unknown, comprise the remaining 14 spills in the watershed. Figure IV-3 shows the location and general type of spills in the watershed, and Appendix H has detailed information about each spill.

Please note that the spills information provided by the Ohio EPA DERR to create Figure IV-3 and Appendix H appears to contain errors. The Nimishillen Creek Watershed Partners Core Committee reviewed the Ohio EPA report and identified some inaccuracies regarding entities responsible for the spills and the spill locations. Specifically, some of the entities cited in the Ohio EPA report do not exist, like the North Canton Waste Water Treatment Plant. Also general locations were given for some of the spills making precise mapping of the spills difficult. If updated and/or corrected Ohio EPA DERR information becomes available regarding these reporting errors, it will be included in future Action Plan updates. Lastly, despite these apparent reporting errors the information provided by Ohio EPA clearly shows spills as a past, present, and future threat to all the Nimishillen Creek subwatersheds.

General Watershed Issues

Nimishillen Creek is not meeting State of Ohio water quality standards as a result of various natural processes and human activities. Some of these activities directly lead to pollution being dumped into the Creek. Other activities lead to the indirect introduction of pollutants to the stream. Still other activities may not lead to pollutants being introduced to the Creek, but ultimately reduce the ability of Nimishillen Creek to process or assimilate increase pollution or water loads. It is a combination of all of these actions and pollution sources that have lead to degraded water quality in the basin.

Below are general watershed issues that affect the water quality in the entire Nimishillen Creek Watershed. These issues represent, in the view of local stakeholders, either a


Summit Co.
Stark Co.
Summit Co.
Stark Co.
Stark Co.
Tuscarawas Co.
Figure IV-3
Reported Spills in
Nimishillen Creek Watershed
1990 - 2006
Fish Kill
Paint
Waste Water, Sewage
Petroleum Products
Other
Lake/Pond
Stream
Road
Political Boundary
Subwatershed Boundary
0 1 2 3
Miles
N
W
E
S
Sources: Ohio Environmental Protection Agency (OEPA),
Division of Emergency & Remedial Response

primary reason why the water quality is not meeting standards and/or a prominent local water issue. Each issue contains a brief overview of the problem and the subwatersheds most impacted by the issue. The individual subwatershed plans contained in Section VII expand on these issues by establishing goals, objectives, and actions to address these issues. Please refer to these subwatershed plans for more information regarding specific watershed issues for each of the six subwatersheds.

- **Issue: Erosion and Sedimentation**

  Subwatersheds of Concern: East Branch, West Branch, and Middle Branch

  Erosion and sedimentation of concern in the Nimishillen Creek Watershed occurs when excessive soil particles are transported from land by wind or water and deposited in nearby streams and lakes. Erosion and deposition of sediments is a natural and beneficial process that occurs in every river basin. However, excess erosion and sedimentation in a watershed can severely impact a stream. Sediments can cloud the water reducing the sunlight reaching aquatic plants, blanketing the streambed covering fish spawning areas and macroinvertebrate habitat, and clogging the gills of fish. In addition, eroded soil particles often have attached to them other pollutants like nutrients, heavy metals, and pathogens that can also degrade water quality. For these reasons, the Ohio EPA ranks sedimentation as one of the leading causes of aquatic life use impairment.

  The two primary erosion types of concern in the basin are in-stream erosion and erosion associated with storm water runoff. In-stream erosion occurs when the water velocity is sufficient to remove soil particles. This type of erosion results in either a combination of lateral erosion along the banks, down cutting (deepening) of the stream bed, or headward erosion along the stream's upslope. An increase in water velocity and/or volume can increase a streams in-stream erosion potential.

  Erosion from runoff after a rain event is also a concern. As rain water moves over a field, lawn, or parking lot it picks up loosened dirt and other particles. Areas with exposed or barren soils are most at risk of being eroded by rain water because the lack of cover to break the fall of rain and hold the soil together. The type of areas often susceptible include construction sites, tilled agricultural fields, animal pastures, and any barren areas near a stream or lake.

  Best management practices are available to combat both in-stream and runoff erosion to reduce the amount of sediment entering Nimishillen Creek. The NPDES Storm Water Phase 2 permit program requires all construction sites over one acre in size to implement erosion prevention measures. There are also several erosion prevention programs available through the United States Department of Agriculture and other similar agencies to educate and assist farmers and ranchers in reducing erosion. Lastly, there are techniques based on natural channel design principals that can help repair and/or stabilize in-stream erosion. All of these options should be promoted as appropriate to address erosion and sedimentation problems in the watershed.

- **Issue: Urbanization/Suburbanization**
  Subwatersheds of Concern: West Branch, Middle Branch (Canton Portion), Mainstem (Canton Portion), and Hurford Run

  Historically, the development of urban and suburban areas often come as a detriment to the health of local water resources. Although water is a valuable resource for any community, it was often utilized and controlled without regard for the health of the stream or lake. Streams were straightened, dammed, moved, filled in, and/or used as waste dumps depending on the needs of the community. It was not until the passage of the Clean Water Act in the 1970s that streams and lakes began to receive protection from these actions. However, many of these historical modifications to and uses of the lakes and streams still impact the health of the water body today.

  The protections now in place prevent many of the most directively destructive actions to local water resources that have historically occurred as a result of development. However, urbanization and suburbanization still can and do negatively impact the quality of local water resources. Development typically leads to increased impervious areas, more storm water runoff, decreased groundwater recharge, increased water volume in streams, more pollution in runoff, and decreased open space and agricultural lands.

  New regulations as a result of the NPDES Storm Water Phase 2 permit program require minimum measures to address current and future water quality concerns with regards to development and urbanization (see Section II). However, water quality impacts as the result of development prior to the implementation of the Phase 2 requirements will remain and continue to impact the Creek. A wide variety of preventative and restorative measures to deal with past, current, and future development pressures are needed to ensure healthy water quality in the Nimishillen Creek Watershed.

- **Issue: Improperly Treated Wastewater**
  Subwatersheds of Concern: East Branch, Middle Branch, West Branch, Mainstem, and Sherrick Run

  Failing wastewater treatment systems add pollutants to a waterway that can prevent attainment of aquatic life use designation standards and jeopardize the public's health. Untreated or poorly treated wastewater, or sewage, often contains bacteria, viruses, parasites, and other pathogenic organisms from humans that are transmitted through water and infect individuals who come into contact with a polluted waterway. Wastewater can also contain chemicals and nutrients (nitrates and phosphorus) that also impact a stream and cause local health concerns. In addition to public health, improperly treated wastewater can affect in-stream vegetation and organisms. Increased phosphorus levels can cause algae blooms and increased weed growth killing off more beneficial, native vegetation. Organic

material in sewage is broken down by bacteria which consumes oxygen and in effect starves other organisms in the water of oxygen.

Fortunately, since the passage of the federal Clean Water Action in the 1970s, the U.S. and Ohio Environmental Protection Agencies have regulated discharges from wastewater treatment (sewage) plants and other point source dischargers through the National Pollutant Discharge Elimination System (NPDES) permit program. This program monitors and limits the amount of pollution that sewage treatment facilities can discharge in to nearby surface waters and has been responsible for significant water quality improvements in Ohio including Nimishillen Creek. The Cities of Canton and Louisville and the Village of Hartville have wastewater treatment plants that discharge into the Mainstem and East Branch, respectively. No area within the Nimishillen Creek Watershed has a combined storm water and municipal sewage system. This limits the occurrences of untreated or "raw" sewage from being dumped into Nimishillen Creek without treatment.

Since discharges from a wastewater treatment plant is regulated by the Ohio EPA and combined storm water and sanitary sewer overflows do not exist in the Nimishillen Creek Watershed, the impact of improperly treated wastewater on water quality is primarily the result of failing home sewage treatment systems (HSTSs), often referred to as septic systems.

Over half the watershed is unsewered and uses HSTSs. The Stark County Health Department estimates that there are approximately 3,000 to 5,000 systems in the watershed. Section VI contains an HSTS Plan designed to reduce pollution from failing septic systems including the establishment of an operations and maintenance (O&M) program. The greatest concern for HSTS pollution into Nimishillen Creek is unsewered areas with high housing densities which are located on soils that poorly treat home sewage. These are mainly located in townships surrounding the Cities of Canton, North Canton, and Louisville.

- **Issue: Riparian Corridor Segmentation and Incursion**
  Subwatersheds of Concern: Middle Branch, West Branch, Swartz Ditch, Mainstem within the City of Canton, and Hurford Run

As discussed in Section II, riparian or streamside vegetation plays an important role in the overall health on Nimishillen Creek. In general, riparian vegetation reduces the amount of sediment and nutrients introduced to the stream by filtering runoff and stabilizing streambanks. Riparian vegetation also provides shade or cover that decreases the maximum temperatures in the summer and increasing minimum temperatures in the winter. Lastly, riparian areas provide important habitat to wildlife (Allan, 1995).

However, removal or degradation of the riparian habitat is often commonplace when human settlement occurs (Allan, 1995). Native vegetation is often cleared to make

room for cropland, houses, roads, railroads, and/or businesses. This streamside vegetation removal results in increases in sediment and nutrients reaching nearby streams, increased variations in water temperature due to the loss of shade, and reduction in wildlife habitat.

In the Nimishillen Creek Watershed, the riparian habitat has been disturbed in both agricultural and urban areas. Riparian habitat degradation from agricultural improvements occurred primarily along the headwaters of the Middle and East Branches in Nimishillen, Marlboro, and Lake Townships. The loss of riparian vegetation along the West Branch was the combination of agricultural improvements in the first half of the 1900s followed by urbanization and suburbanization along Interstate 77 and near the Akron-Canton Airport. Riparian vegetation within the City of Canton has been removed as the city has expanded. However, Canton has numerous parks along Nimishillen Creek that would be logical areas for riparian habitat restoration. Lastly, Hurford Run was found to have the most degraded riparian vegetation of any of the areas studied due to the heavy industrial use of the area. Restoration along most sections of Hurford Run will be difficult and require the cooperation of the industrial owners of the riparian areas.

- **Issue: Channel Modification**

  Subwatersheds of Concern: West Branch, Middle Branch, and Hurford Run

  Channel modification is a human alteration of the natural condition of a stream's shape and/or flow. Typical modifications include channelization, dams, culverts, dredging, and ditches. Channel modifications disrupt the natural functions of a stream often leading to number of problems that can include changes in water velocities, changes in water temperature, reduced habitat for aquatic organisms, and changes to the stream's ability to transport sediment. In addition, channel modification not only impacts the section of a stream being modified, but can also change the stream characteristics upstream and downstream of the modified section. These impacts can include channel downcutting, excess bank erosion, and aquatic habitat loss.

  Channelization and ditching are the primary channel modification issues for Nimishillen Creek and its tributaries. As the watershed was settled and developed, the Creek was straightened to "improve" drainage and provide more land for farming and buildings. Most of this work was completed prior to the 1950s. Some of the ditches created include Swartz Ditch (Middle Branch), McDowell-Zimber Ditch (West Branch), and Domer Ditch (Hurford Run). Maintenance of the ditches has been sporadic over the years resulting in problems such as sedimentation and log jams.

  It is impractical return all these modified sections of Nimishillen Creek back to a natural condition. However, where appropriate, improvements to these channelized sections must be considered and implemented to improve channel and habitat conditions. Types of improvements could include better riparian vegetation, bank

stabilization, two-stage ditches, and limited restoration of natural channel geomorphology.

- **Issue: Flooding**

  Subwatersheds of Concern: East Branch, West Branch, and Mainstem

  Floods are natural events for all stream and rivers and occur when there is enough water to spill over streambanks and onto adjacent land called the floodplain. Typically, communities experience some kind of flooding after spring rains, heavy thunderstorms, or winter snow melts. These events generally develop over a period of days. However flash floods, as the name implies, develop quickly when intense storms dump a large amount of rain in a small area over a short time. Flash floods provide little or no warning and reach their maximum intensity in just a few minutes.

  The magnitude of flooding in a given area results from both environmental and societal factors. Climate, land slope, soils, and other environmental factors all influence the amount, duration, and frequency of floods in a given area. However, society, collectively and individually, also make choices that influence flooding, usually for the worse. All of the following can affect the frequency, duration and magnitude of a flood and increase damage caused by an event: increasing the number of people living in or near floodplains, reducing the amount of wetlands, increased pavement (impervious area) over soil, removing stream-side (riparian) vegetation, filling in floodplains, and altering the shape of a stream channel (straightening or ditching).

  Nimishillen Creek is typical in that it has had its share of flooding. Community interest in flooding has recently heightened due to above average rainfall in the watershed since late 2002 which has resulted in several minor and two serious flood events. The most severe flooding within the last few years occurred in July 2003 resulting in the Federal Emergency Management Agency (FEMA) declaring the watershed area a "major disaster." Homes, businesses, roads, and infrastructure were damaged or lost as a result of the flooding. The Cities of Canton, Louisville, and North Canton along with neighboring townships all received flood damage. A county-wide initiative called the Stark County Drainage Task Force was initiated after the July 2003 flooding to address both environmental and societal issues related to reducing flooding impacts to Stark County and Nimishillen Creek Watershed residents (see Section II).

Although reducing flooding in Stark County is a water quantity (amount) and not a water quality issue, many of the factors exacerbating flooding also adversely impact water quality. The reduction of wetlands, increase of impervious areas, removal of stream-side vegetation, and stream ditching are all practices that have been shown to increase the amount or magnitude of flooding while decreasing water quality. In addition, some traditional approaches to reducing flooding impacts such as dredging, dikes, levees, and channelization can also have a negative impact on water quality. Therefore, the goal in the Nimishillen Creek Watershed in addressing flooding problems is to promote practices or actions that are beneficial to both water quantity and quality concerns while working to limit or eliminate water quantity practices that impair water quality.

- **Issue: Acid Mine Drainage**

  Subwatersheds of Concern: Sherrick Run, Mainstem

  Acid Mine Drainage (AMD) is a common byproduct of coal mining that results when mineral pyrite (FeS_2) is exposed to air and water producing a reaction that forms sulfuric acid and iron hydroxide. This drainage can severely impact local waterways by lowering pH levels and coating stream bottoms with orange sediment comprised of iron hydroxide, commonly called “yellow boy”. The problem occurs primarily in areas with old abandoned coal mines.

  The Nimishillen Creek Watershed has a history of coal mining, particularly in the unglaciated southern portion of the watershed. Sherrick Run and the Mainstem have the greatest number of abounded mines as shown in Table IV-2. Both waterbodies show signs of decreased water quality from AMD in a few distinct locations. These sites clearly display the typical “yellow boy” colored coating on the stream bottom, and preliminary tests show an impact on the biological communities downstream of these sites. Treatment options for AMD sites need to be explored to alleviate AMD’s impacts on Nimishillen Creek and its tributaries.

Table IV-2: Abandoned Underground Coal Mines in the Nimishillen Creek Watershed

Mine Name	Identification Number	Bedrock Formation	Year Abandoned	Subwatershed
Arntz Coal	341518011402	Middle Kittanning No.6	1914	Mainstem
Bernhardt	341538002102	Brookville No. 4	1918	West Branch
Black Oak	341518014602	Not Given	1921	Mainstem
Black Oak No. 2	341518009802	Brookville No. 4	1938	Mainstem
Canton Hollow Block	341518002302	Brookville No. 4	1914	Sherrick Run
Chestnut Ridge	341518019802	Lower Kittanning No. 5	1922	Mainstem
Coal and Limestone	341518022002	Brookville No.4	1919	Mainstem
Deibel	341518027102	Not Given	Not Given	Mainstem
Eberhart	341518016402	Middle Kittanning No. 6	1932	Mainstem
Edegefield	341518009202	Brookville No. 4	1917	West Branch
Edegefield No. 2	341518021102	Brookville No. 4	1935	Sherrick Run
Failor	341518027202	Not Given	Not Given	Mainstem
Harrisburg	34158021402	Middle Kittanning No. 6	1916	East Branch
Hipple	341518025702	Middle Kittanning No. 6	1942	Mainstem
Hoover	341518013602	Not Given	Not Given	West Branch
Immel No. 1	341518022202	Middle Kittanning No.6	1924	Sherrick Run
Jones	341518013402	Not Given	1923	Sherrick Run
Lake Erie No. 1	341518001002	Not Given	1898	Sherrick Run
Martin	341518024202	Not Given	1920	Middle Branch
Massillon Standard	341518004002	Not Given	1896	Sherrick Run
McGintey	341518018402	Middle Kittanning No. 6	1919	East Branch
Milton	341518020502	Brookville No. 4	1920	Mainstem
Myers	341518017302	Brookville No. 4	1939	West Branch
Pike	341518010502	Brookville No. 4	1919	Mainstem
Pike Run No. 2+4	341518014502	Brookville No. 4	1922	Mainstem
Pike Run No. 1	341518014302	Brookville No. 4	1920	Mainstem
Pike Run No. 6	341518019002	Not Given	1938	Mainstem
Rindchen	341518024302	Middle Kittanning No. 6	1937	Sherrick Run
Sauter	341518018702	Middle Kittanning No. 6	1938	Mainstem
Shotmacher	341518017202	Brookville No. 4	1934	West Branch
Sonnhalter No. 1	341518016102	Brookville No. 4	1924	Mainstem
Summit Hill	341518002402	Not Given	1915	West Branch
Sunnyside	341518027302	Not Given	Not Given	Mainstem
Swan	341518007502	Lower Kittanning No. 5	1901	Mainstem
Thouverin	341518023302	Middle Kittanning No. 6	1935	Sherrick Run
Tressel	341518004402	Not Given	1896	Sherrick Run
Willow Springs	341518005302	Lower Kittanning No. 5	1896	Mainstem
Wymer	341518012202	Middle Kittanning No. 6	Not Given	Sherrick Run

Source: Ohio Department of Natural Resources, Division of Geological Survey.

V. Load Reductions

Nimishillen Creek Total Maximum Daily Load (TMDL) Summary
The Ohio EPA completed the Nimishillen Creek TMDL in October, 2009. The TMDL report can be found online at:

http://www.epa.ohio.gov/dsw/tmdl/NimishillenCreekTMDL.aspx

For the TMDL the Ohio EPA conducted stream surveys in 2003, 2004, and 2005. Impairments were found for fish and insect communities as well as elevated phosphorus and bacteria. Of the 33 sites sampled by Ohio EPA, 19 (57%) were not attaining biological goals, 11 (33%) were partially attaining the goals, and only 3 (9%) were in full attainment.

Biological communities have been impacted over the years by a number of sources including discharges from industrial and municipal wastewater treatment plants, agriculture, and septic (home sewage treatment) systems. The modification of natural drainage patterns through dredging and ditching is also a significant issue in the watershed.

When trees along the stream banks are removed, the lack of shade allows the water temperature to increase, which decreases the amount of dissolved oxygen for aquatic organisms. The depletion of dissolved oxygen is worsened by manure runoff and untreated sewage flowing from failing home septic systems and small communities without any wastewater collection or treatment. Lack of water in small headwater streams, especially in the summer, makes it hard for pollutants to be absorbed and treated by the natural stream ecology. Agricultural drainage improvements such as tiling and routine dredging contribute to uneven and unsustainable water flow in these small streams, making it difficult to support good aquatic life communities.

Because there are many reasons streams in the Nimishillen Creek watershed fail to meet water quality goals, several actions are required to improve the current condition and protect the watershed in the future. The recommendations should focus on reducing pollutant loads and/or increasing the capacity of the streams to handle the remaining pollutant loads. Restoring a more natural flow regime is an essential component of protecting water quality and aquatic biological communities. The basic principles of providing floodplain connectivity, stable stream morphology and watershed hydrology that approximates natural conditions are applicable to all areas of the watershed. Likewise, stream buffers are appropriate for all land use types in the watershed (Ohio EPA, 2009).

There will continue to be a need for drainage projects within the watershed given the risks of flood damage in urbanized areas and agricultural drainage needs in the northern and eastern sections. All local governmental agencies involved with drainage maintenance and flood control practices should reassess current practices in light of the severe degree of impact shown in the water quality and biological data. This problem is

not unique to the Nimishillen Creek watershed. Alternative methods of ditching and stream channel management can be implemented to achieve the necessary drainage with less environmental impact.

Local planning and zoning will need to look at better ways of integrating watershed stewardship and storm water management into land use decision making. Good planning decisions early will help to minimize long term consequences and expenses.

TMDLs Developed

In the Nimishillen Creek Watershed, the Ohio EPA developed TMDLs for total phosphorus (TP), pathogens (bacteria), habitat, and sediment. The pathogen TMDL addresses impairment of recreational uses in the basin. The sediment, pathogens, and total phosphorus TMDLs deal with impairments to aquatic life. For each of these sources of impairment, the TMDL establishes an existing load, the load need to no longer be impaired, and a percent reduction needed. The TMDL shows the load reduction needs for each HUC 12 subwatershed that is not in attainment.

TMDL Load Reductions

Phosphorus

The lower section of the East Branch Nimishillen Creek and all of the mainstem Nimishillen Creek do not meet their aquatic life use designation of warm water habitat. Nutrients are a cause of impairment in all of these sites with major municipal wastewater treatment plants and urban runoff as the main sources of these nutrients. Times of low stream flow in warmer months are believed to be the critical condition in which these nutrients cause the most detriment to aquatic life. This is generally based on the fact that the nutrient rich discharge from municipal wastewater treatment plants on both East Branch Nimishillen Creek and the mainstem dominates stream flow during these events. Nutrients, and dissolved oxygen (DO), are assessed using the QUAL2K model, version 2.04 (Ohio EPA, 2009). Table V-1 show the TMDL and load allocations for total phosphorus in Nimishillen Creek's East Branch and Mainstem.

Table V-1: TMDL and Allocations of Total Phosphorus

	Design Flow (MGD)	Phosphorus WLA/LA at Sources		Phosphorus Loads at Compliance Points[1] (kg/day)		
		Conc. (mg/l)	Load (kg/day)	TMDL[2]	WLA[2]	LA[2]
East Branch Nimishillen Creek				2.34	2.315	0.026
Louisville WWTP	2.00	1.00	7.56			
Republic Steel Corp. 010 Outfall	2.74	0.16	1.66			
Republic Steel Corp. Other Outfalls	0.30	0.08	0.09			
Nonpoint Sources	-	-	0.11			
Nimishillen Creek				21.78	21.368	0.416
Canton WPCF	39.00	0.40	59.05			
Canton Water Dept. NE Plan	0.16	1.00	0.60			
Marathon Ashland Petroleum	1.67	0.27	1.70			
Timken Company	3.50	0.27	3.58			
Nonpoint Sources	-	-	1.34			

1 Compliance point at RM 0.05 on East Branch Nimishillen Creek and at RM 0.62 on Nimishillen Creek. The allocations for the Nimishillen Creek compliance point reflect the sum of the loads contributed in Nimishillen Creek. The allocations for the East Branch compliance point reflect the sum of the loads contributed in East Branch. The loads contributed upstream of the East Branch compliance point are included in the model and are reflected in the Nimishillen Creek compliance point.

2 The loads contributed to the streams decay and assimilate so that the TMDL is met at both compliance points.

Abbreviations: MGD=million Gallons per Day; WLA = Waste Load Allocation; LA = Load Allocation; mg/l = milligrams per liter; kg/day = kilograms per day; WWTP = wastewater treatment plan; WPCF = water pollution control facility; Conc. = concentration

Source: Nimishillen Creek TMDL, Ohio EPA, 1999.

During low flow periods, effluents from point sources are rich with phosphorus resulting in noncompliance with Ohio EPA's permits limits. Therefore, the TMDL recommends that all wastewater treatment plants with a designed flow greater than 100,000 gallons per day limit their total phosphorus discharge to 1.0 mg/l. According to the Ohio EPA, this reduction should provide enough in stream nutrient production (approximately 60 percent) to improve aquatic life throughout the watershed while imposing achievable permit limits on dischargers (Ohio EPA, 2009).

Pathogens (Bacteria)

The TMDL states that recreation use impairments from pathogens in the Nimishillen Creek Watershed are primarily from failing home sewage treatment systems (HSTS) and agriculture from both crops and livestock. Wildlife is believed to make a relatively small contribution to the pathogen load. Urban areas contributions to some extent attributed to storm water runoff and failing HSTS. The recreational impact is from both point and nonpoint sources of pollution. Table V-2 show the existing load, TMDL, waste load allocations, and the percent reduction needed to reach attain water quality standards (Ohio EPA, 2009).

Table V-2: Total Existing Load, TMDL, and Allocations of Fecal Coliform Loads (for the recreation season)

12-digit HUC	Subwatershed	Existing Loads			TMDL[1]	% Reduction	Allocations	
		PS	NPS	Total			WLA	LA
-04	Upper Middle Branch Nim. Cr.	467.8	141.4	609.2	74.8	87.7	0.09	74.7
-02	East Branch Nim. Cr.	1404.0	286.3	1690.3	164.2	90.3	1.6	162.6
-03	West Branch Nim. Cr.	2246.7	41.1	2287.8	143.6	93.7	113.3	30.4
-05	Sherrick Run[2]	560.3	6.03	566.4	35.1	93.8	29.1	6.03
-06	Lower Mainstem Nim. Cr.	664.3	2.49	666.8	94.6	85.5	92.1	2.49

[1] cfu * 10^3 * season^{-1} (for cfu * 10^3 * day^{-1} divided each value by 138)
[2] Sherrick Run is only part of the 12-digit HUC
Source: Nimishillen Creek TMDL, Ohio EPA, 2009

Tables V-3 and V-4 further breakdown the load reductions from point and nonpoint sources, respectively.

Table V-3: Point Source Fecal Coliform Loads. These Include Existing, Percent Reduction Required, and Wasteload Allocation (WLA) by Source

12-digit HUC	Subwatershed	Point Source Loads[1]				
			NPDES Discharger	MS4	HSTS	Total WLA
-04	Upper Middle Branch Nim. Cr.	Existing	0.08	0.015	467.78	467.8
		% Reduction	0	24.2	100	
		Allocation	0.08	0.011	0	0.09
-02	East Branch Nim. Cr.	Existing	1.38	0.36	1402.2	1404.0
		% Reduction	0	30.2	100	
		Allocation	1.38	0.25	0	1.6
-03	West Branch Nim. Cr.	Existing	0.20	0.78	2245.7	2246.7
		% Reduction	0	0	95.0	
		Allocation	0.20	0.78	112.29	113.3
-05	Sherrick Run[2]	Existing	0.01	0.05	560.27	560.3
		% Reduction	0	0	94.8	
		Allocation	0.01	0.05	28.33	29.1
-06	Lower Mainstem Nim. Cr.	Existing	24.82	0.07	639.39	664.3
		% Reduction	0	0	98.5	
		Allocation	24.82	0.07	67.20	92.1

[1] cfu * 10^3 * season^{-1} (for cfu * 10^3 * day^{-1} divided each value by 138)
[2] Sherrick Run is only part of the 12-digit HUC
Source: Nimishillen Creek TMDL, Ohio EPA, 2009

Table V-4: Nonpoint Source Fecal Coliform Loads. These Include Existing, Percent Reduction Required, and Load Allocation (LA) by Source

12-digit HUC	Subwatershed	Non-Point Source Loads[1]						
			Cropland	Pasture	Forest	Urban[2]	Cattle in Stream	**Total LA**
-04	Upper Middle Branch Nim. Cr.	Existing	31.44	66.74	0.18	0.11	42.91	141.4
		% Reduction	24.2	24.2	0	24.2	100	
		Allocation	23.85	50.61	0.18	0.08	0	74.7
-02	East Branch Nim. Cr.	Existing	65.20	166.64	0.72	0.12	53.64	286.3
		% Reduction	30.2	30.2	0	30.2	100	
		Allocation	45.49	166.27	0.72	0.09	0	162.6
-03	West Branch Nim. Cr.	Existing	12.96	17.01	0.24	0.17	10.73	41.1
		% Reduction	0	0	0	0	100	
		Allocation	12.96	17.01	0.24	0.17	0	30.4
-05	Sherrick Run[3]	Existing	4.37	1.29	0.32	0.05	0	6.03
		% Reduction	0	0	0	0	-	
		Allocation	4.37	1.29	0.32	0.05	0	6.03
-06	Lower Mainstem Nim. Cr.	Existing	0.77	0.64	0.98	0.09	0	2.49
		% Reduction	0	0	0	0	-	
		Allocation	0.77	0.64	0.98	0.09	0	2.49

[1] cfu * 10^3 * season^{-1} (for cfu * 10^3 * day^{-1} divided each value by 138)
[2] This is non-MS4 Urban
[3] Sherrick Run is only part of the 12-digit HUC
Source: Nimishillen Creek TMDL, Ohio EPA, 2009

Habitat

Habitat alteration is a cause of impairment throughout the Nimishillen Creek Watershed. Poor habitat quality is an environmental condition, rather than a pollutant load, so development of a load-based TMDL to address this cause of impairment is not possible. However, the Qualitative Habitat Evaluation Index (QHEI) is a tool that provides a numeric value, which is assigned to a particular stream segment based on the quality of its habitat. The QHEI evaluates six general aspects of physical habitat that include channel substrate, instream cover, riparian characteristics, channel condition, pool/riffle quality, and gradient and drainage area (Ohio EPA, 2009).

The analysis of the QHEI components as they relate to fish community scores by the Ohio EPA led to the development of a list of attributes that are associated with degraded communities. These attributes are modifications of natural habitat and are listed in Table V-5. The Ohio EPA further divided modified attributes into high influence and moderate influence attributes based on the statistical strength of the relationships. The presence of these attributes can strongly influence the characteristics of the fish communities, and the QHEI score itself may not reflect this effect. High influence modified attributes are particularly detrimental. The presence of one is likely to result in impairment, and two will likely preclude a site from achieving aquatic biology standards (Ohio EPA, 2009).

Table V-5: QHEI Modified Attributes		
QHEI Category	**Modified Attributes**	
	High Influence	**Moderate Influence**
QHEI Score	- Channelized or No Recovery - Silt/Muck Substrate - Low Sinuosity - Sparse/No Cover - Max Pool Depth < 40 cm (Wadable streams only)	- Recovering Channel - Sand Substrate (boat sites) - Hardpan Substrate Origin - Fair/Poor Development - Only 1-2 Cover Types - No Fast Current - High/Moderate Embeddedness - Ext/Mod Riffle Embeddedness - No Riffle
Source: Nimishillen Creek TMDL, Ohio EPA, 2009.		

The habitat TMDL equation presented in Table V-6 reflects the relationship between the QHEI score, modified attributes and fish community performance. The TMDL is based upon a total score of three (3), and is the sum of three component scores each worth one point (Ohio EPA, 2009). Sites with a Habitat TMDL score below three are considered impaired.

Table V-6: Habitat TMDL

	Allocations			TMDL
	QHEI Score	# of High Influence Attributes	Total # of Modified Attributes	
TMDL Targets	≥ 60 = 1 point	< 2 = 1 point	< 5 = 1 point	3 points

Stream (12-Digit HUC)	River Mile	QHEI Score	# of High Influence Attributes	Total # of Modified Attributes	Sub-Score			Total Habitat Score
					QHEI Score	High Influence	Total # Modified	
Middle Branch Nim. Cr. (-04)	13.6	28	5	10	0	0	0	0
Swartz Ditch (-04)	1.2	31.5	3	8	0	0	0	0*
Middle Branch Nim. Cr. (-01)	10.4	52	2	8	0	0	0	0
	3.8	56	1	7	0	1	0	1
Nimishillen Cr. (-01)	14.2/ 14.3	71.5	1	7	1	1	0	2
East Branch Nim. Cr. (-02)	0.1	60.5	1	7	1	1	0	2
West Branch Nim. Cr. (-03)	10.5/ 10.4	60.5	1	4	1	1	1	3
	9.3/ 9.0	47	3	9	0	0	0	0
	4.6/ 4.7	58.5	1	6	0	1	0	1
	3.2	77	0	1	1	1	1	3
	0.4/ 0.3	74	0	3	1	1	1	3
	0.1	69	1	5	1	1	0	2
McDowell Ditch (-03)	1.9/ 1.8	67.5	1	5	1	1	0	2*
Zimber Ditch (-03)	2.4	60	1	5	1	1	0	2
Nimishillen Creek (-05)	11.1	68.5	1	5	1	1	0	2
Sherrick Run (-05)	0.1	78.5	0	0	1	1	1	3
Nimishillen Creek (-06)	9.9	79.5	0	6	1	1	0	2
	6.8/ 6.7	78	0	3	1	1	1	3
	2.7	78	0	3	1	1	1	3

* Note that these two streams are designated Modified Warmwater Habitat (MWH)
Source: Nimishillen Creek TMDL, Ohio EPA, 2009.

Sediment

In the Nimishillen Creek watershed, three of Ohio EPA's TMDL assessment areas have some type of sedimentation listed as a cause of impairment in addition to habitat alteration. In order to address this, Ohio EPA developed numeric targets for

sediment based upon the QHEI metrics. The QHEI substrate, riparian characteristic, and channel metrics all evaluate stream attributes related to sediment. Each of these factors influences the degree to which sediment affects a stream, and cumulatively serves as its numeric target (Ohio EPA, 2009).

The individual components of the sediment TMDL are QHEI metric scores for substrate, channel and riparian. These metric target scores are based on the same associations made between QHEI and aquatic biology results as explained in the habitat TMDL above. Table V-7 show the minimum scores expected for the sediment TMDL (Ohio EPA, 2009).

Table V-7: Sediment TMDL

TMDL Target for Warm Water Habitat (WWH)	QHEI Categories			Total TMDL Score
	Substrate	Channel	Riparian	
	Allocations			
	≥ 13	≥ 14	≥ 5	32

Existing Scores

Stream (12-Digit HUC)	River Mile	QHEI Scores			Total Sediment Score	Percent Deviation from Target	Main Impairment Category
		Substrate	Channel	Riparian			
Middle Branch Nim. Cr. (-04)	13.6	1	4	3	8	75.0	Substrate
Middle Branch Nim. Cr. (-01)	10.4	5.5	8	6.5	20	37.5	Substrate
West Branch Nim. Cr. (-03)	10.5	12	14	6.5	32.5	-	Substrate

Source: Nimishillen Creek TMDL, Ohio EPA, 2009.

Nimishillen Creek TMDL Important "Fixes"

- Include phosphorus effluent limits of 1 mg/l in NPDES permits to wastewater treatment plants
- Improve erosion and sediment controls in all areas
  - Practice conservation tillage on row crop farms
  - Install filter strips along all agricultural tributaries
  - Install storm water controls in developing areas and construction sites
  - Establish and protect vegetation along stream banks
- Develop better storm water management – reduce dependency on "ditching"
  - Remedy current methods of ditching, which are destructive to habitat, exacerbate downstream flooding, and are harmful to aquatic life and water quality
  - Integrate a holistic view of storm water and its management to provide long-term cost effective solutions
- Eliminate pervasive bacteria problems
  - Improve planning for environmentally sustainable manure and nutrient management agricultural facilities
  - Reduce and correct home sewage treatment system failures