Regional Niagara River Lake Erie Watershed Management Plan - Phase 2

June 2019

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To view information from the Regional Niagara River Lake Erie Watershed Management Plan (Phase 2) online, please visit. www.erie.gov/wmp. For more information on the *Niagara River Watershed Management Plan (Phase 1)*, also known as *Healthy Niagara,* visit Buffalo Niagara Riverkeeper online at www.bnriverkeeper.org.

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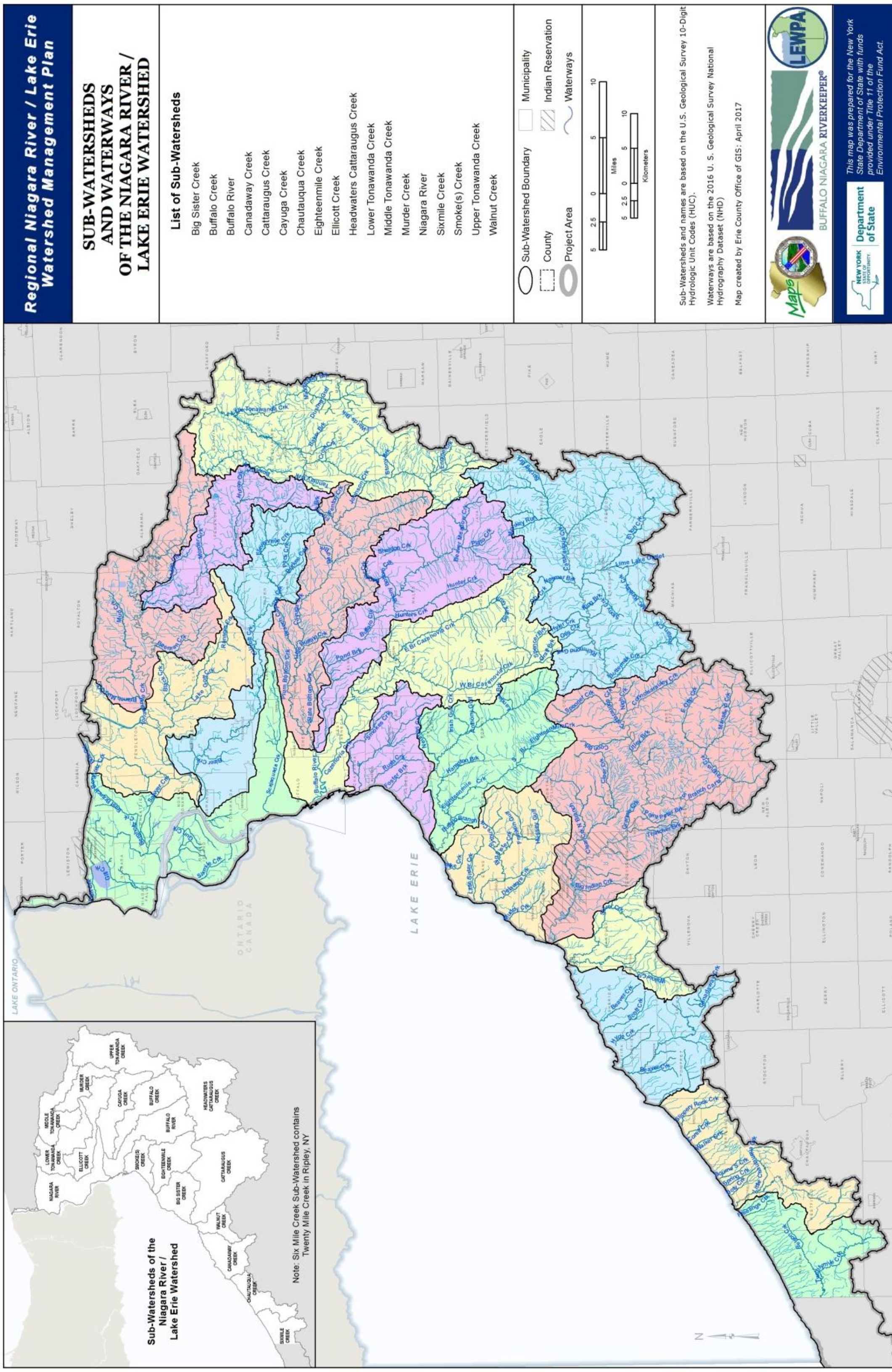
Figure 1.1: Sub-watersheds and Waterways of the Niagara River/Lake Erie Watershed

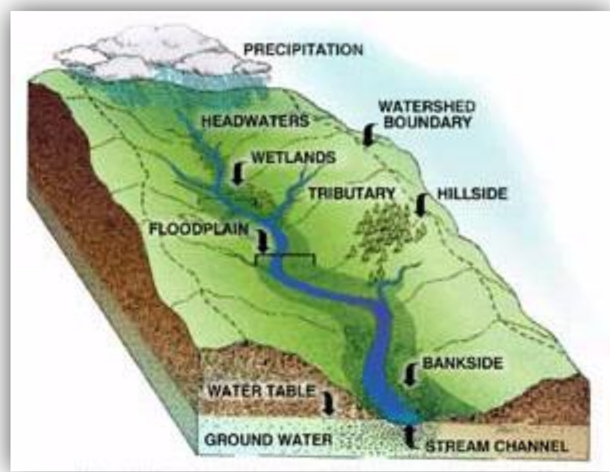


Chapter 1: Introduction

What is a Watershed?

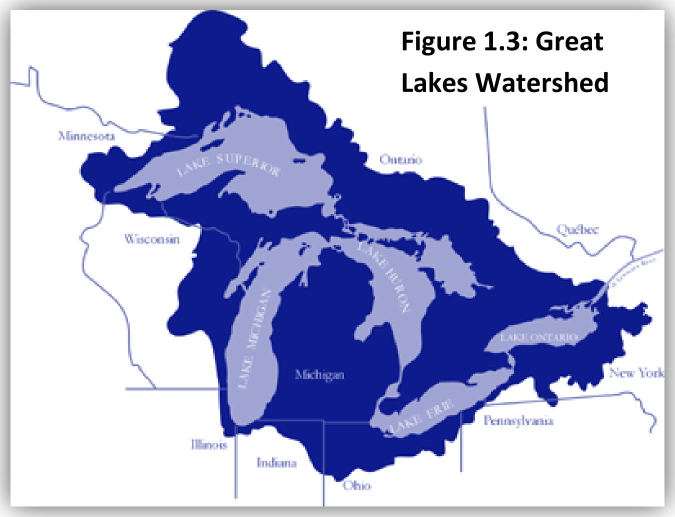
A watershed or drainage basin is a delineation of land within which water collects and drains to a common place, such as a set of streams, rivers and eventually a larger body of water (Figure 1.2). For example, Figure 1.3 outlines the watershed for the Great Lakes, which encompasses 8 U.S. states and the Canadian province of Ontario. Rainfall and snow melt within these watershed lands will drain into the Great Lakes. This Watershed Management Plan encompasses the New York State portion of the Niagara River and Lake Erie watershed, which is termed the **Niagara River/Lake Erie Watershed or "Watershed,"** and is illustrated in Figure 1.1.

Figure 1.2: Watershed Diagram



Source: Gualala River Watershed Blog

Figure 1.3: Great Lakes Watershed



Source: GreatLakes.net

Each watershed can also be broken down into smaller delineations, such as sub-watersheds or sub-basins, and further more into catchments that identify lands where waters enter smaller order creeks and streams. In the Niagara River/Lake Erie Watershed there are 18 sub-watersheds that outline areas of land that collect waters draining to the major tributaries of the basin. These are defined by the U.S. Geological Survey (USGS). The 2013 10-digit Hydrologic Unit Codes were used to define the sub-watersheds. Changes have since been made by USGS to these delineations and are discussed further in Chapter 2.

Defining the boundaries of a watershed is important to identify how water moves, and therefore plan for maintaining those waters as a resource. The overall Niagara River/Lake Erie Watershed drains over 1.5 million acres of land or over 2,300 square miles. It includes all of Erie County and portions of 7 other counties. Major waterways include Tonawanda Creek, Buffalo River, and Cattaraugus Creek. Water quality and quantity are affected by the lands over and under which they move, as such factors as soils, vegetation, development patterns and historic land uses influence what types of contaminants waters may pick up or how they are filtered and cleaned on their journey to a larger body of water. In addition, much of today's research evaluating quantitative thresholds at which water quality and watershed conditions begin to degrade, utilize geographic parameters..

Historical Context

The Niagara River/Lake Erie Watershed was inhabited by Iroquoian-speaking tribes when Europeans arrived to New York State. They relied heavily on agriculture and subsistence hunting, fishing, and gathering. For generations, they taught respect for the land and resources, which are borrowed from future generations. As European settlement increased and the population grew, more and more land was developed. Buffalo became a city in 1832 and grew to become an industrial center, primarily as a result of its location on the Buffalo River, Great Lakes, and Erie Canal terminus. Shipping and manufacturing industries located along the waterfront to take advantage of the water resources. The first hydro-electric power plant in the world was built in Niagara Falls and the alternating current power transmission system allowed designers to light the Pan American Exposition in 1901 in Buffalo, the eighth largest city in the U.S., using power generated 25 miles away. Similarly, the first natural gas well in America was drilled in Fredonia, NY and was used to light the first stores in the village. As industry grew, areas such as Love Canal in Niagara Falls and West Valley in Ashford, were used as dumping grounds for toxic materials from the Manhattan Project and power generation. Nuclear waste is still buried at West Valley today.

As a result of limited environmental regulation, Lake Erie and the Buffalo River became heavily polluted from industrial discharges and were once considered, "dead." The residents of Love Canal started getting sick and this resulted in the creation of Superfund through the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) to clean up toxic waste sites. In addition, the 1987 Great Lakes Water Quality Agreement designated the Buffalo River and Niagara River as Areas of Concern by the U.S. Environmental Protection Agency due to the high levels of contamination. Millions of dollars have been spent in this region to clean up this legacy of pollution. While the clean-up is not complete, the focus has shifted toward the need to protect our natural resources while growing our economy. This is why watershed management planning is so critical.

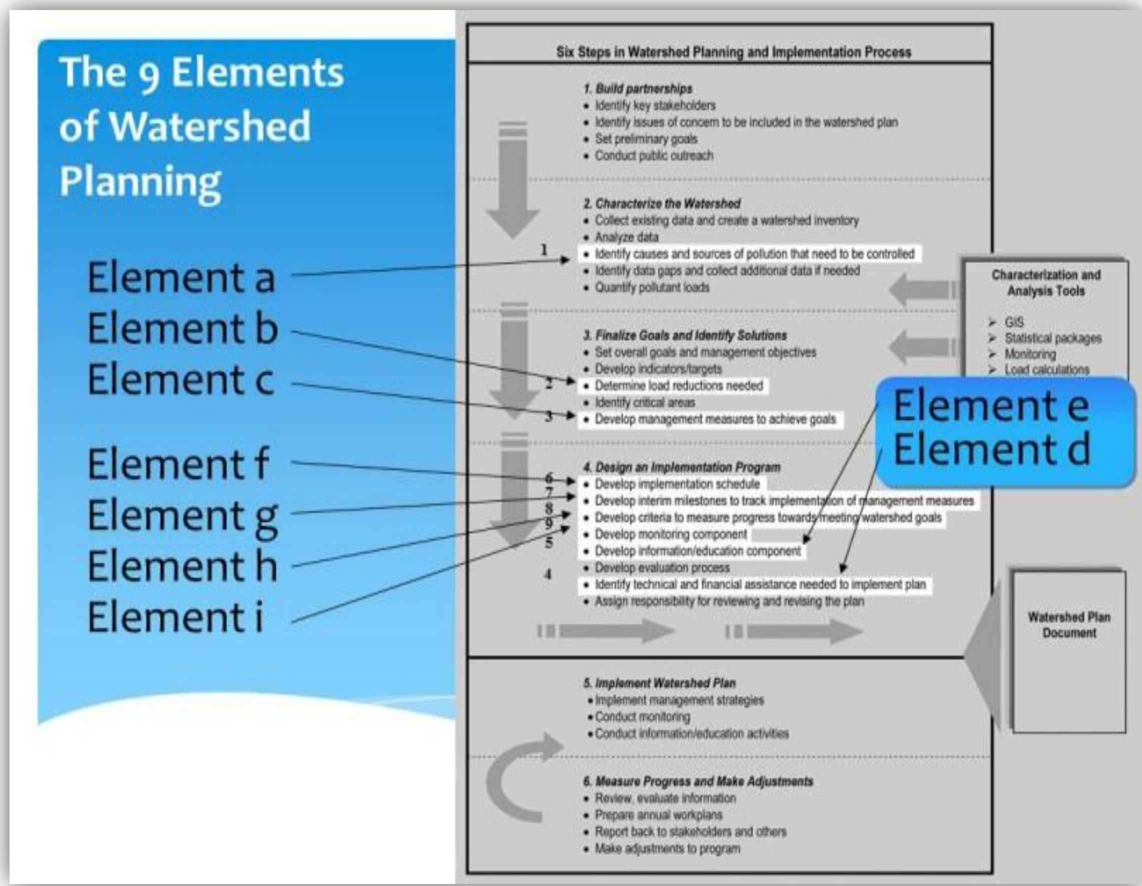
Purpose of a Watershed Plan

Water plays such an essential role in our lives, so essential that it's connected to everything in our world. We use it for drinking, cooking, cleaning, agriculture, industrial processes, bathing, shipping, fishing and aquaculture, plus our recreational enjoyment. Its uses are many and also essential to our lives, lifestyles, and economy. Water is also a finite resource. There is only so much water on the earth and we have little control over where that water moves and locates, as much of it is dependent upon our local geography, topography, and weather patterns. As a finite resource that is so interconnected with our health and economies, it is vital that planning be conducted to properly manage its usage and all of the factors that affect its quality. For the Niagara River/Lake Erie Watershed, many planning efforts[1] have occurred over the last several decades to address various issues present in the watershed, but until now there hasn't been an overall Watershed Management Plan developed that looked at the watershed in its entirety. In addition, addressing water quality through the lens of flood management has become very important with the increase in storm events.

Watershed Planning Process

Watershed management planning, according to the U.S. Environmental Protection Agency, involves six steps and watershed management plans have nine key elements, as outlined in Figure 1.4. They involve building partnerships, identifying all of the contributing factors, issues and trends affecting

Figure 1.4: Planning Process



Source: US Environmental Protection Agency

[1] The Niagara River/Lake Erie Watershed Atlas and Bibliography is a comprehensive resource for these materials, and has been prepared in conjunction with this Plan.

our water resources; setting goals for improvement and outlining strategies to meet those goals; and finally, implementing the plan's strategies and tracking their progress and effectiveness (Figure 1.4). Ideally watershed management planning is an on-going process that continually re-evaluates itself and reacts to the changing conditions of the watershed. It is essential to the planning and implementation process that the watershed's citizens, municipalities, stakeholders and other organizations are involved at the very beginning. Their role helps guide the planning process and ensures waters are managed in line with local values.

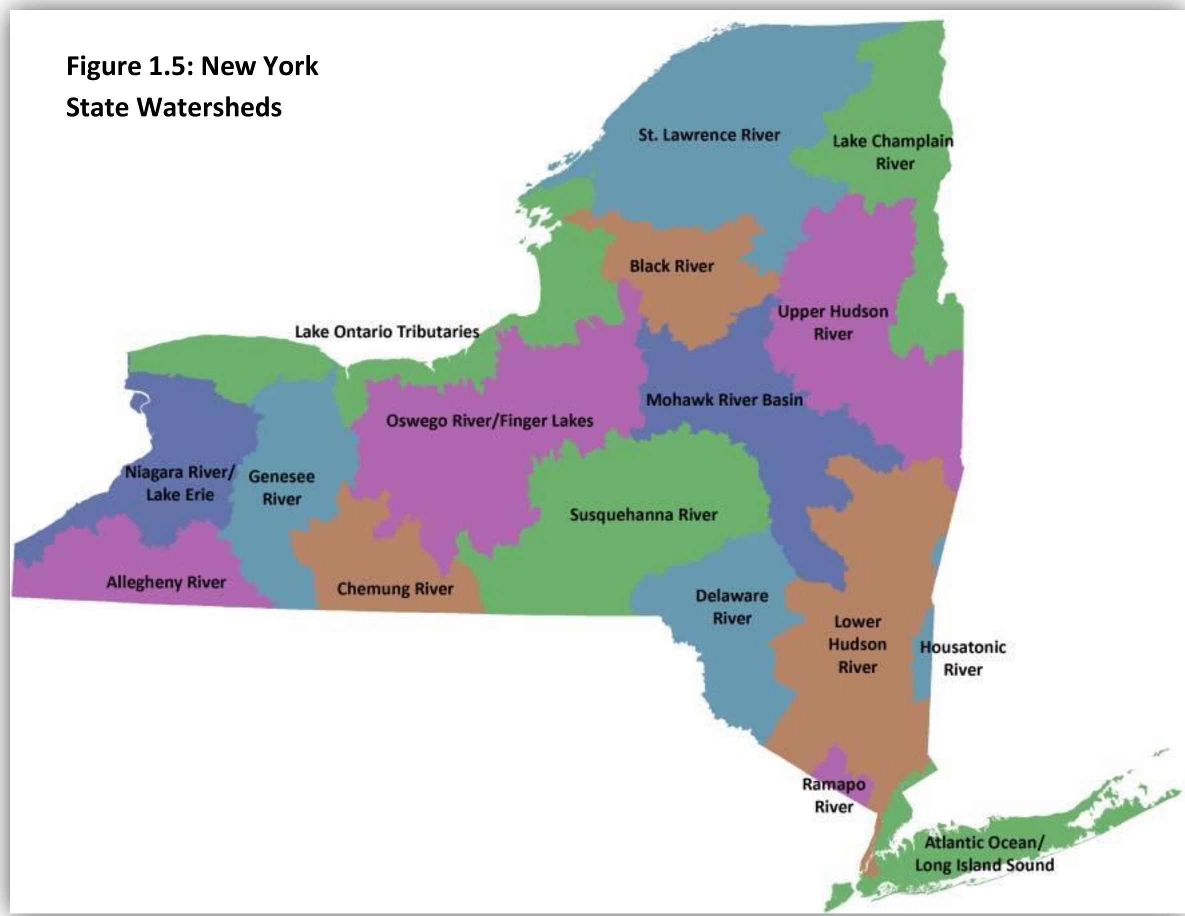
New York State provides for home-rule, meaning local cities, towns, and villages serve as the primary authority for community planning. Counties and regional planning organizations can only make recommendations to local municipalities. Therefore, this Plan serves as a tool to educate municipalities on the importance of watershed planning and what to look for when developing or updating a comprehensive plan, zoning codes, or other local laws that impact water quality. It also serves as a resource for existing conditions and potential future impacts.

In addition, this Plan follows ecosystem-based management principles taking the entire ecosystem into consideration when making recommendations including, plants, animals, and humans, in a process that aims to conserve major ecological services and restore natural resources while meeting the socioeconomic, political, and cultural needs of current and future generations. The goal is to create a sustainable regional plan for our Niagara River/ Lake Erie Watershed that can be utilized for years to come. It is designed to be a working document that will be amended over time.

Methodology

The Regional Niagara River/Lake Erie Watershed Management Plan-Phase 2 builds upon the Phase 1 efforts by Buffalo Niagara Riverkeeper, which characterized the Niagara River Watershed between 2010 and 2014. This Phase 2 Plan expands the original Plan to include land and waterways in the southern part of the watershed that drain to Lake Erie. This ensures that the entire western portion of New York State draining to the Niagara River and Lake Erie is addressed as one unit, since water flows across many municipal boundaries. This also matches the New York State Department of Environmental Conservation (NYSDEC) definition of the Niagara River/Lake Erie Watershed, as shown in Figure 1.5. New York State has a total of 17 major watersheds. The Niagara River/ Lake Erie Watershed is the westernmost drainage basin in the state.

Figure 1.5: New York State Watersheds



Source: NYSDEC

The plan focuses on assessing the current conditions, trends, and major contributors to water quality conditions in the watershed. A description of the Plan chapters is provided below. The very beginning of the planning process involved the creation of an Atlas and Bibliography of existing data, including maps, studies, reports, and plans that were gathered and analyzed to help assess the physical, biological, and ecological conditions of the watershed. The work completed by Buffalo Niagara Riverkeeper and the original Project Advisory Committee to create the *Niagara River Watershed Management Plan (Phase I) Atlas* was updated to include the Lake Erie watershed as part of Phase 2 of this project and can be found as an accessory document to this Watershed Management Plan. It is entitled, *Niagara River/Lake Erie Watershed Atlas and Bibliography,* and includes all of the original data, as well as reports, maps, etc. covering the expanded territory. It was put together with the assistance of the Lake Erie Watershed sub-committee of the overall Project Advisory Committee and is available online at the Lake Erie Watershed Protection Alliance's website[2].

[2] www.erie.gov/wmp

Regional Niagara River Lake Erie Watershed Management Plan (Phase 2) Components:

Chapter 2: Watershed Characterization. This chapter outlines the current context of the watershed, including its geographic setting, geology, topography, hydrology, climate and precipitation, and other related infrastructure influencing our waters.

Chapter 3: Population and Development in the Watershed. Building on the context of Chapter 2, this chapter outlines the current demographics and population trends in the watershed, as well as how land is utilized and how much of it is protected as these are major elements influencing our water resources.

Chapter 4: Water Quality. Reporting on the most current data and reports, this chapter outlines water quality conditions and identifies the most significant impairments found in the watershed today.

Chapter 5: Ecology & Biology. Ecological health and biological indicators are another way of assessing the health of the overall watershed and identifying what factors are contributing to its decline. This chapter outlines the available ecological resources found in the watershed with a focus on the habitat assessment work conducted by Buffalo Niagara Riverkeeper under the Niagara River Habitat Conservation Strategy.

Chapter 6: Assessment of Local Laws & Practices Affecting Water Quality. Understanding the laws and practices governing use of land and resources in the watershed is essential to understanding factors that influence watershed health. This chapter looks at the regulatory and non-regulatory practices found in municipalities within the watershed.

Chapter 7: Watershed Projects Inventory. This chapter outlines the current and recently completed large-scale water-related projects within the watershed, including those associated with infrastructure and research. The focus is on State and Federal projects with some large-scale local projects also mentioned.

The remaining components of the Watershed Management Plan pull together all of the information from the preceding chapters listed above to outline the major findings of the watershed investigation and outline recommendations to address the major issues found. The remaining element of the plan involves exploring the next steps to the watershed management plan to continue with this important work.

Chapter 8: Key Findings and Recommendations. This chapter outlines the findings from the preceding chapters of the report and identifies recommendations to address the issues presented.

Chapter 9: Management Plan Phase 3 Strategy. This final chapter of the report outlines the immediate next steps needed for continued watershed management planning in the Niagara River/Lake Erie watershed, including a structure for implementation, key stakeholders and implementation partners, and funding.

It should be noted that in addition to the completion of an overall Watershed Management Plan, the region's stakeholders and watershed management organizations ultimately desire a Nine-element Watershed Management Plan for the region, developed by the U.S. EPA and approved by NYSDEC. Watersheds with a recognized nine-element plan become eligible for federal funding resources for watershed restoration. Currently the Niagara River/Lake Erie Watershed does not have a Nine-element Watershed Management Plan and is not eligible for those federal resources. However, the development of this Phase 2 Watershed Management Plan will fulfill a portion of the nine-elements required for such a plan. As follow-up planning occurs, subsequent planning efforts will aim to fully complete a nine-element plan. Work is underway with NYSDEC, US Geological Survey, and the Lake Erie Watershed Protection Alliance to conduct baseline water quality monitoring and modeling in the Watershed so that target load levels can be created, best management practices and projects can be designed, and projects can be implemented to achieve those goals.

Advisory Committee & Public Involvement

The planning process for the Watershed Management Plan included involvement from a wide array of citizens, key individuals, organizations, and other entities in an advisory capacity in both Phase 1 and Phase 2. Project Advisory Committees were established at the beginning of the planning process for both Phase 1 and Phase 2. Some committee members remained the same for both phases, however new individuals were brought in to advise on Phase 2 due to the expanded territory. The full community engagement strategy and list of organizations involved in the Phase 2 Project Advisory Committee and various subcommittees can be found in the *Regional Niagara River/Lake Erie Watershed Management Plan – Phase 2 Community Outreach and Participation Plan*.

Project Advisory Committee members and subcommittees guided the development of the *Niagara River Watershed Management Plan (Phase I) Atlas*, and *Niagara River/Lake Erie Watershed Atlas and Bibliography* in Phase 2, identifying watershed characterization content, and reviewing the plan's drafts through electronic email communications and meetings. A full list of Phase 2 Project Advisory Committee members and Lake Erie Subcommittee members is provided in the Acknowledgements.

In addition to contributions by the Advisory Committee, public involvement and input were encouraged throughout the planning process. There were two Public Informational Meetings during Phase 1. One took place November 2011 at the North Tonawanda Public Library and asked participants to break into small groups to discuss and identify the major positive and negative aspects of the watershed, as well as the future threats to watershed health as they see it. A second Public Information Meeting was held in December 2014 at the Anna M. Reinstein Public Library and provided participants with an in-depth review of the findings of the watershed's characterization, and update on the next steps in the planning process. Final draft Phase 1 recommendations were presented to the public via the Watershed Management Plan webpage[3].

During Phase 2, in order to reach a wider audience, public presentations were taken "on-the-road" and tables were set up at events and festivals throughout the watershed to interact with participants and obtain input. These included the Erie County Fair in 2015, Williamsville Earth Day/Arbor Day Event in 2015, Cattaraugus County Farmer Neighbor Dinner in 2016, Elmwood Festival for the Arts in 2016, Daemen College Environmental Summit in 2015 and 2016, and Great Lakes Experience in 2015 (Dunkirk, NY), 2016 (Buffalo, NY), and 2017 (Dunkirk, NY). Buffalo Niagara Riverkeeper conducted a public meeting on April 6, 2017 in Buffalo, NY to explain the Watershed Management Plan and present their findings. In May of 2017 there was a presentation given and table set-up at the Lake Erie Rally in Dunkirk, NY as well. In early 2019, the Watershed Management Plan was discussed at three public meetings, one in each county at their respective water quality committees. Feedback was solicited on how to prioritize sub-watersheds. The public comments from all public meetings and events throughout the development of the plan were taken into account and incorporated into the Watershed Management Plan process.

[3] http://bnriverkeeper.org/healthyniagara

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Chapter 2: Watershed Characterization

Figure 2.1: Aerial photograph of the Niagara River/Lake Erie Watershed

Source: Erie County Office of Geographical Information Services

The Niagara River/Lake Erie Watershed is located along the westernmost portion of New York State and drains into Lake Erie and the Niagara River. The Niagara River is the channel that connects two Great Lakes - Erie and Ontario – and divides the U.S. from Canada. The Watershed is highlighted in the aerial photograph shown in Figure 2.1. In total, the watershed encompasses 1,523,515 acres, 5,543 miles of watercourses[1], and several small lakes and ponds within Allegany, Cattaraugus, Chautauqua, Erie, Genesee, Niagara, Orleans and Wyoming counties.

Watershed Boundary & Sub-watersheds

Within New York State, the Niagara River/Lake Erie Watershed is largely made up of eighteen smaller sub-watersheds (see Figure 2.2 on the following page), each of which has defined boundaries based upon a 10-digit Hydrological Unit Code (HUC). The U.S. Geological Survey established the hydrological unit system as a basis for watershed planning on science-based hydrologic principles, rather than favoring administrative boundaries or a particular agency. The codes are structured in a hierarchy system to identify smaller sub-watersheds nested within larger watersheds. The smaller number of digits correlates to a larger watershed. For instance, there is a 2-digit HUC for each of the twenty-one hydrologic regions in the United States. The Great Lakes (04) covers the entire Great Lakes drainage basin. As the number of digits increases, the area of delineation gets smaller. Sub-regions are represented by a 4-digit HUC (0412 eastern Lake Erie), basins are represented by a 6-digit HUC (041201 Niagara River/Lake Erie), sub-basins are represented by an 8-digit HUC (04120103 Buffalo-Eighteenmile), watersheds are represented by a 10-digit HUC (0412010305 Eighteenmile Creek), and sub-watersheds are represented by a 12-digit HUC (041201030501 located mostly in the town of Colden in the headwaters of Eighteenmile Creek). The nomenclature used in Phase 1 of this report has been continued in Phase 2 despite the disparity with U.S. Geological Survey naming

[1] According to the U.S. Geological Survey Hydrography Data Set

standards. In this report, the Niagara River/Lake Erie Watershed will refer to the 6-digit hydrologic unit and sub-watersheds will refer to the 10-digit hydrologic units.

Table 2.1 below lists the eighteen sub-watersheds that are part of the Niagara River/Lake Erie Watershed, their 10-digit HUC, and total acreage. The HUC's used in this report are based upon 2013 data. Since 2013 the U.S. Geological Survey has begun editing the hydrologic unit system in order to coordinate better with Canada. As of 2016, the edits were not finalized and had not been adopted by New York State agencies. Therefore, this report utilizes the 2013 HUC's for consistency between Phase 1[2] and Phase 2 of this project.

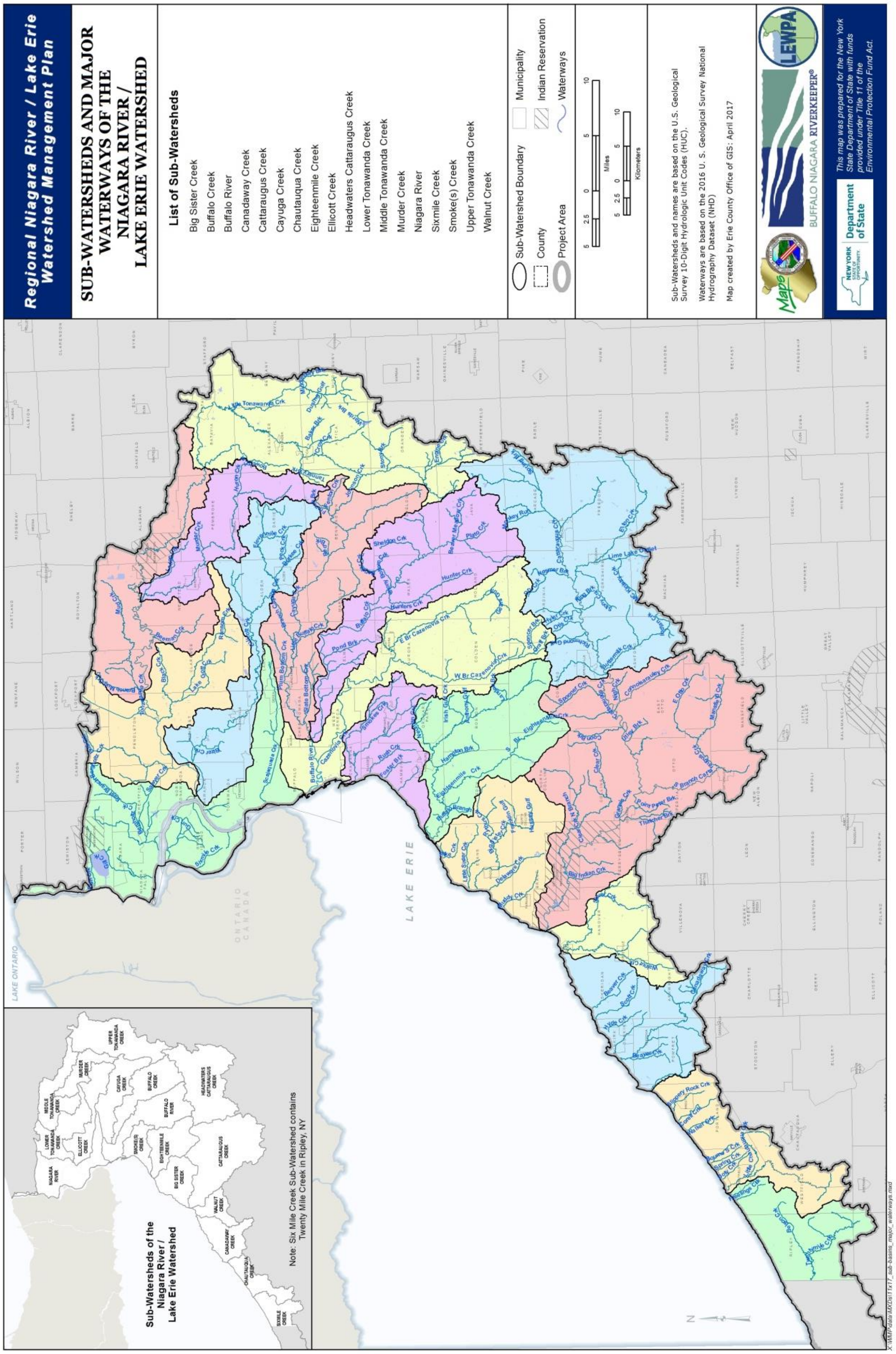
Table 2.1: Sub-watersheds of the Niagara River/Lake Erie Watershed

Sub-Watershed Name	10-Digit Hydrologic Unit Code (2013)	Acreage	Square Miles
Big Sister Creek	0412010306	62,363.0	97.4
Buffalo Creek	0412010302	93,158.5	145.6
Buffalo River	0412010303	105,367.8	164.6
Canadaway Creek	0412010102	64,538.8	100.8
Cattaraugus Creek	0412010202	197,523.2	308.6
Cayuga Creek	0412010301	81,358.2	127.1
Chautauqua Creek	0412010103	51,266.3	80.1
Eighteenmile Creek	0412010305	76,834.0	120.1
Ellicott Creek	0412010404	76,824.3	120.0
Headwaters Cattaraugus Creek	0412010201	160,605.7	250.9
Lower Tonawanda Creek	0412010405	78,788.8	123.1
Middle Tonawanda Creek	0412010403	79,090.0	123.6
Murder Creek	0412010402	46,666.4	72.9
Niagara River	0412010406	102,812.1	160.6
Sixmile Creek (within NYS)	0412010104	43,537.6	68.0
Smoke(s) Creek	0412010304	39,522.8	61.8
Upper Tonawanda Creek	0412010401	127,237.9	198.8
Walnut Creek	0412010101	36,019.9	56.3
Watershed Total		**1,523,515.3**	**2,380.5**

Source: U.S. Geological Survey Hydrologic Unit codes

[2] Phase 1 refers to the *Healthy Niagara: Niagara River Watershed Management Plan (Phase 1)* completed by Buffalo Niagara Riverkeeper in December 2014.

Figure 2.2: Sub-watersheds and Major Waterways of the Niagara River/Lake Erie Watershed



USGS's hydrological units were utilized to characterize the watershed because a watershed's boundary does not follow municipal boundaries. However there are 80 towns, 28 villages, and 8 cities located completely or partially within the Niagara River/Lake Erie Watershed's Boundary, including the major cities of Niagara Falls and Buffalo. These 116 municipalities include:

City of Batavia
City of Buffalo
City of Dunkirk
City of Lackawanna
City of Lockport
City of Niagara Falls
City of North Tonawanda
City of Tonawanda

Town of Alabama
Town of Alden
Town of Alexander
Town of Amherst
Town of Arcade
Town of Arkwright
Town of Ashford
Town of Attica
Town of Aurora
Town of Batavia
Town of Bennington
Town of Bethany
Town of Boston
Town of Brant
Town of Cambria
Town of Centerville
Town of Charlotte
Town of Chautauqua
Town of Cheektowaga
Town of Clarence
Town of Colden
Town of Collins
Town of Concord
Town of Darien
Town of Dayton
Town of Dunkirk
Town of Eagle
Town of East Otto
Town of Eden
Town of Ellicottville
Town of Elma
Town of Evans
Town of Farmersville
Town of Freedom
Town of Grand Island
Town of Hamburg
Town of Hanover
Town of Holland
Town of Java
Town of Lancaster
Town of Lewiston
Town of Lockport
Town of Machias
Town of Mansfield
Town of Marilla
Town of Middlebury
Town of Mina
Town of New Albion
Town of Newstead
Town of Niagara
Town of North Collins
Town of Orangeville
Town of Orchard Park
Town of Otto
Town of Pembroke
Town of Pendleton
Town of Perrysburg
Town of Persia
Town of Pomfret
Town of Porter
Town of Portland
Town of Ripley
Town of Royalton
Town of Rushford
Town of Sardinia
Town of Shelby
Town of Sheldon
Town of Sheridan
Town of Sherman
Town of Stafford
Town of Stockton
Town of Tonawanda
Town of Villenova
Town of Wales
Town of Warsaw
Town of West Seneca
Town of Westfield
Town of Wethersfield
Town of Wheatfield
Town of Yorkshire

Village of Akron
Village of Alexander
Village of Alden
Village of Angola
Village of Arcade
Village of Attica
Village of Blasdell
Village of Brocton
Village of Cattaraugus
Village of Corfu
Village of Delevan
Village of Depew

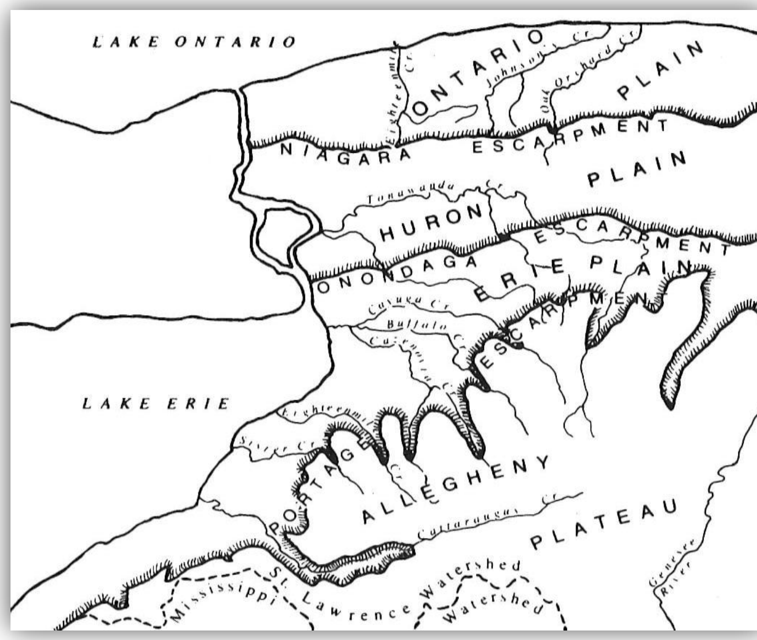
Village of East Aurora
Village of Farnham
Village of Fredonia
Village of Gowanda
Village of Hamburg
Village of Kenmore
Village of Lancaster
Village of Lewiston
Village of North Collins
Village of Orchard Park
Village of Silver Creek
Village of Sloan
Village of Springville
Village of Westfield
Village of Williamsville
Village of Youngstown

Geology & Topography

In describing physical conditions of the Niagara River/Lake Erie Watershed it is useful to traverse from the headlands in the southeast in a northwest direction toward Lake Erie and the mouth of the Niagara River where it meets Lake Ontario. Refer to Figure 2.2: Sub-watersheds of the Niagara River/Lake Erie Watershed on a previous page for orientation with the following geology and topography descriptions of the watershed.

Geology

Figure 2.3: Western New York Geography



In terms of bedrock geology, the Niagara River/Lake Erie watershed descends through four plains, from the Allegheny Plateau at over 2,000 feet above sea level in southwestern New York to the Lake Ontario Plain at 246 feet above sea level in northwestern New York (Figure 2.3[3]). An east-west trending escarpment marks each step down.

Southernmost and highest in elevation is the Portage Escarpment, the dissected northern border of the Allegheny Plateau. The fast flowing headwaters of the main tributaries—Twentymile, Chautauqua, Canadaway, Walnut, Cattaraugus, Eighteenmile, Cazenovia, Buffalo, Cayuga, and Tonawanda Creeks—originate here, flowing north and west toward Lake Erie and the Niagara River.

[3] Figure from Marian E. White, *Iroquois Culture History in the Niagara Frontier Area of NYS.*

Figure 2.4: Serenity Falls, Scajaquada Creek

Source: M. Wooster

Ten to twenty miles north of the Portage Escarpment, the Onondaga Escarpment marks a decrease in elevation across the watershed to the level of the Huron Plain. It creates waterfalls and barriers to fish migration on several Niagara River tributaries to the east of the watershed including Indian Falls on Tonawanda Creek near Akron, Glen Falls on Ellicott Creek in the Village of Williamsville, and Serenity Falls on Scajaquada Creek in Buffalo (Figure 2.4). Vernal pools at the base of these escarpments provide critical habitat for amphibians like spotted salamanders. The Onondaga Escarpment becomes much less pronounced as it progresses to the west until it reaches the Niagara River just north of the Peace Bridge where a 30 foot drop marks the rapids between Lake Erie and the upper Niagara River.

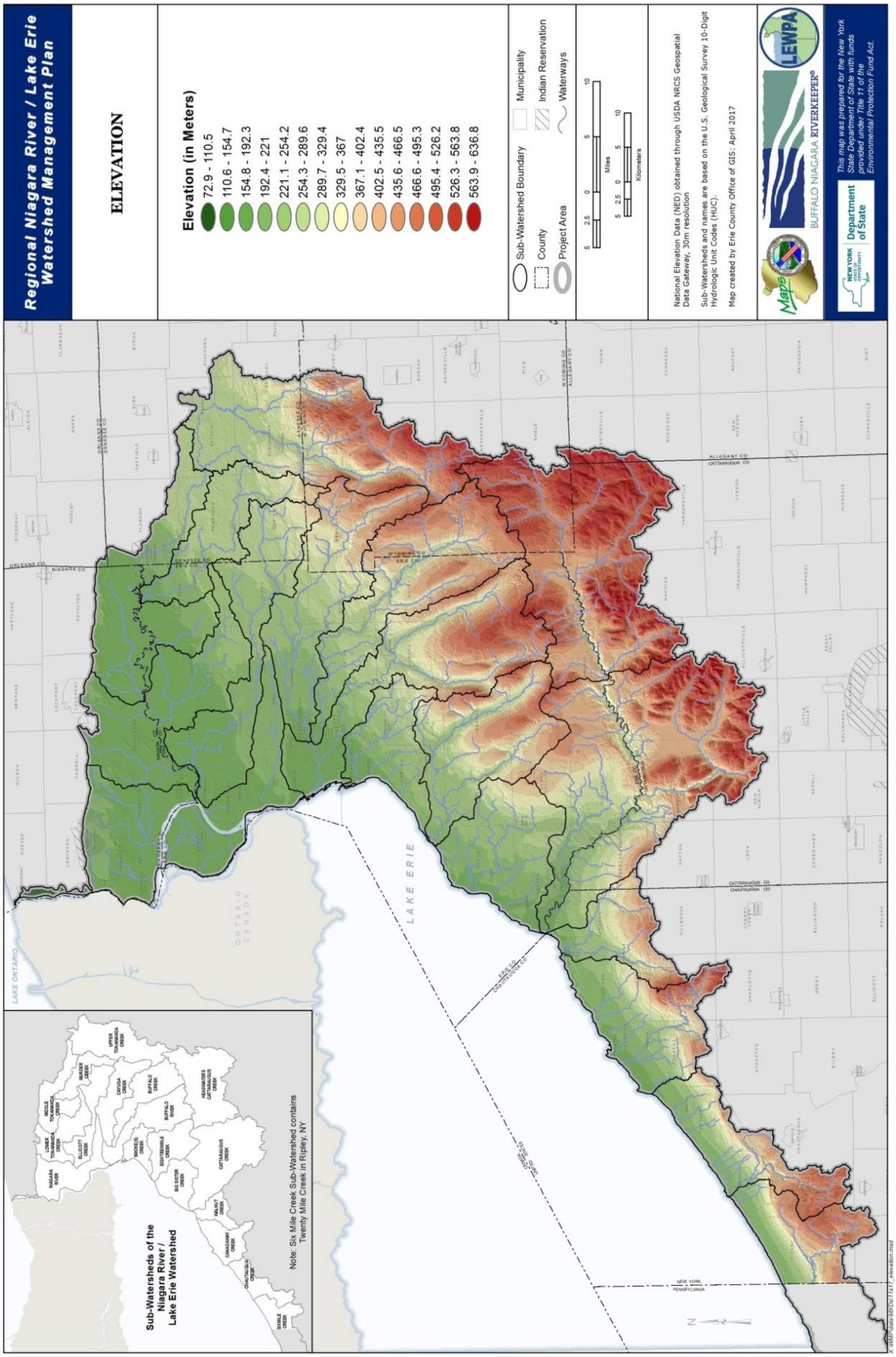
Northernmost is the Niagara Escarpment - a defining feature of the Great Lakes basin. The escarpment determines the northern boundary of the Watershed. It creates Niagara Falls and divides the Niagara River into two separate aquatic ecosystems.

The three escarpments can be identified in Figure 2.5, the watershed's Elevation Map. Bedrock throughout the entire watershed is shale with dolomite, sandstone, siltstone, and limestone intrusions visible at the escarpments.

Landforms

The landforms also change across the Niagara River/ Lake Erie Watershed. There are two main physiographic regions. The southeastern portion in the upland headwaters of the Watershed consists of the *Allegheny Plateau*, which is characterized by broad ridges with "U"-shaped valleys. This dissected plateau is characterized by rolling hills of similar height and plateau toe slopes consisting of deposited materials at the bottoms of steep slopes. The northwest and lakeshore areas of the Watershed consist of the *Erie-Ontario Lake Plain*, which is generally flat with glacial deposits. An example of this is the lowland area of the Tonawanda Floodplain in the middle and lower Tonawanda Creek sub-watersheds.

Figure 2.5: Elevation



Common Resource Areas

Figure 2.6 shows the Common Resource Areas (CRA) of the Niagara River/Lake Erie Watershed defined by U.S. Department of Agriculture as, "a geographical area where resource concerns, problems, or treatment needs are similar. It is considered a subdivision of an existing Major Land Resource Area (MLRA) map delineation or polygon. Landscape conditions, soil, climate, human considerations, and other natural resource information are used to determine the geographic boundaries of a Common Resource Area.[4] These generally follow the physiographic regions described above under "Landforms," however, a third designation, *Lake Erie Glaciated Plateau,* is added.

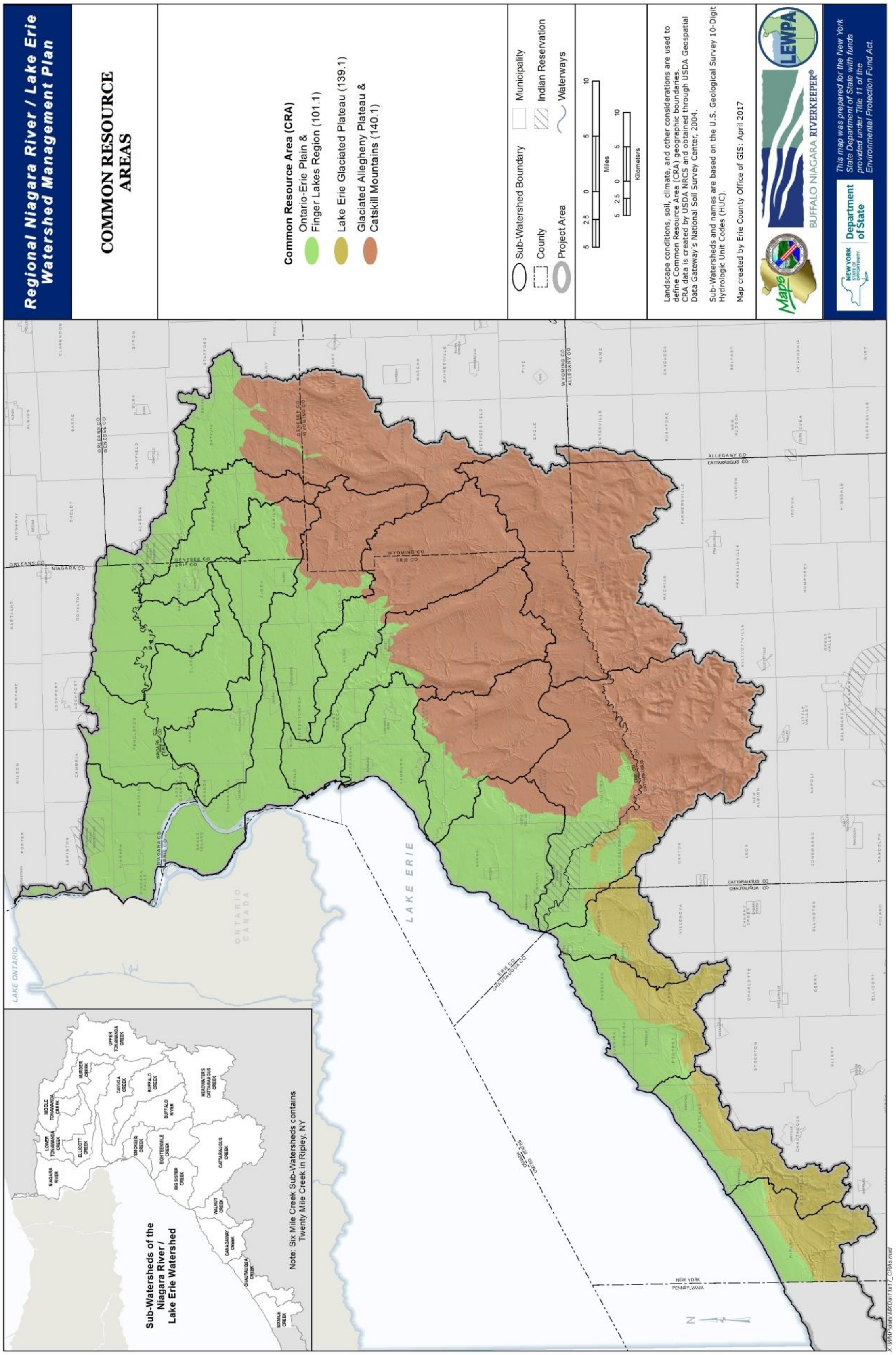
The *Glaciated Allegheny Plateau and Catskill Mountain* CRA is found in the southeastern portion of the Watershed. It is in the Southern New York Section of the Appalachian Plateaus Province of the Appalachian Highlands and includes narrow valleys with steep walls and glacial outwash deposits of sand and gravel on the valley floors. Bedrock is mostly shale and sandstone. Inceptisols are the dominant soils in this region as described in the soils section. There are about 165 freeze-free days per year. About 9% of the water withdrawals in this area are from ground water with 91% from surface waters.

The *Lake Erie Glaciated Plateau* can be found primarily in Chautauqua County including Dunkirk and Fredonia, with a small portion in Cattaraugus County. It is in the Eastern Lake Section of the Central Lowland Province of the Interior Plains and is fairly flat along Lake Erie with gently rolling dissected glaciated plateau in the southernmost headwaters of the Watershed. This area averages a 180-day freeze-free period and more precipitation than the other two CRA's within the Watershed. Soils are Alfisols that are primarily loamy or clayey. It supports mainly beech forest vegetation and bedrock is classified as mostly sandstone, siltstone, and shale. Approximately 2% of water withdrawals are from ground water while 98% is from surface water sources.

The *Ontario-Erie Plain and Finger Lakes Region* of the Niagara River/Lake Erie Watershed is in the Eastern Lake Section of the Central Lowland Province of the Interior Plains as well. It includes remnant glacial-worn beach ridges, such as seen in Hamburg and Eden, where sandier soils feature better drainage and faster warming in the springtime for productive farming. The freeze-free period is only 165 days on average. Dominant soils include Alfisols and Inceptisols as described below. Land use is primarily cropland and hardwood forests, as well as the urbanized areas around the cities of Buffalo and Niagara Falls. Roughly 3% of water withdrawals are from ground water sources with 97% from surface waters. Bedrock underlying this area consists of limestone, dolomite, sandstone, and shale.

[4] Information from the USDA and NRCS publication, "Land Resource Regions and Major Land Resource Areas of the United States, the Caribbean, and the Pacific Basin." https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_050898.pdf

Figure 2.6: Common Resource Areas



Soils

There are three main soil types found in the Watershed. Alfisols are very fertile soils that formed underneath old forests. They are moderately well drained, giving the soil a good balance of moisture. Alfisols have a layer of clay underneath the surface of the soil. Many of them are used for growing new forests or for agricultural purposes. Alfisols are primarily found in western and central New York.

The northern and western regions of the state are home to Histosols. These soils have a very dark layer directly underneath the surface. They have a large amount of organic material. They form in wetlands of all types, including swamps and marshes, anywhere that is poorly drained. Organic material in these places decays very slowly. Histosols are commonly called "peats," and are often mined and burned as fuel.

Inceptisols are found everywhere in the southern half of New York State. They have vaguely defined layers under the surface, and are found in all types of environments. These soils support approximately one fifth of the world's human population, more than any other type of soil.

Hydric soils are formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions and support the growth and regeneration of hydrophytic vegetation. The northern portion of the watershed, where historic Lake Tonawanda once existed hosts the largest swath of hydric soils. A map of the watershed's hydric soils is provided in Figure 2.7.

Prime farmland soils are designated by the U.S. Department of Agriculture as land that has the best combination of both physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops. It must also be available for these uses. Thus, once this land is developed, it is no longer considered prime farmland. These areas are generally not excessively erodible, are not saturated for long periods of time, and do not flood frequently. Notice the difference between Figures 2.7 and 2.8. There is little overlap between hydric soils and prime farmland soils. Where there are hydric soils, generally they are considered prime farmland only if they are drained.

Erosion/ Slope

Steep slopes can affect water quality with the erosive force that increases as grade increases, allowing runoff to pick up and move more sediment, increasing downstream turbidity and further eroding upstream channels. In the watershed, the percentage of areas with steep slopes decreases as you move northwest across the watershed into the flatter plains. However, the uplands in the southeast, where many of the watersheds' headwaters originate, have a large amount of steep slopes, some being very steep or over 35% (See Figure 2.9). In the lowlands and lake plains in the north and west of the watershed most slopes are nearly level (0 – 2%).

Figure 2.7: Hydric Soils

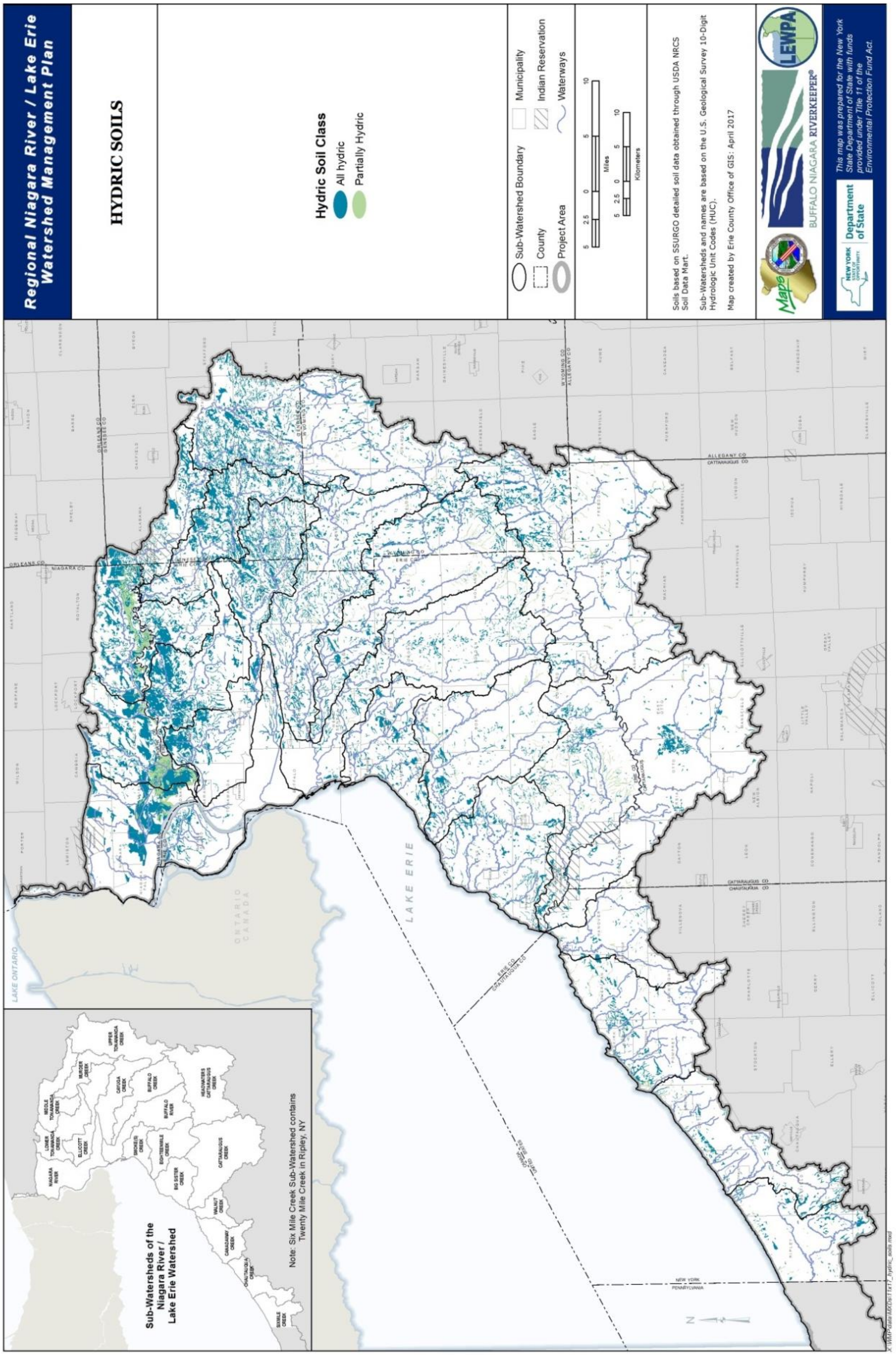


Figure 2.8: Prime Farmland Soils

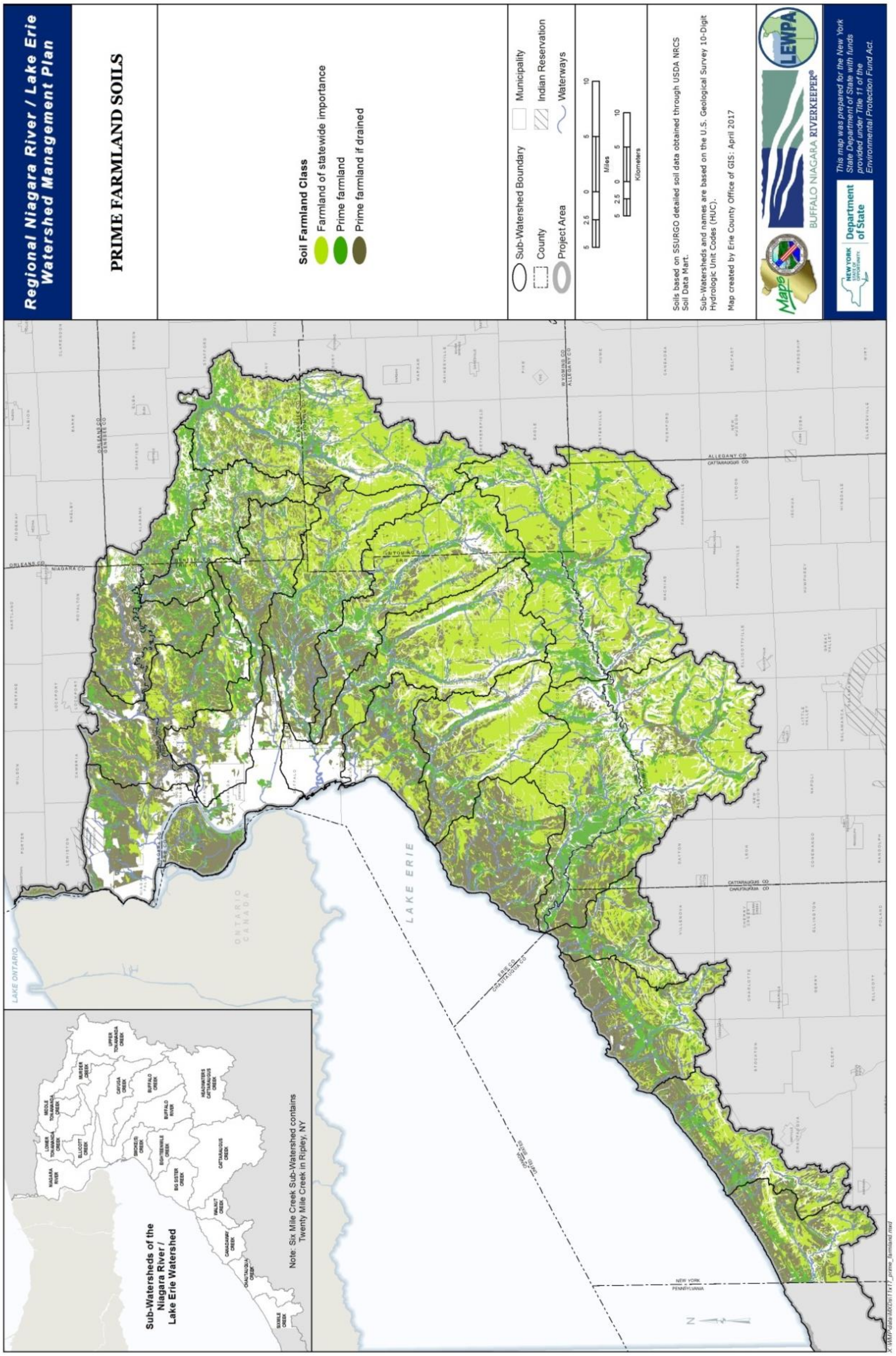
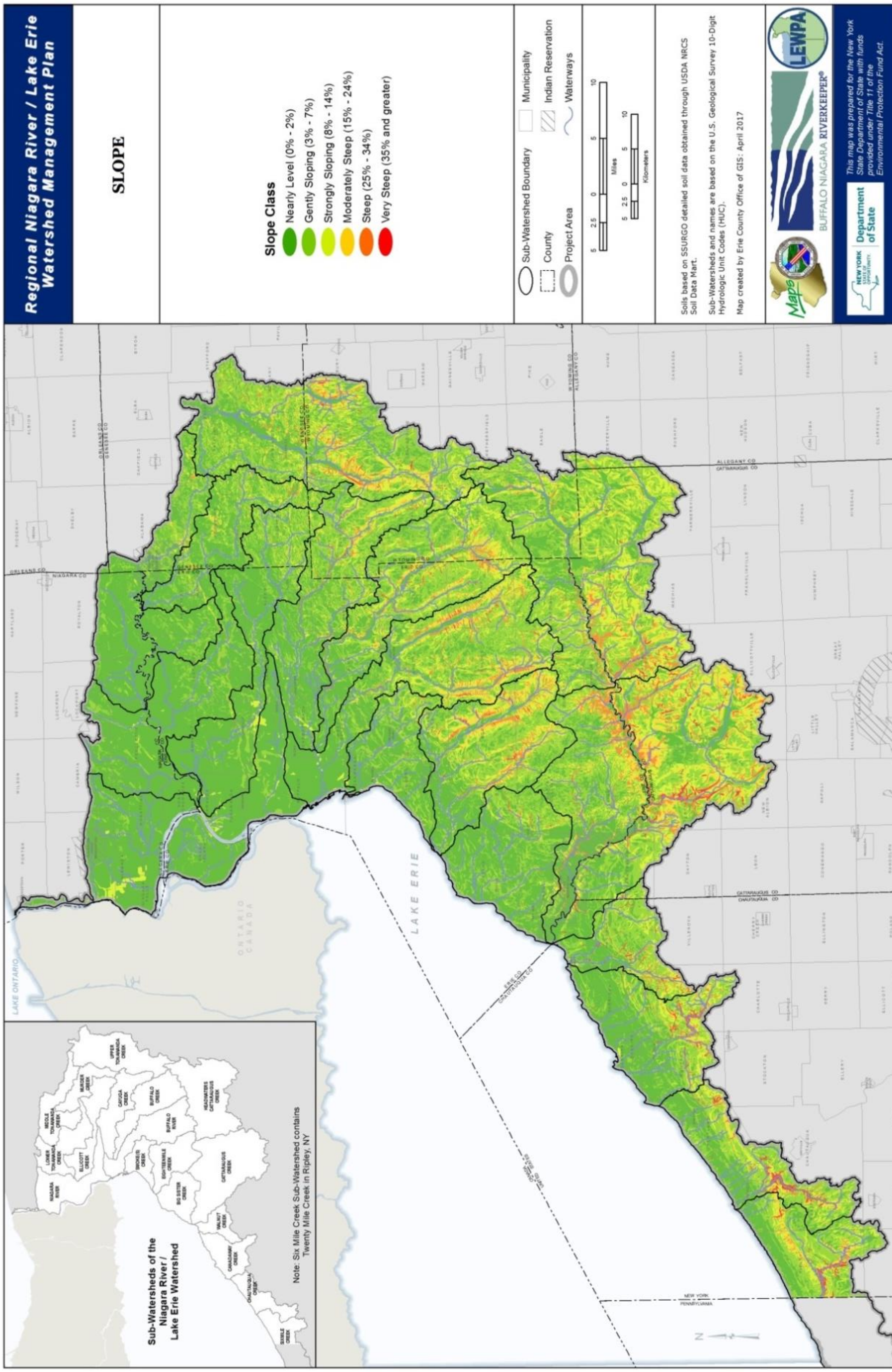


Figure 2.9: Slope



Hydrography

Surface Hydrology

Surface water is the water that collects on the ground, in a stream, river, lake or wetland. This water naturally increases with precipitation and is lost through evaporation, evapotranspiration, infiltration and runoff. The Niagara River/Lake Erie Watershed is primarily home to rivers, creeks, and streams, with some smaller ponds/reservoirs and the larger Lewiston Reservoir. The surface water located in the Niagara River/Lake Erie Watershed drains into Lake Erie and the Niagara River. The watershed covers an area of 1,523,515 acres drained across approximately 5,543 total miles[5] of waterways. The general direction of surface movement is from the highlands in the southeast flowing north and west to the floodplains, lowlands, or Lake Erie.

In the uplands, streams and creeks are much more clustered due to the slopes they traverse. Tributaries to Eighteenmile Creek, Buffalo River, and Buffalo Creek follow a parallel pattern down the steep slopes into their larger streams. In the lowland areas to the north, the waterways meander and run further apart in a dendric pattern. Along the Lake Erie shoreline, most streams run parallel to each other and perpendicular to Lake Erie. In the most urban areas, waterways have been filled, covered, or diverted for development. Several of the waterways have been channelized when they flow through the industrialized areas of Niagara Falls, the Tonawandas, Buffalo, and Dunkirk.

Sub-watershed Descriptions from East to West

The **Upper Tonawanda Creek** Sub-watershed and its main tributary, Little Tonawanda, start on the Allegheny Plateau and flow northeast through steep wooded ravines as far as the village of Attica. After which both creeks meander through wetlands and farmed mucklands. Just south of the City of Batavia the two branches join on the Onondaga Escarpment and take a sharp turn left, flowing west into the Middle Tonawanda Creek Sub-watershed.

The **Middle Tonawanda Creek** Sub-watershed is located between the Lower and Upper Tonawanda Creek Sub-watersheds. The Middle portion covers Tonawanda Creek's 20 mile stretch from its confluence with Bowen Creek in the Town of Batavia west to the Town of Pendleton. In this section it travels through a broad floodplain and many wetlands which are the remaining imprint of the ancestral, 50-mile long, glacial Lake Tonawanda. Mud Creek and Beeman Creek are the major tributaries of this portion of Tonawanda Creek.

In the **Lower Tonawanda Creek** Sub-watershed the last 11.6 miles of the Tonawanda Creek was historically deep slack water but is now channelized and dredged to a width of 75 feet and a depth of 12 feet to accommodate the Erie-Barge Canal. A lock in Pendleton controls the

[5] Based on the USGS National Hydrography Dataset.

flow, and is also where the Creek diverges from the Erie Canal. Ransom Creek, Gott Creek and Black Creek are the major tributaries running north-northwest from the Clarence and Newstead Townships to the Canal section in the Creek in Pendleton. Bull Creek is the other primary tributary running southwest from the Niagara Escarpment through low-lying hydric soils to the Canal in the Town of Wheatfield.

Most of the waterways in the **Niagara River** Sub-watershed drain directly to the upper Niagara River. Many, like Two Mile Creek, have been channelized and turned into drainage ditches receiving runoff from industries, landfills and storm sewer systems. While others, have had their historic hydrology significantly altered from urban development. Several of the tributaries located on Grand Island are the last remaining minimally-altered waterways of this sub-watershed.

Historically fifteen-mile Scajaquada Creek, a primary tributary of the Niagara River sub-watershed, rose in spring-fed wetlands in the present Town of Lancaster and flowed almost due west through the Village of Depew, Town of Cheektowaga, and City of Buffalo to its mouth on the Black Rock Canal on the Niagara River. Its course was generally level except for a small falls over the Onondaga Escarpment in present day Forest Lawn Cemetery in North Buffalo. Originally the creek was wide, shallow and meandering. Much of the creek has been channelized and tunneled underground. Portions receive overflows from the City of Buffalo's combined sewer system and Town of Cheektowaga's sanitary sewer system. Springs recharge the creek not only at its source, but also downstream in Forest Lawn Cemetery. These springs are now a major component of the base flow of lower Scajaquada Creek.

Another major tributary of the Niagara River Sub-watershed, 7.6 mile long Gill Creek originates in the wetlands of the Tuscarora Nation and flows south to its mouth on the Little Niagara River approximately 1,000 feet above the upper Niagara River. The watershed is mainly flat and underlain with Lockport Dolomite covered by lake clays and silts. Today, the Lewiston reservoir occupies over half the upper watershed on Tuscarora Nation Land, with a discharge channel to Gill Creek to supplement low flows in the summer. The creek is ditched around the reservoir's southern end until it reaches the original stream bed and turns south. A dam about 1.2 miles upstream of the creek's mouth creates 30 acre Hyde Park Lake.

Murder Creek is its own sub-watershed but also the major tributary to Tonawanda Creek in the Middle Tonawanda Creek Sub-watershed. Located primarily in the southwestern portion of the Genesee County, Murder Creek also includes many low-lying areas and meanders through the Towns of Pembroke and Newstead.

Ellicott Creek, 47 miles long, flows northwest from its headwater wetlands in Genesee County through the Towns of Darien, Alden, Lancaster, and Amherst to join Tonawanda Creek about a half mile above its mouth at the Niagara River, in the Town of Tonawanda.

Many of the natural tributaries of Ellicott Creek have been channelized into stormwater conveyance systems in the urban and suburban areas of the Ellicott Creek Sub-watershed, and no longer include natural hydrologic features.

The **Cayuga Creek** Sub-watershed (in Erie County) includes Little Buffalo, Slate Bottom, and Plum Bottom creeks as tributaries. It begins in primarily farmland/wooded areas in higher elevation Wyoming County in the Towns of Sheldon and Bennington and passes through several residential areas in the Erie County Towns of Marilla, Alden, and Lancaster before its confluence with Buffalo Creek in Cheektowaga.

The 43-mile-long **Buffalo Creek** originates in the eastern portion of the watershed, in the Towns of Arcade, Java and Sheldon in Wyoming County, where higher elevations create a multitude of smaller feeder streams and tributaries, such as Plato Creek, Beaver Meadow Creek, Glade Creek, Sheldon Creek, Stoney Bottom Creek, Bender Creek, and Hunter Creek. Buffalo Creek itself flows northwest towards the City of Buffalo through Wales, Marilla, and Elma, joining Cayuga Creek 8 miles above Lake Erie in the Town of West Seneca, shortly after which Cayuga Creek flows into the Buffalo River.

The headwaters of the **Buffalo River** include the east and west branches of Cazenovia Creek and flow north-northwest to the lake plain. Cazenovia Creek joins the Buffalo River about 6 miles above Lake Erie. Its two major branches, an 18-mile long West Branch and a 24-mile long East Branch, pass through the Towns of Sardinia, Concord, Holland, Colden, Wales, and Aurora to join in the Village of East Aurora, 17 miles upstream from the confluence with the Buffalo River. At 1820 feet above sea level, the source of the East Branch is the Buffalo River Sub-watershed's highest elevation. The lower Buffalo River meanders across the flat Lake Erie Plain through Elma, West Seneca, and the City of Buffalo before draining into Lake Erie. Within the City of Buffalo, a portion of the Buffalo River is a federally-designated navigation channel and dredged to maintain a 22 foot depth. The average daily flow of the Buffalo River is about 355.5 million gallons daily.

The **Smoke(s) Creek** Sub-watershed includes several small tributaries draining directly to Lake Erie in the Town of Hamburg and City of Lackawanna. Smokes Creek, sometimes referred to as Smoke Creek or Smoke's Creek, begins in the Town of Orchard Park and flows west-northwest to its mouth on Lake Erie in the City of Lackawanna. The creek's one principal tributary is South Branch. It has the least number of waterway miles of the 18 sub-watersheds though it is not the smallest sub-watershed by area.

Eighteen Mile Creek drains into the eastern end of Lake Erie in the Town of Evans. Its principal tributary is the South Branch. The headwaters of both of these creeks start in the Town of Colden and meander through the Towns of North Collins and Boston. Middle reaches of Eighteenmile Creek flow through steep sided gorges in the Towns of Hamburg and

Eden. At its lower end it is a large meandering stream where the lower half mile is low gradient with a broad floodplain that forms the border between the Towns of Hamburg and Evans.

Big Sister Creek Sub-watershed has sometimes been referred to as the Seven Creeks Watershed. The main tributaries to Lake Erie in this sub-watershed include Big Sister, Little Sister, Delaware, and Muddy Creeks. The headwaters in the Towns of North Collins, Brant, and Eden include steep ravines in Franklin Gulf and Hussey Gulf, while the shoreline areas include several bathing beaches such as those found at Evans Town Park, Evangola State Park, and Erie County Bennett Beach Park.

The **Headwaters Cattaraugus Creek** Sub-watershed is the second largest of the 18 sub-watersheds with many of the tributaries generally characterized by steep valley walls. This sub-watershed, along with Cattaraugus Creek Sub-watershed, has some of the highest slopes and elevations in the overall Niagara River/Lake Erie Watershed. The headwaters start in Cattaraugus, Wyoming, and Allegany counties with tributaries such as Elton Creek flowing through the Towns of Farmersville, Freedom, Yorkshire, and the Village of Delevan and eventually into Cattaraugus Creek, which heads west toward Lake Erie and forms the boundary between Cattaraugus and Erie counties. There is a Spring Brook in the headwaters in the Towns of Arcade and Eagle in Wyoming County, as well as a Spring Brook in the Town of Concord and the Village of Springville in Erie County.

The largest of the 18 sub-watersheds is **Cattaraugus Creek** Sub-watershed, which starts mainly west of Springville, NY. Cattaraugus Creek continues flowing west toward Lake Erie through Zoar Valley, a 3,014 acre Multiple-Use Area managed by NYS DEC and known for its deep gorge and dense forests. Main tributaries include South Branch Cattaraugus and Connoissarauley Creeks in Cattaraugus County and Clear Creek in Erie County and the Seneca Nation Cattaraugus Reservation.

Walnut Creek Sub-watershed is the smallest of the 18 sub-watersheds. It includes Walnut Creek, which starts in the Town of Arkwright and flows north through the Towns of Sheridan and Hanover. Silver Creek begins in the Town of Villenova and flows through the Town of Hanover to join with Walnut Creek within the Village of Silver Creek.

Canadaway Creek Sub-watershed includes the City of Dunkirk. Canadaway Creek begins in the high elevations of the Chautauqua Ridge in the Town of Charlotte before flowing through the Towns of Arkwright, Pomfret, Dunkirk, as well as the Village of Fredonia. Several other tributaries to Lake Erie, such as Crooked Brook, Hyde Creek, Beaver Creek, and Scott Creek, flow north northwest to Lake Erie through the lower elevations of the Lake Plain.

The **Chautauqua Creek** Sub-watershed's largest tributary to Lake Erie is Chautauqua Creek. Little Chautauqua Creek joins with Chautauqua Creek in the Village of Westfield. Both of these streams' headwaters originate in the Chautauqua Ridge area of the sub-watershed. Several other smaller tributaries to Lake Erie flow through the Lake Plain including Slippery Rock Creek through the Village of Brocton.

Sixmile Creek Sub-watershed is the only sub-watershed that includes area outside of New York State. Approximately 43,500 acres occur in New York State while approximately 125,100 acres are located in Pennsylvania. It is named after Sixmile Creek, which is located in Pennsylvania, but the largest creek in the New York State portion is Twentymile Creek, which flows west into Pennsylvania before emptying into Lake Erie.

Table 2.2 shows the number miles of waterways in each sub-watershed. Cattaraugus Creek, Headwaters Cattaraugus Creek, and Upper Tonawanda Creek Sub-watersheds have the highest number of waterway miles within their limits. These are also the three largest sub-watersheds in acreage. The "% of total column" shows the percent of waterways in the entire Watershed that occur in that particular sub-watershed. Therefore, 15% of the waterways in the Niagara River/Lake Erie Watershed occur in the Cattaraugus Creek sub-watershed.

Table 2.2: Watershed Waterway Miles

Sub-watershed Name	Miles	% of Total
Big Sister Creek	186.65	3.37%
Buffalo Creek	353.72	6.38%
Buffalo River	318.02	5.74%
Canadaway Creek	187.33	3.38%
Cattaraugus Creek	837.00	15.10%
Cayuga Creek	356.19	6.43%
Chautauqua Creek	180.43	3.25%
Eighteenmile Creek	274.28	4.95%
Ellicott Creek	244.02	4.40%
Headwaters Cattaraugus Creek	615.27	11.10%
Lower Tonawanda Creek	216.63	3.91%
Middle Tonawanda Creek	331.05	5.97%
Murder Creek	222.21	4.01%
Niagara River	223.02	4.02%
Sixmile Creek	159.48	2.88%
Smoke(s) Creek	119.86	2.16%
Upper Tonawanda Creek	588.67	10.62%
Walnut Creek	129.44	2.34%
Total Watershed	**5,543.28**	**100.00%**

Source: USGS National Hydrography Data Set

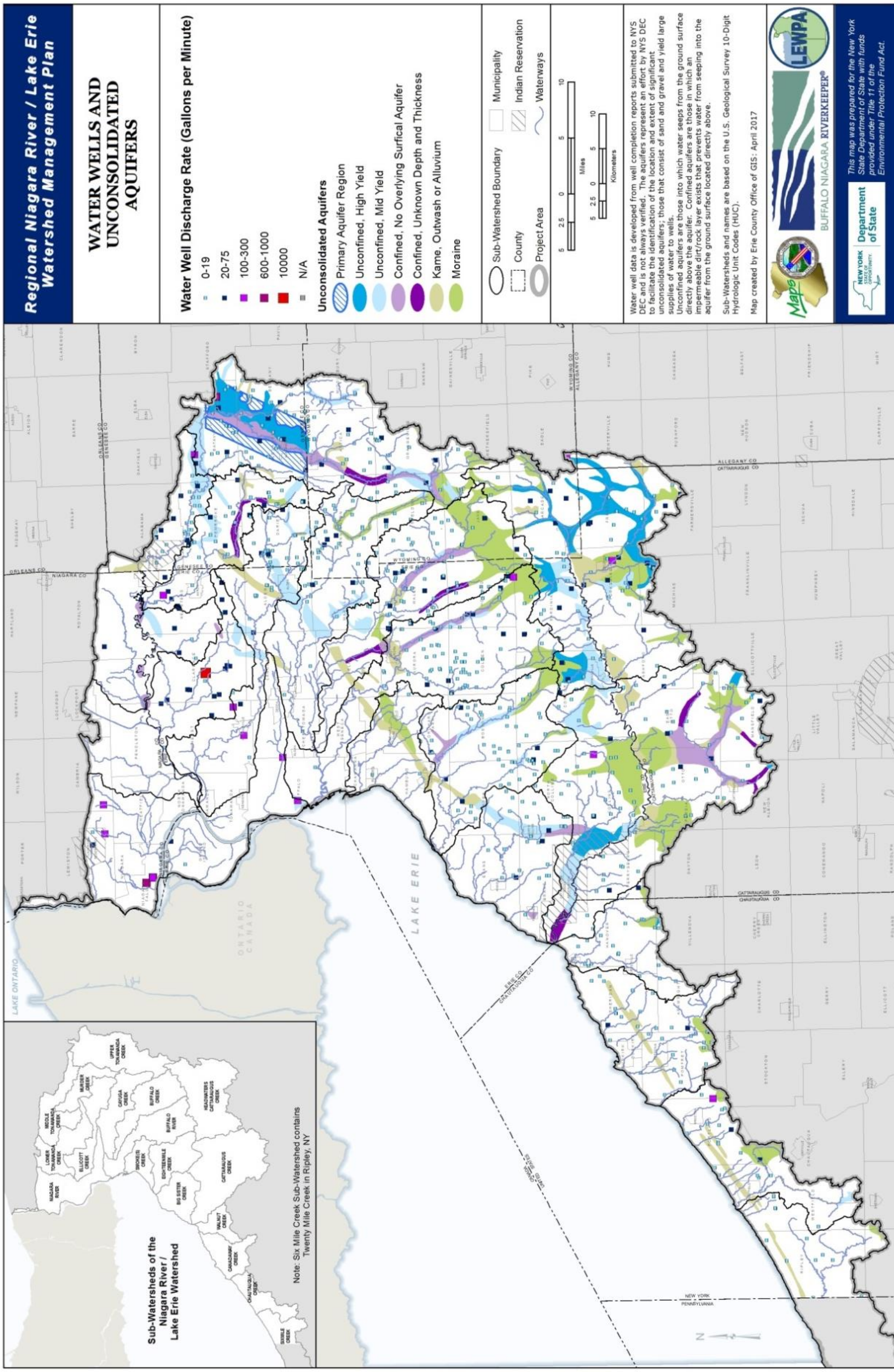
Groundwater

Groundwater is the water located beneath the ground that fills the pore or void space in soils, or fractures of rock formations. These saturated soils and rock formations that store water in the subsurface are called aquifers. Aquifers can be sand and/or gravel, glacial tills, or layers of sandstone or cavernous limestone bedrock. Water stored in these aquifers moves within the subsurface through interconnected pore space. This movement of water is generally very slow and as a result groundwater can be much older than surface water, on the order of tens of thousands of years in some cases. In some cases, groundwater can also percolate into soil and rock layers in a matter of seconds. Once there, groundwater can move through fractures in rock layers, especially shale formations, if the fractures are interconnected. As a result, aquifers need to be closely managed to prevent excessive removal of water or potential contamination. Aquifers are recharged from precipitation on the land that infiltrates the surface, seepage from stream beds, and subsurface flow through the till and bedrock. Green infrastructure, such as permeable pavement or rain gardens, can allow stormwater runoff to infiltrate the ground.

In the north and west of the Niagara River/Lake Erie Watershed, groundwater is not the primary source of potable water supply due to the subsurface geology having poorly connected pore space and the proximity to a vast amount of surface water in the Great Lakes. There are exceptions to this rule, however. For example, the towns of Clarence and Newstead have several high-yield groundwater wells that sit on top of the Onondaga Aquifer. New York State Department of Environmental Conservation has mapped and identified a limited number of aquifers throughout the Watershed with most of them being in the east and south (Figure 2.10). The uplands in the southeast sub-watersheds have large moraine aquifers. There are also several productive aquifers within the Upper Tonawanda Creek sub-basin. In the southeastern portions of the Watershed, many public and private water sources are derived from groundwater wells and springs.

Groundwater also supports many ecologically important functions. When groundwater moves upward toward the land surface it forms springs, wetlands, and supports stream flow. These springs and wetlands support both vegetation and animal habitat for some of our most valued natural resources in the region. Springs feed Spring Brook near Springville, NY in southern Erie County. It is a one of a few native Brook Trout streams in the Watershed because of the cold, clear water. Groundwater discharge into streams is also an important component to stream flow during dry periods. This discharge of groundwater into streams is critical in small and large streams and has been shown to be between 41% and 45% of the total flow at stream gaging stations on Buffalo River, Cayuga Creek, and Cazenovia Creek.

Figure 2.10: Water Wells and Unconsolidated Aquifers



Lake Seiches

Lake Erie experiences more large seiches (standing waves) than the four other Great Lakes due to how shallow it is and the fact that it is lined up with the typical prevailing wind direction. These large waves result in a sudden rise in water due to strong winds and rapid atmospheric pressure changes causing the water to be pushed from one end of the Lake to the other. These typically occur when the winds blow from southwest to northeast. In 1844, a 22-foot high seiche killed 78 people and dammed ice in the Niagara River, cutting off flow temporarily to Niagara Falls.[6] Seiches can cause intense flooding and erosion, as experienced in 2008 when 12-16 foot waves flooded the west side of Buffalo. As the winds die down, seiche waters can "slosh" back and forth across the Lake until water levels equilibrate. This water movement is so forceful that it can cause severe damage to shorelines.

Wetlands

Wetlands occur where land and water meet for extended periods of time. They generally occur along water bodies, lakes, rivers, streams, etc., in low lying areas where water ponds, and even on hillsides where groundwater seeps to the surface. They provide natural open space and help to provide food and homes to fish, amphibians, shellfish, insects, birds, and other animals. Wetlands also clean our water by filtering pollution and recharging aquifers. They maintain dry season stream flows and stabilize shorelines from erosion.

Figure 2.11: Tifft Nature Preserve Wetland

Wetlands are particularly important for flood protection. They act as natural sponges that trap and slowly release surface water, rain, snowmelt, groundwater, and flood waters. The holding capacity of wetlands helps to control floods and prevent water logging of crops. Trees, root mats, and other wetland vegetation also slow the speed of flood waters and distributes them more slowly over the floodplain, reducing flash flooding and downstream inundation. This combined water storage and braking action lowers flood heights and reduces erosion. Wetlands within and downstream of urban areas are particularly valuable, counteracting the greatly increased rate and volume of surface water runoff from pavement and buildings (impervious cover). Figure 2.11 shows an example of a wetland in the Watershed.

[6] NOAA https://oceanservice.noaa.gov/facts/seiche.html

Wetlands are characterized as having a water table that stands at or near the land surface for a long enough period of time each year to support aquatic plants. These lands have hydric soils that are often saturated with water permanently or for part of the year. Most importantly they have plants and animals that can withstand this flooding.

The amount and the character of wetlands in the Niagara River/Lake Erie Watershed changes as you transit from the south to the north. Figure 2.12 shows that the headwater areas, which have steeper slopes, better drainage, and deeper riverbeds contain only small pockets of wetlands. The floodplains are very narrow in this area as well. As you pass north over the Portage escarpment the waterways start to meander more and the amount of wetlands increases.

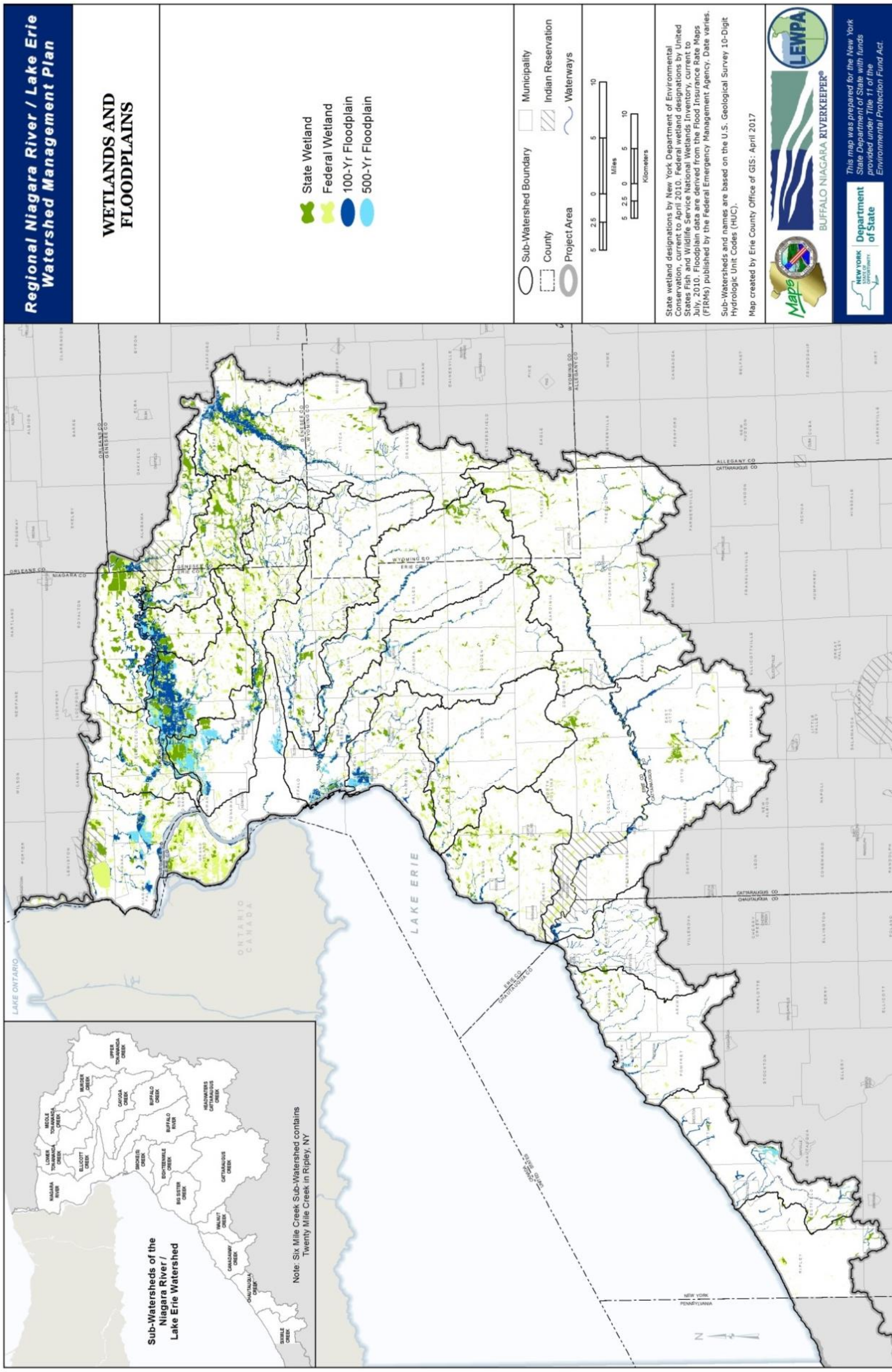
Table 2.3 outlines the acreage of wetlands as determined by the National Wetlands Inventory (NWI) and New York State Department of Environmental Conservation (NYS DEC) located within each sub-watershed. NWI and NYS DEC wetlands often overlap, which is why the "All Wetland Acres" category is not simply an addition of the two NWI and NYS DEC columns.

Table 2.3: Wetlands by Sub-watershed

Sub-Watershed Name	All Wetland Acres*	NWI Acres	NYS DEC Acres	% of Sub-watershed Acreage as Wetlands	% of Wetlands Protected by NYS DEC
Sixmile Creek	947	750	392	2.18%	41.42%
Walnut Creek	902	630	505	2.50%	55.93%
Chautauqua Creek	1,340	1,089	559	2.61%	41.73%
Canadaway Creek	1,852	1,529	611	2.87%	33.02%
Cattaraugus Creek	8,960	7,993	2,307	4.54%	25.75%
Buffalo River	5,366	4,894	1,041	5.09%	19.40%
Headwaters Cattaraugus Creek	9,166	8,118	3,438	5.71%	37.51%
Eighteenmile Creek	4,497	4,199	987	5.85%	21.96%
Buffalo Creek	6,218	5,432	1,967	6.67%	31.64%
Cayuga Creek	6,629	6,101	1,318	8.15%	19.88%
Smoke(s) Creek	3,876	3,491	1,059	9.81%	27.32%
Big Sister Creek	6,650	5,834	1,641	10.66%	24.68%
Upper Tonawanda Creek	13,662	11,748	5,763	10.74%	42.18%
Ellicott Creek	12,657	11,888	4,104	16.48%	32.42%
Lower Tonawanda Creek	14,356	13,145	5,452	18.22%	37.98%
Niagara River	20,865	20,463	3,308	20.29%	15.85%
Middle Tonawanda Creek	17,053	15,188	8,760	21.56%	51.37%
Murder Creek	10,680	9,203	5,252	22.89%	49.18%
Niagara River/Lake Erie Watershed	**145,675**	**131,696**	**48,466**	9.56%	33.27%

* Includes both State listed (Department of Environmental Conservation) and Federally listed (National Wetlands Inventory).

Figure 2.12: Wetlands and Floodplains



The table illustrates that the sub-watersheds in the northern portion of the Niagara River/Lake Erie Watershed, such as Tonawanda Creek and its tributaries, have the largest percentage of their total acreage as wetlands. The four sub-watersheds north of the Onondaga Escarpment (Lower & Middle Tonawanda, Ellicott Creek and Niagara River Sub-watersheds) have a significant amount of wetland habitat, hydric soils, and connection with underlying aquifers including the Onondaga Aquifer (See Figures 2.7, 2.10, and 2.12). Wetlands constitute an average of 18% of sub-watershed habitat within the three sub-watersheds of Tonawanda Creek, Murder Creek, Ellicott Creek, and the Niagara River sub-watersheds. Tonawanda Creek flows through the former lake bed of the prehistoric Glacial Lake Tonawanda, and many of the wetlands are remnants of that earlier time. On the northeastern edge of the Watershed, halfway between Lockport and Batavia, the Tonawanda Wetland Area is located in the Middle Tonawanda Creek Sub-watershed. It is a 5,600-acre wetland tract. From there, a broad floodplain sprinkled with wetlands, extends westward across the watershed until it meets and is stopped by the urban development in the City of Buffalo and the Tonawandas.

The amount of wetlands decreases generally as you move south through the Watershed. Sixmile Creek Sub-watershed has the least percentage of delineated wetlands within the New York state boundaries making up only 2.18% of the acreage of the sub-watershed. The 12 southern sub-watersheds not mentioned in the paragraph above average only 5.5% of their habitat as wetlands.

The final column of Table 2.3 shows the percent of all wetlands that are protected by the NYS DEC. It ranges from 15% to 55% of the wetlands within each sub-watershed. The amount of wetland acreage protected by the NYS DEC is much higher in the northern portion of the Watershed.

Floodplains

The Niagara River/Lake Erie Watershed has approximately 107,818 acres of designated floodplain as depicted in Figure 2.12. These include both 100-year floodplains, which have a 1% chance of a flood occurring in any given year, and 500-year floodplains, which have a .02% chance of a flood occurring in a given year.

Presently the northern low-lying areas of the watershed host the largest acreage of floodplain (Table 2.4). Former Lake Tonawanda's boundary can be seen from Figure 2.12, spanning the large 100-year and 500-year floodplain complex sprawled across Tonawanda Creek from northern Amherst to the Tuscarora Reservation. The development in and around this floodplain complex has seen increased high-water flooding events in the downstream cities of Tonawanda and North Tonawanda. The other large floodplain complex existing along Tonawanda Creek in the Upper Tonawanda Creek Sub-watershed is located just south of the City of Batavia in Genesee County, where several tributaries converge.

The middle of the Niagara River Sub-watershed shows an area of 500-year floodplain just west of the Village of Depew in the Town of Cheektowaga. This area coincides with extensive commercial and residential development along Scajaquada Creek before it is channelized underground. In the northern section of the Niagara River Sub-watershed, a series of both 100-year and 500-year floodplains are located near Bull Creek, Bergholz Creek and Cayuga Creek in the Town of Wheatfield.

The lower Buffalo River meanders across the flat Lake Erie plain to the lake with a very wide floodplain extending up Buffalo Creek, Cayuga Creek, and Cazenovia Creek. The land area susceptible to 100 and 500-year flooding greatly expands as the river reaches the industrialized lower six miles of the Buffalo River in the urban areas of West Seneca and Buffalo. At the mouth are remnants of one of the most extensive and productive coastal marshes on Lake Erie.

Smokes Creek's floodplain, near the Lake Erie shoreline, expands as it goes through Lackawanna. This is mostly industrial land with very little wetlands to help mitigate the issues of impervious cover. This area of Smokes Creek also experiences a lot of erosion during high rain events as minimal riparian vegetation exists to stabilize banks.

Table 2.4: Acreage of Floodplains by Sub-watershed

Sub-watershed	Total Acres	100-Year Floodplain Acres	500-Year Floodplain Acres	% of sub-watershed in 500 year floodplain
Walnut Creek	127,237.9	1,639.14	1,681.67	1.32%
Sixmile Creek	36,019.9	675.41	675.41	1.88%
Eighteenmile Creek	76,834.0	1,470.88	1,576.03	2.05%
Canadaway Creek	64,538.8	1,511.93	1,639.03	2.54%
Big Sister Creek	62,363.0	1,490.25	1,635.18	2.62%
Headwaters Cattaraugus Creek	160,605.7	4,206.78	4,224.85	2.63%
Cattaraugus Creek	197,523.2	5,348.69	5,410.19	2.74%
Buffalo Creek	93,158.5	3,837.01	4,343.78	4.66%
Buffalo River	105,367.8	4,136.66	5,102.47	4.84%
Chautauqua Creek	51,266.3	1,894.69	2,620.75	5.11%
Cayuga Creek	81,358.2	4,310.91	4,709.35	5.79%
Smoke(s) Creek	43,537.6	2,176.32	3,123.01	7.17%
Niagara River	102,812.1	8,543.98	11,444.13	11.13%
Murder Creek	46,666.4	6,157.37	6,233.78	13.36%
Ellicott Creek	76,824.3	6,131.45	11,992.75	15.61%
Middle Tonawanda Creek	79,090.0	11,410.38	12,661.27	16.01%
Lower Tonawanda Creek	78,788.8	12,763.39	17,344.33	22.01%
Upper Tonawanda Creek	39,522.8	11,152.59	11,399.68	28.84%
TOTAL	**1,523,515.3**	**88,857.8**	**107,817.7**	**7.08%**

Source: FEMA Flood Insurance Rate Maps

Further south, narrow bands of floodplains can be seen along Cattaraugus Creek in the steep valleys, widening at the mouth. In addition, there is a swath of 500-year floodplains just north of the Village of Mayville in the Town of Chautauqua. These are the headwaters of Chautauqua Creek.

It is important to note that the Federal Emergency Management Agency's (FEMA) flood insurance rate maps were created for insurance purposes in developed areas and do not map farmland. FEMA maps may not be up-to-date with farmland that has been developed since the last map version. Therefore, communities should not rely solely on them for the most accurate floodplain information.

Climate & Precipitation

The climate of the Niagara River/Lake Erie Watershed is typical humid continental, which is a climate type that exhibits large seasonal temperature contrasts, with cold winters and hot summers. These diverse climatic conditions are influenced by the region's location, the Great Lakes themselves, and air masses from other regions. The Great Lakes central position in North America exposes the region to alternating flows of warm, moist air from the Gulf of Mexico and cold, dry air from the Arctic. The Great Lakes are well-known for lake-effect snow, where cold Artic air masses move across the lakes picking up heat and moisture and depositing it in extreme rain or snowfall events on the downwind side of the lake. Despite this reputation for extreme snowfall events, winters are changeable and often there are periods of bare ground. Lake Erie shoreline areas are frequently cooler than inland areas due to breezes off the lake.

A review of 1981-2010 weather station normals (three-decade average) shows that the region typically experiences its first frost during the month of October when temperatures dip to 32°F (Table 2.5). Approximate last frost can be as late as May 20th in the valleys in the southern portion of the Watershed. On average the hottest month of the year is July, and the coldest month is January, though occasionally comparable lows can be found during February. Figure 2.13 shows the locations of the weather stations used in Tables 2.5 and 2.6.

Variations in local climate are demonstrated in Table 2.6. Areas located along the Lake Erie shoreline and in the northern portions of the Watershed generally have less precipitation than inland areas.

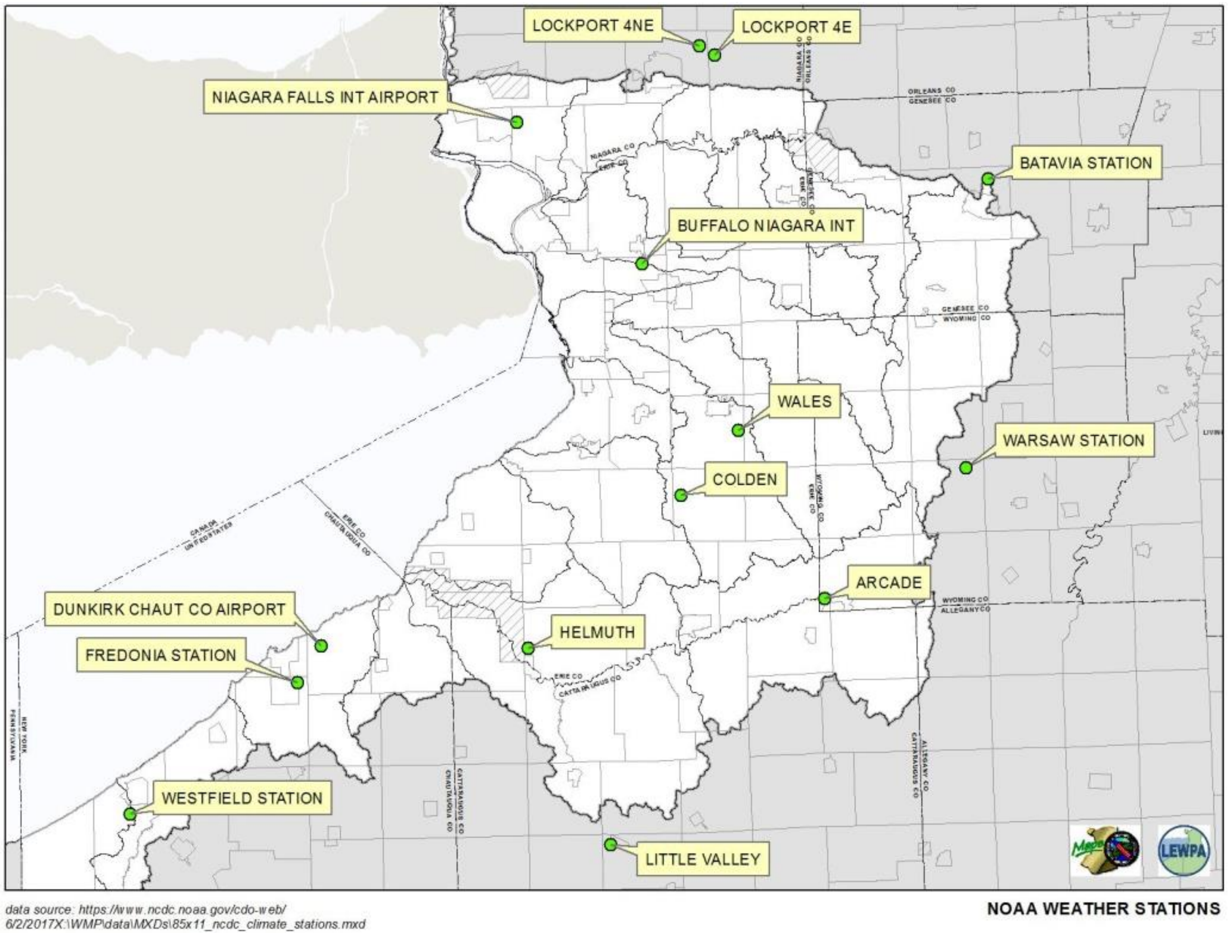
Weather stations located in the southern valleys see lower average temperatures than shoreline and northern stations. Based on data provided by the National Climatic Data Center, the average annual temperature for the watershed ranges from 44.1-50.2 °F.

Table 2.5: Approximate First & Last Frost dates for the Niagara River/Lake Erie Watershed (1981-2010)

Measuring Station	Approximate First Frost	Approximate Last Frost
Arcade	October 2nd	May 13th
Batavia	October 7th	April 29th
Buffalo Niagara International Airport	October 22nd	April 24th
Colden	October 5th	May 14th
Dunkirk Chautauqua County Airport	October 26th	May 3rd
Fredonia	October 27th	April 27th
Helmuth	October 10th	May 10th
Little Valley	October 2nd	May 20th
Lockport 4E	October 21st	April 29th
Lockport 4NE	October 20th	April 28th
Niagara Falls International Airport	October 14th	May 2nd
Wales	October 7th	May 11th
Warsaw	October 6th	May 9th
Westfield	November 1st	April 24th

Source: National Climatic Center Station Annual Normals (1981-2010) based on 50% probability of temperature reaching 32 degrees F.

Figure 2.13: Map of weather stations



Western New York's climate is strongly driven by Lake Erie. Early autumn can bring lake-effect rain. Intense lake-effect snow is common from November to January, sometimes resulting in historic storms, but lake-effect events taper off as the lake freezes over. The lake also modulates summer climate, resulting in the areas closest to the lake having more sunshine and fewer thunderstorms than inland areas in early summer, while late summer thunderstorms off the lake and closer to the shoreline are more common.

The average annual precipitation (rain and melted snow) for the Niagara River/Lake Erie Watershed ranges from 34.97 inches in Niagara Falls to 47.86 inches in Little Valley. Higher precipitation levels are found primarily in the areas with higher elevations toward the southern areas of the Watershed including the hills in the towns of Boston and Colden. This can be clearly seen in Watershed Precipitation maps in Figures 2.14 and 2.15. The precipitation levels decrease as you move north through the Watershed. Similar trends can be seen with snowfall, with the southern tier receiving considerably more snowfall than the northern end of the watershed.

However, since 1975, the number of days with land snow cover has decreased by 5 days per decade, and the average snow depth has decreased by 1.7 cm per decade. From 1973 to 2010, annual average ice coverage on the Great Lakes declined by 71%.[7] If this trend continues, reduced ice cover may result in increased lake-effect precipitation, which can lead to increased flooding. However, reduced ice cover can also increase evaporation, and decrease water recharge, leading to falling water levels, especially for Lake Erie.

Table 2.6 Average Temperatures and Precipitation for the Niagara River Watershed (1981-2010)

Measuring Station	Temperature (Fahrenheit)			Average Annual Precipitation (Inches)
	Winter Average (Jan)	Summer Average (July)	Annual Average	
Arcade	25.1	65.9	46.3	42.50
Batavia	26.9	69.5	48.9	35.34
Buffalo Niagara International Airport	27.1	69.0	48.3	40.48
Colden	24.4	65.6	45.5	46.91
Dunkirk Chautauqua County Airport	28.7	69.0	49.0	37.95
Fredonia	29.3	69.9	50.2	41.93
Helmuth	No Data	No Data	No Data	No Data
Little Valley	24.0	64.8	44.8	47.86
Lockport 4E	28.4	70.2	49.7	37.85
Lockport NE	No Data	No Data	No Data	No Data
Niagara Falls International Airport	26.2	68.8	47.7	34.97
Wales	24.8	65.7	45.8	42.35
Warsaw	22.6	64.8	44.1	45.85
Westfield	No Data	No Data	No Data	No Data

Source: National Climatic Center Station Normals, 2013

[7] Great Lakes Integrated Science Assessments, 2012

Figure 2.14: Average Annual Precipitation (1971-2000)

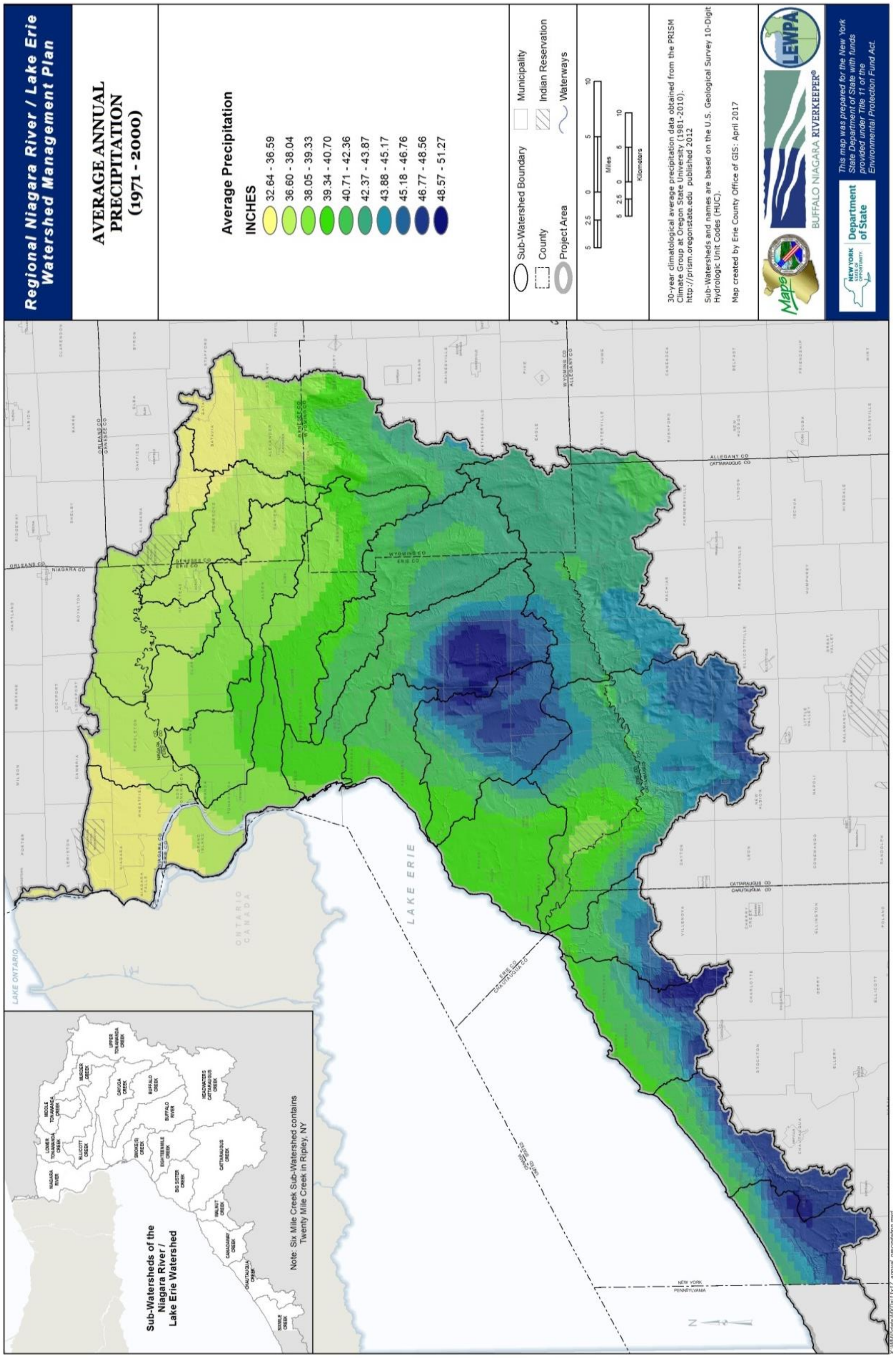
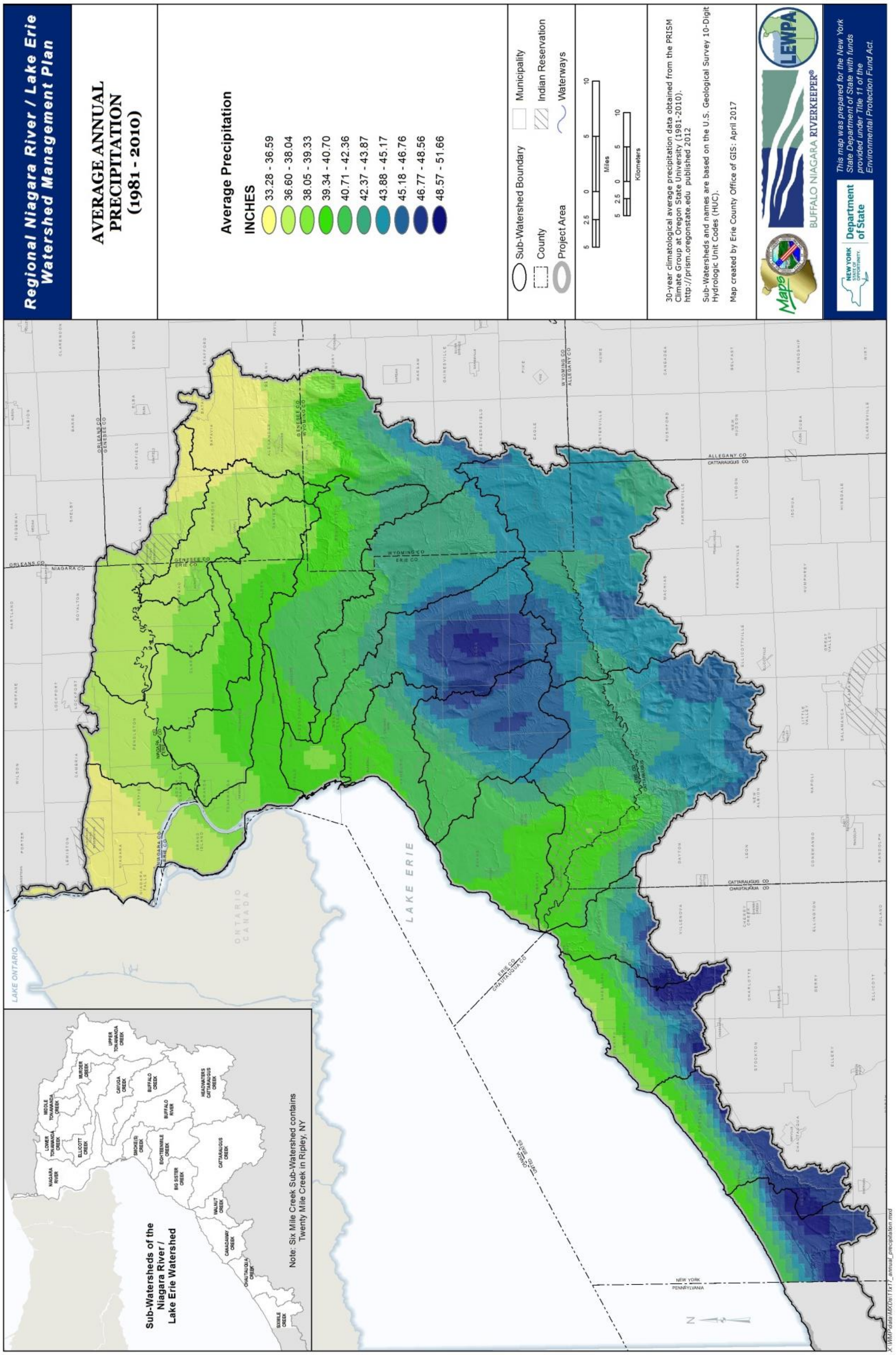


Figure 2.15: Average Annual Precipitation (1981-2010)



Climate Change

The Earth's atmosphere is warming, and nearly all communities around the Great Lakes will need to adapt to changes in regional climate over the next century. These changes may include: warming air temperatures; shifts in the timing, frequency, and severity of precipitation events; higher water temperatures; reductions in lake ice cover; and fluctuating lake levels due to increased evaporation at times and increased precipitation events.

Potential Emerging Climate Change Impacts

1. **Warming Temperatures, Heat Waves, and Reduced Cold Events**

   Recent climatological research indicates that regional temperatures are warming slightly, especially in the winter and spring, with spring showing the strongest warming. Summer and fall are not as affected by this trend, with the fall season even showing a slight cooling trend. Winter/spring warming results in shorter frost periods, and reduced ice cover on the lakes, which due to their weather modulating capabilities can significantly impact the region's seasons and climate. This can also explain why annual precipitation is increasing, while the ratio of snow to total precipitation is decreasing.[8]

   Heat waves are expected to become much more common in a region where they have historically been rare. This may have significant impact on the region's agricultural industries by changing growing conditions for staple crops, such as blueberries and apples, and by increasing irrigation demands. Projected warmer temperatures also can negatively impact the dairy industry, which is a significant economic driver in the watershed. Heat stress in cows can dramatically reduce milk production and slow birth rates.[9] Extreme cold events, defined both as the number of days per year with minimum temperature at or below 32°F and those at or below 0°F, are expected to decrease.[10] New York State modeling indicates that New York could be 3°F warmer by the 2020s.[11]

2. **Increased Rainfall**

   Climate change is expected to increase annual precipitation across the Great Lakes region. Relatively large increases in winter and spring precipitation are projected by the end of the century, with large decreases for summer months. The frequency of heavy rainfall events is expected to continue increasing with longer dry spells in between. Figure 2.16 shows the

[8] Alden, M., Mortsch, L., Sheraga, J. *Climate Change & Water Quality in the Great Lakes Region: Risks, Opportunities & Responses.* 2003

[9] US Global Change Research Program, *Global Climate Change Impacts in the United States*, 2009

[10] NYS's Open Space Conservation Plan, 2016

[11] http://www.dec.ny.gov/energy/94702.html

report from the U.S. Geological Survey on the Flooding that occurred in Goawanda and Silver Creek after 4 inches of rain fell in August 2009.

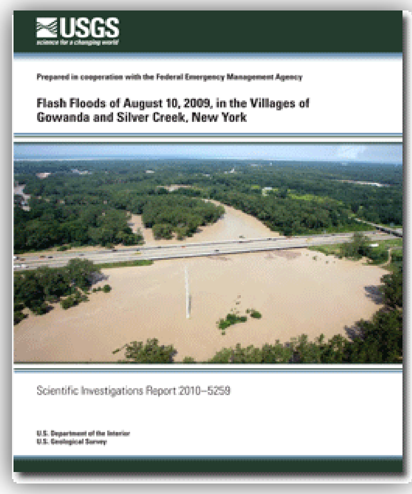


Figure 2.16: USGS report on Gowanda and Silver Creek Floods

3. **Increased Flooding**

An increase in flooding is considered one of the most probable impacts of climate change in this region. Factors that could influence flooding include shifts in the intensity and tracks of storms and changes in the type of precipitation. Land conditions such as smaller snow-packs, less soil moisture and frozen soil when large storms take place can also change and influence the intensity of flooding effects. According to the NYS Open Space Conservation Plan, "climatologists expect that even if the frequency of storms does not increase, the proportion of storms that become severe is likely to be greater."

A 2011 study did not come up with a clear pattern of how climate change will alter flooding in the future but did indicate that changes in snow packs, frozen ground, soil moisture, and storm tracks are all factors that could be altered by greenhouse gas concentrations and possibly alter current flooding patterns.[12] In the study the United States was divided into four large regions and the research showed some regional differences in the way that flooding has varied with CO2 levels over the past century. For the northeastern region that includes New York State, the study shows a tendency towards increases in flooding over this period.

4. **Changing Lake Levels**

As mentioned previously, warmer air and water temperatures along with reduced snowpack and shorter duration of ice cover may result in greater evaporation and overall lower Lake Erie levels. The frequency and duration of low water levels could increase, falling below historic low-water levels. However, increase in frequency and intensity of storm events may also raise lake levels at times. Water level change will not be equal among all of the Great Lakes. Considerable range in the change in lake levels is due to differences in precipitation patterns and evapotranspiration.

5. **Changing Winter Freeze and Thaw Dates**

In the Great Lakes Region, later ice-in dates may increase the frequency and intensity of lake-effect storms, very heavy snowfalls that occur when open water in the lakes is warmer than the

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[12] Hirsch, R.M. and Ryberg, K.R., 2012. *Has the magnitude of floods across the USA changed with global CO2 levels?* Hydrolological Sciences Journal, 57 (1), 1–9.

surrounding land surface. If the lakes freeze-over later in winter (or not at all), more lake-effect events are expected. As the climate further warms, air and lake temperatures may remain closer, in which case, the frequency of lake-effect storms may actually decrease.[13]

6. **Extreme Weather Events**
   Studies have indicated that if current trends continue, the region's already variable climate could become increasingly volatile and unpredictable, with increases in both extreme wet and dry events.[14]

Existing Infrastructure in the Watershed

Dams

According to the NYS Dam Inventory (2009) there are 491 dams within the Niagara River/Lake Erie Watershed. The volume impounded by the dams at the elevation of a single or service spillway is 91,530 acre feet or over 29 billion gallons of water.[15] The oldest damn in the record was built in 1808 (South Branch Smokes Creek Dam) and the most recent dams were built in 2010 (Paul Snyder Pond Dam and Pierce Pond Dam). The earliest dams were built for irrigation, fire protection, and drinking water supply purposes between the mid 1800's and early 1900's. Many dams were built in the 1950's and 60's, with the vast majority of these dams built for "recreation" purposes. Figure 2.17 is a map of the watershed's dams and their designated purposes.

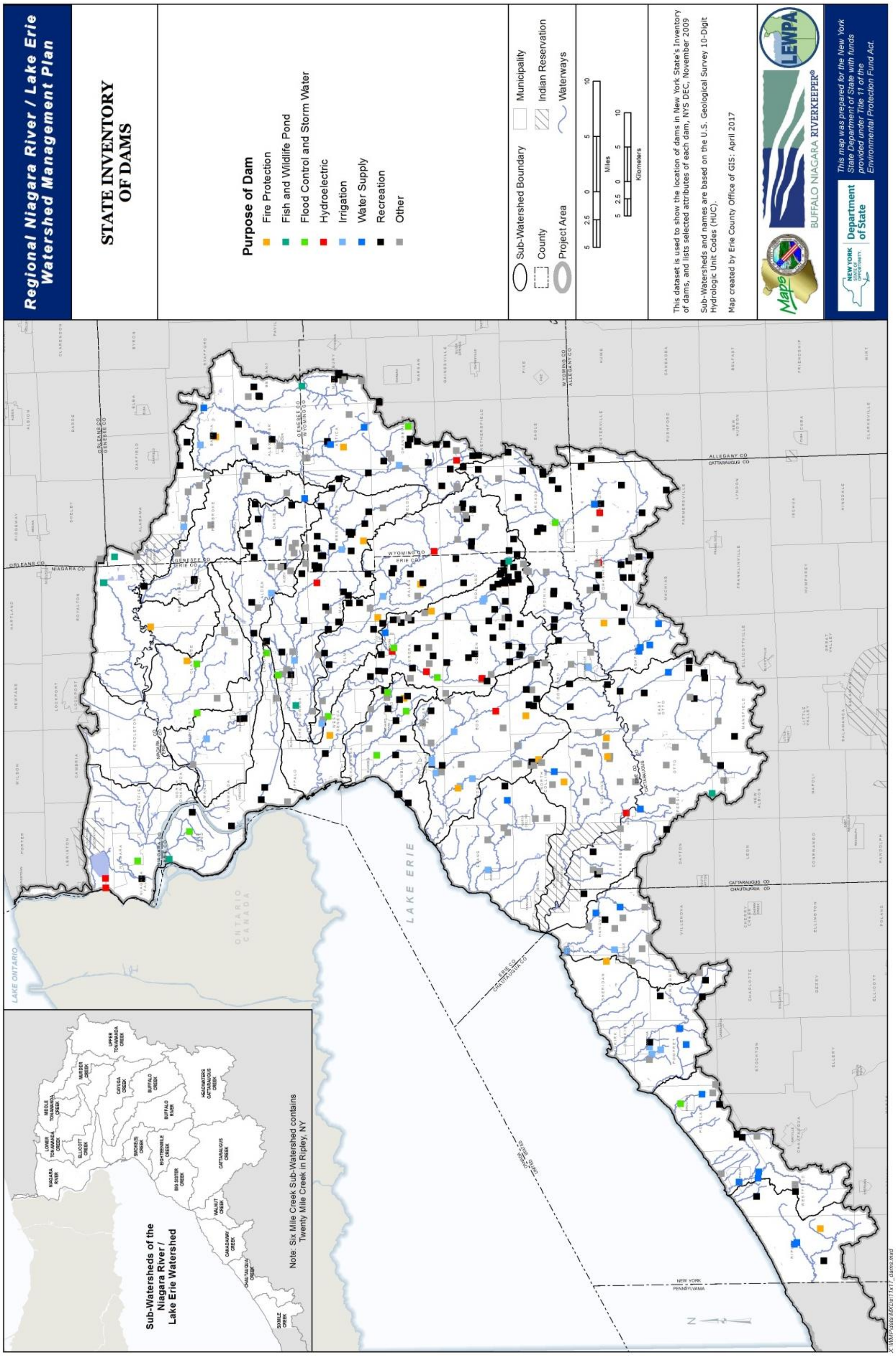
Most of the dams in the watershed are small earthen dams (71%), with the remaining consisting of timber crib, concrete, masonry, rockfill, laid up stone, and buttress style designs. The Lewiston Pump Generating Plant, shown in Figure 2.18, is the largest dam in the watershed and located in the Niagara River Sub-watershed. It was built by the NY Power Authority in 1960 and stores approximately 22 billion gallons of water to feed the Lewiston Hydroelectric generation facility. The Robert Moses-Niagara Dam is also located in the Niagara River Sub-watershed.

The other ten dams classified as hydroelectric in the watershed include:

- Sweewaldt Dam on Tonawanda Creek
- Haungs Dam on Cayuga Creek
- Depew & Lancaster Co Dam on Cazenovia Creek
- Yaws Mill Dam on the West Branch of Cazenovia Creek
- Grays Mill Dam on the West Branch of Cazenovia Creek
- Hyman Brothers Saw Mill Dam on Buffalo Creek
- Brunnen Mill Dam on Eighteen Mile Creek

[13] NYS Open Space Conservation Plan, 2016
[14] Ibid
[15] Normal storage capacity, NYS DEC Inventory of Dams, 2009

Figure 2.17: State Inventory of Dams



- Shermans Mills Dam on Cattaraugus Creek
- Goo & Hopkins Mill Dam on a tributary to Cattaraugus Creek
- Cattaraugus Creek Dam in Gowanda on Cattaraugus Creek

Most of the watershed's dams are in private ownership for irrigation, private stocked ponds, and other recreational purposes as shown in Table 2.7.

Table 2.7: Number of Dams by Owner

Owner	Number of Dams
Public Utility	2
Local Government, Private	4
Not Found	12
State	17
Local Government	60
N/A	162
Private	234
Total	**491**

Source: NYS DEC Inventory of Dams (2009)

Table 2.8: Number of Dams by Subwatershed

Sub-watershed	Number of Dams
Sixmile Creek	5
Lower Tonawanda Creek	6
Big Sister Creek	8
Murder Creek	11
Canadaway Creek	13
Niagara River	13
Walnut Creek	13
Middle Tonawanda Creek	15
Chautauqua Creek	16
Smoke(s) Creek	17
Ellicott Creek	24
Eighteenmile Creek	33
Buffalo Creek	39
Cayuga Creek	46
Cattaraugus Creek	53
Upper Tonawanda Creek	53
Headwaters Cattaraugus Creek	58
Buffalo River	68
Total	**491**

Source: NYS DEC Inventory of Dams (2009)

Table 2.8 outlines the number of dams located in each sub-watershed. The NYS Dam Inventory also classifies a dam's hazard class, which indicates the level of hazard the dam poses if it were ever to fail or be breached. Dam's hazard classes range from A-C, with A equaling a low-level hazard (minor damage to property) and C equaling a high-level hazard (causing loss of life, damage to public infrastructure, and property). Dams classified as D, are considered no longer functioning and therefore have a negligible or no hazard. There are a total of 287 dams classified as Hazard Level A (low-hazard), 25 as level B (moderate-hazard), 9 as level C (high-hazard), and 117 as class D (no-hazard). A hazard level has not been assigned to 53 of the dams in the Watershed. The Class C dams included in this inventory include:

- McKinley Mall Retention Pond Dam on Blasdell Creek
- Lewiston Hydroelectric Generation Dam on the Niagara River
- Robert Moses-Niagara Dam
- Green Lake Dam on South Branch Smoke Creek (work was completed on this dam in 2016)
- Attica Dam (upper) on Crow Creek
- Springville Dam on Cattaraugus Creek
- Clear Lake Dam on North Branch Clear Creek
- Fredonia Reservoir Dam on Canadaway Creek
- Brocton Reservoir Dam on Slipper Rock Creek

Owners of Class C dams are required to have an Emergency Action Plans and Inspection and Maintenance Plans in place, as well as regularly scheduled safety inspections.

NYPA Niagara Power Project Impacts & Relicensing

Prior to the relicensing of the Lewiston Hydroelectric Generation facility by the NYPA in 2007 the generation facility, its reservoir, and other infrastructure were argued to be the cause of significant environmental impacts to the Niagara River. Findings from environmental studies completed as part of the relicensing effort identified major impairments caused by the water diversions necessary for the operations of the plant.[16] As of a 2005 study, water level draw-downs average 1.5 feet/day just above the intakes, up to 12 feet/day in the gorge area above the tailrace, up to 36 feet/day in the Lewiston Reservoir, and .6 feet/day at Lake Ontario.[17]

Due to the environmental impacts and the infrastructure's limitation of public access to the waterfront, relicensing included a settlement to waterfront (Greenway) communities of Western New York of $9 million/year for 50 years. The settlement provides three Standing Committees that

[16] Many sources can be found in the Regional Niagara River Lake Erie Watershed Management Plan Atlas and Bibliography at www.erie.gov/wmp.
[17] Niagara River Water Level and Flow Fluctuation Study (URS Corporation, 2005)

oversee disbursement of the funds for environmental and public access projects in the Greenway Communities, plus allocations to Erie and Niagara Counties.[18]

Stormwater Infrastructure

The other primary man-made infrastructure impacting how water moves in the watershed is stormwater infrastructure. In the Niagara River/Lake Erie Watershed this encompasses both combined and separated storm sewer infrastructure. Combined Sewer Systems (CSS) are conveyance systems that are designed to collect stormwater runoff, domestic sewage, and industrial wastewater in the same pipe. Most of the time, combined sewer systems transport all of the wastewater to a sewage treatment plant, where it is treated before being discharged to a local waterbody. However, during heavy rain events, combined systems can be inundated and include overflow release points that discharge untreated water into the watershed. Presently the Cities of Buffalo, Dunkirk, Lockport, and Niagara Falls , as well as the Town and Village of Lewiston have Combined Sewer Systems, which are discussed more in chapter 4.

Municipal Separate Storm Sewer Systems, or MS4s for short, are storm water conveyance systems that are completely separate from sanitary sewer systems. MS4 infrastructure can include underground pipes, stormwater retention ponds and roadside ditches, all of which either store or convey water along man-made routes in the watershed. It is important to note that MS4 conveyed waters are not treated prior to entering their final destination, a waterbody or tributary in the watershed. Therefore, stormwater has the potential to contribute pollutants into the watershed, including animal waste, litter, roadway contaminants, yard clippings, fertilizers, and pesticides. Because of this pollution potential, the US Environmental Protection Agency (US EPA) regulates all municipal, industrial, and commercial stormwater discharges as part of the National Pollutant Discharge Elimination System (NPDES) under the Federal Clean Water Act. In New York State, the NYS DEC manages the State Pollutant Discharge Elimination System (SPDES) under the NPDES.

All municipalities have some type of stormwater infrastructure; however communities that meet a certain threshold for population density as outlined by the most recent US Census Urbanized Areas (see Chapter 3 for a map of the urbanized area), must meet additional requirements to manage their stormwater discharges in accordance with the NPDES. These municipalities are often referred to as "MS4 communities" because of this designation and include the following municipalities in the Niagara River/Lake Erie Watershed:

[18] A list of projects funded by NYPA Relicensing Greenway Funds is available online at http://niagara.nypa.gov

City of Buffalo
City of Lackawanna
City of Niagara Falls
City of North Tonawanda
City of Tonawanda

Town of Alden
Town of Amherst
Town of Aurora
Town of Boston
Town of Cambria
Town of Cheektowaga
Town of Clarence
Town of Eden
Town of Elma
Town of Evans
Town of Grand Island
Town of Hamburg
Town of Lancaster
Town of Lewiston
Town of Lockport
Town of Marilla
Town of Newstead
Town of Niagara
Town of Orchard Park
Town of Pendleton
Town of Porter
Town of Tonawanda
Town of West Seneca
Town of Wheatfield

Village of Alden
Village of Angola
Village of Blasdell
Village of Depew
Village of East Aurora
Village of Hamburg
Village of Kenmore
Village of Lancaster
Village of Lewiston
Village of Orchard Park
Village of Sloan
Village of Williamsville
Village of Youngstown

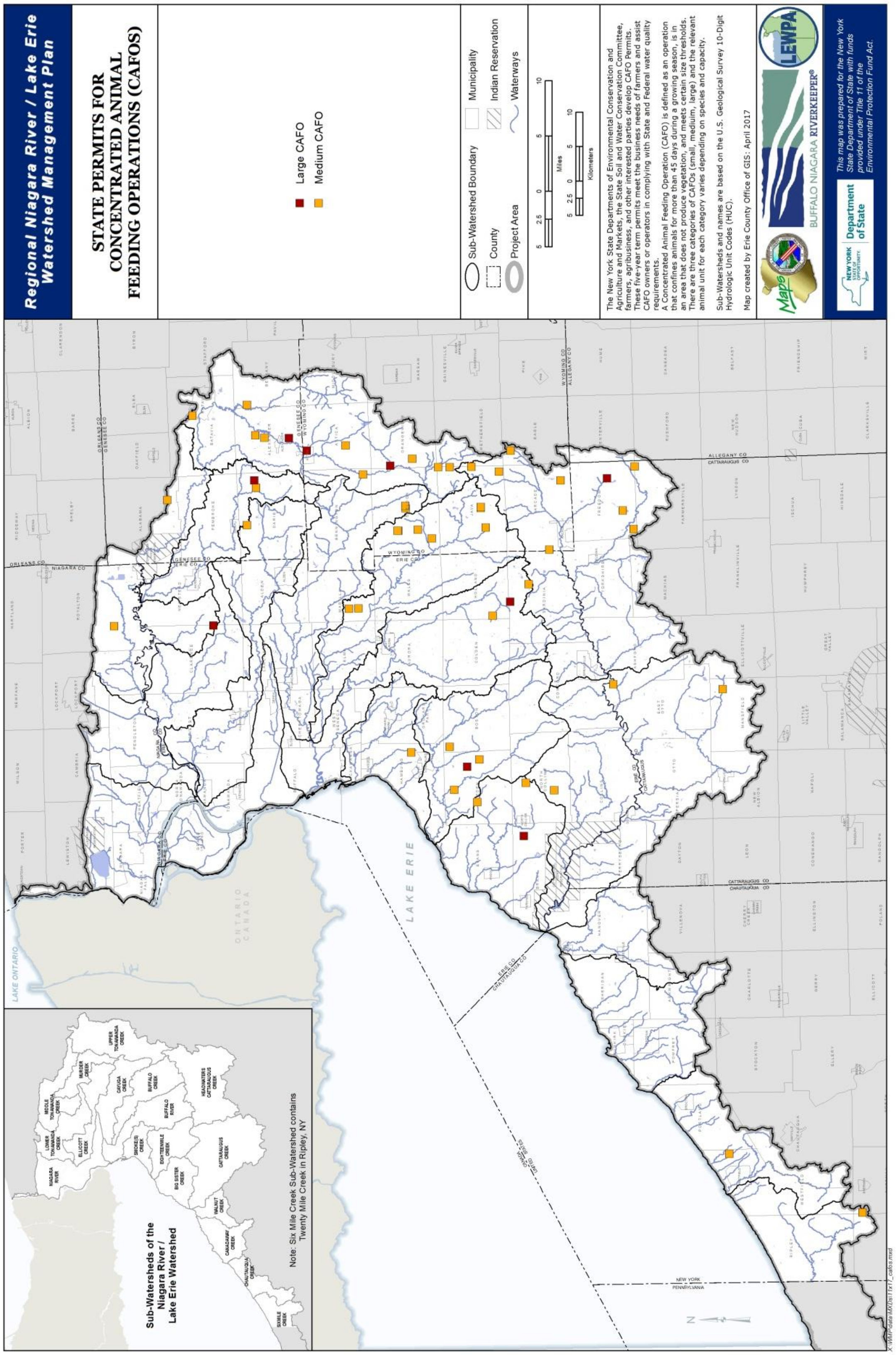
Presently, all of the designated MS4 communities are located within Erie and Niagara Counties. Forty-two regulated entities (municipalities and large-scale institutions) have joined together under the Western New York Stormwater Coalition (WNYSC) to share resources and work in partnership toward compliance with the U.S. Environmental Protection Agency's Phase II Stormwater requirements. The overall goal of WNYSC is to utilize regional collaboration to identify existing resources and develop programs to reduce the negative impacts of stormwater pollution.

A major MS4 mapping effort by the WNYSC has been underway since 2012 to inventory all MS4 infrastructure routes within these communities to identify the paths by which stormwater is directed in these systems and will be wrapping up shortly. The main purpose of this is to aid municipalities in track down of pollutants in these systems.

Agriculture

Agricultural land used for cultivating the soil for crops, rearing animals, or producing products makes up a large portion of the Niagara River/Lake Erie Watershed. Approximately 36% of the land cover of Watershed acreage is classified as cultivated crops or pasture/hay. These agricultural lands are often located in the headwaters areas of the sub-watersheds as more urbanized areas are generally located closer to Lake Erie and the Niagara River. Land use and land classification is discussed further in Chapter 3.

Figure 2.18 State Permits for Concentrated Animals Feeding Operations



As part of the Clean Water Act, the US EPA regulates farms of a certain size, which are referred to as Consolidated Animal Feeding Operations (CAFOs) and considered a source of point source pollution. Figure 2.18 shows the state permits for medium- and large-sized CAFOs. These are defined based upon the number of each type of animal on premises, as well as whether or not an operation is found to be a significant contributor of pollutants by the New York State Department of Environmental Conservation.[19]

Oil & Gas Production

The Medina sandstone rock stratum under the Allegheny plateau contains pockets of natural gas. Figure 2.19 shows the state-regulated gas wells in the Niagara River/Lake Erie Watershed. There are 5,006 gas wells in the Watershed ranging in depth from 0 to 7500 feet with 98% of those wells under 4000 feet in depth.[20]

Along with production wells, the area also houses underground vertical and horizontal gas storage wells. Natural gas produced elsewhere is pumped into and stored in these underground wells in the warm months when demand is low and then pumped out in the cold winter months when household demand is high.

Figure 2.20 shows state regulated oil, brine, and storage wells in the Niagara River/Lake Erie Watershed. Brine wells are clustered in the Upper Tonawanda Creek Sub-watershed. Storage wells are clustered mostly within the Allegheny Plateau. This map also lists wells that are not listed as gas, oil, brine, or storage. There are 7,470 total state regulated wells in the Watershed. The year all wells were drilled along with fault lines are shown in Figure 2.21. Clusters of wells drilled within the past decade can be found in Hanover, Collins, North Collins, Wales, and Darien.

Utility Infrastructure and Right-of-Ways

Utilities such as cable, internet, electric, and natural gas often have infrastructure that follows roadways. In some cases, this infrastructure requires a separate right-of-way to reach its destination. These right-of-ways are often wide strips of land mowed annually to prevent trees from growing into pipelines or wires. This mowing can isolate native habitat and disrupt the ecosystem.

The proposed construction of the Northern Access Pipeline is an example of both utility infrastructure and a utility right-of-way that has generated controversy in recent years. This topic has come up repeatedly at public outreach events throughout the Watershed conducted during this project. National Fuel Gas Company applied to construct a 96.5-mile pipeline to connect natural gas supplies from Pennsylvania, through Western New York to Canada. The NYS Department of Environmental Conservation denied the permit in April 2017 citing concerns about the impacts of

[19] Definitions can be found here: https://www3.epa.gov/npdes/pubs/sector_table.pdf
[20] Data Source: NYS DEC, 2013 http://www.dec.ny.gov/energy/1603.html

Figure 2.19: State Regulated Gas Wells

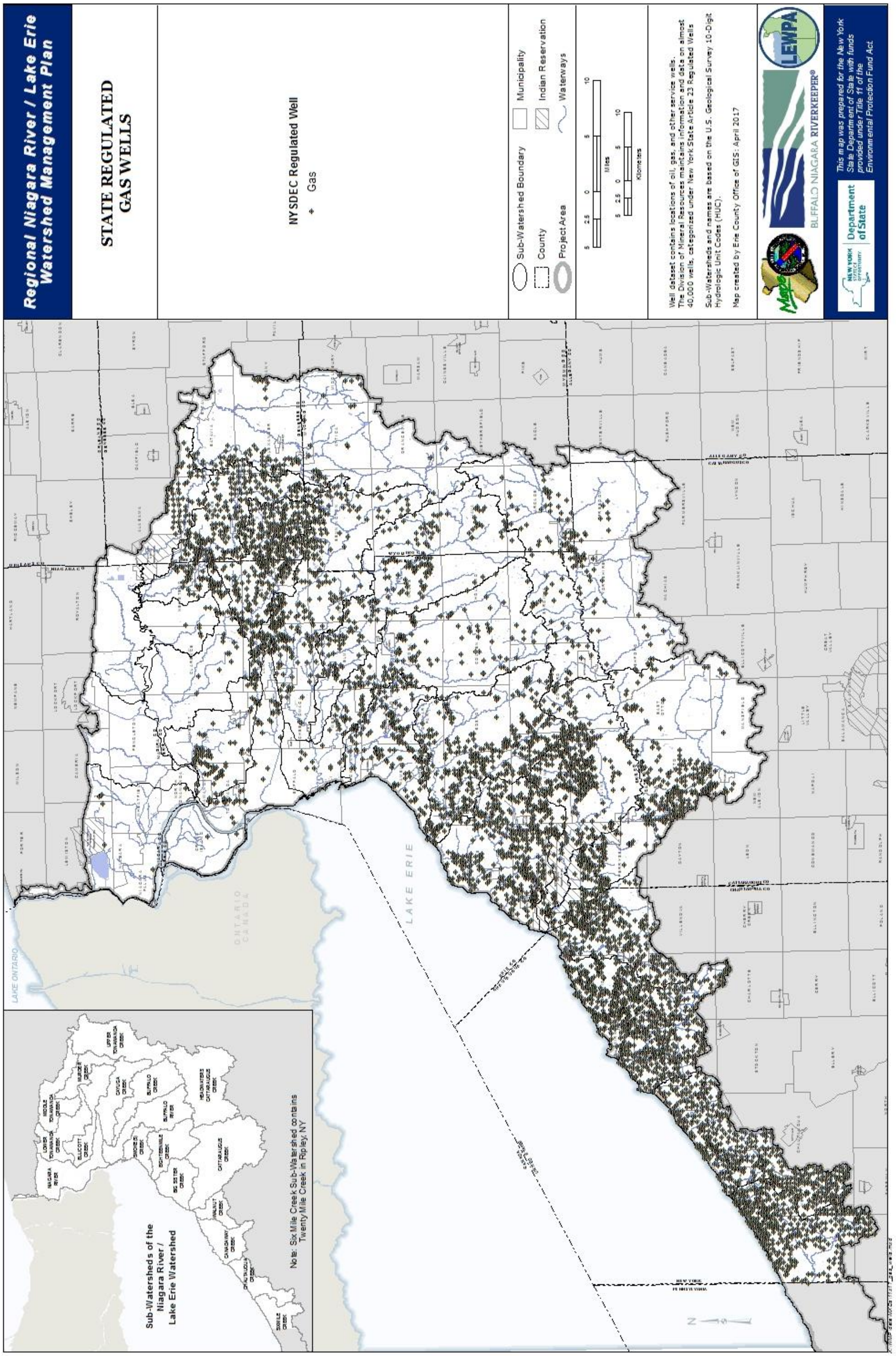


Figure 2.20: State Regulated Oil, Brine, Storage, and Other Wells

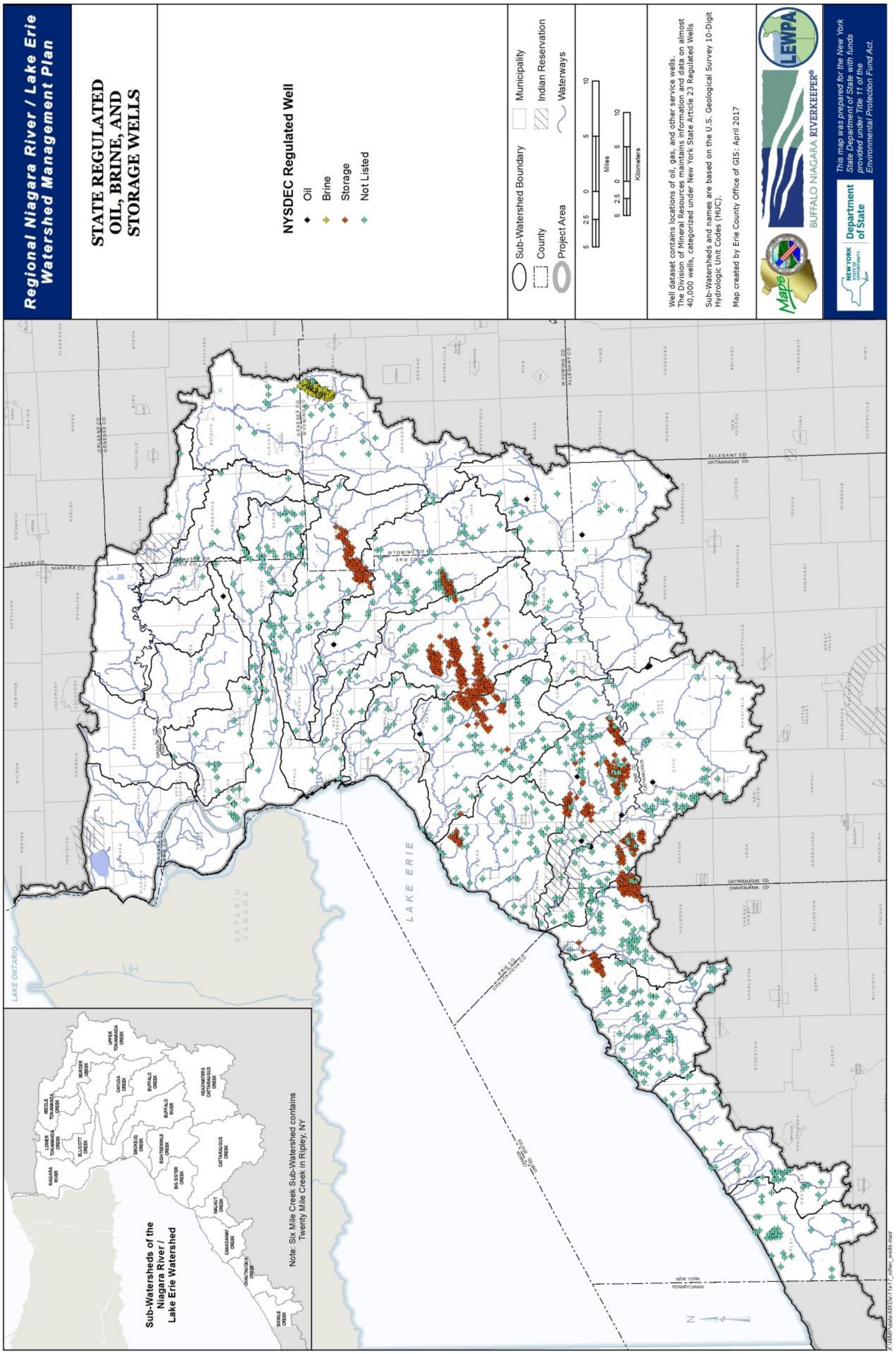
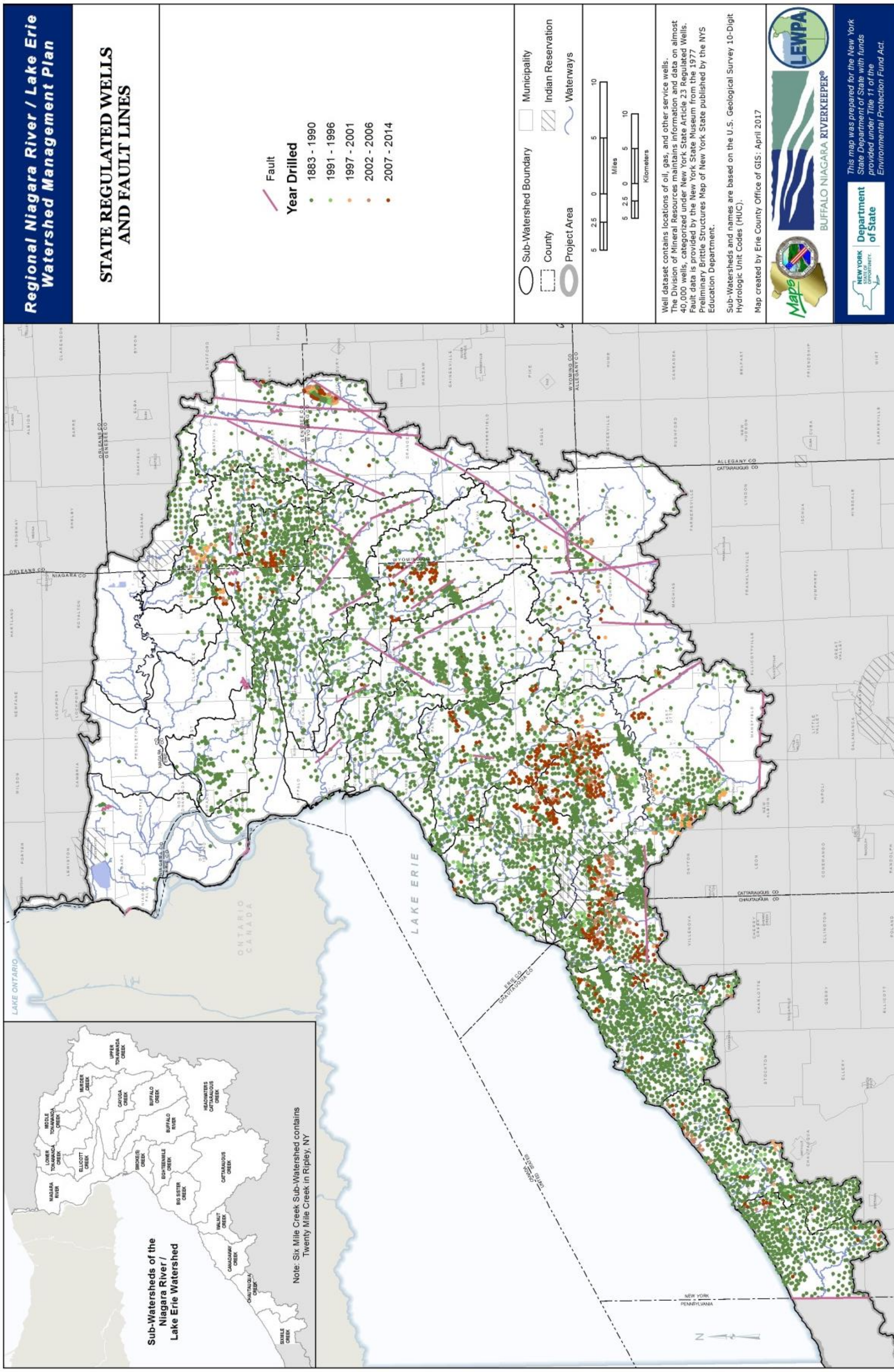


Figure 2.21: State Regulates Wells and Fault Lines



this infrastructure construction on wetlands, waterways, and aquatic habitat.[21] The Pipeline was slated to cross 192 streams and impact 73 acres of wetlands where several significant animal species are located, including the eastern hellbender and brown trout. The majority of the crossings would involve disrupting the stream flow to dig through the stream or wetland to bury the pipe.

Transportation Infrastructure

Drainage for transportation infrastructure makes up the vast majority of MS4 infrastructure. Roadways are typically impervious and act as collection systems, collecting surface waters and diverting rainwater to underground stormwater pipes and roadside ditches, where water is often diverted quickly, and without treatment, to the nearest waterway. Most bridges over waterways also collect and directly convey stormwater into the waterway they cross over, allowing for minimal opportunities to filter and treat roadway runoff prior to its release into area waterways. Figure 2.23 documents the National Bridge Inventory locations where an automobile or railroad bridge exists to cross a waterway, highlighting the extent of direct runoff release points in the watershed.

Navigational Channels, Harbors, and Shipping Infrastructure

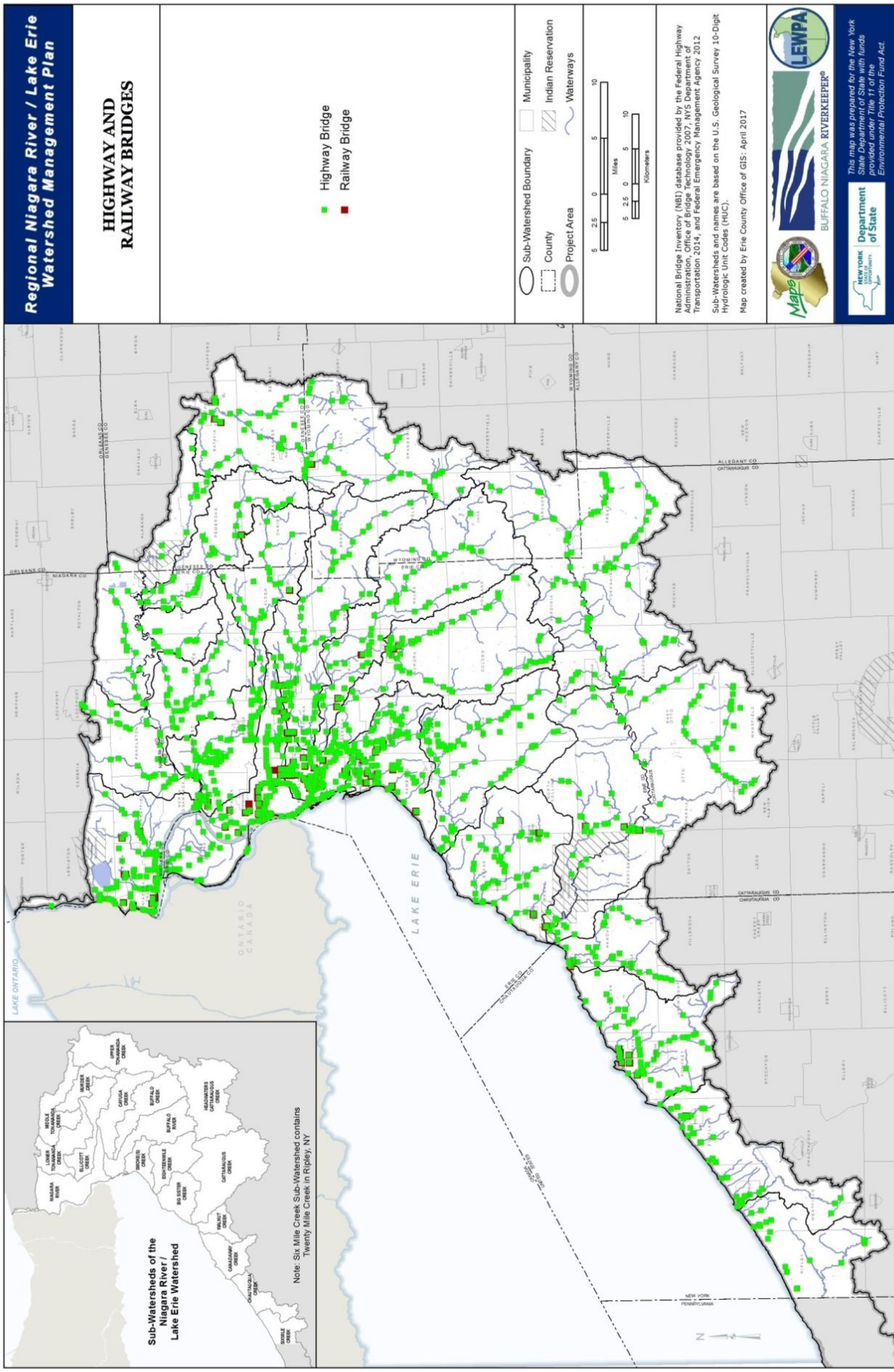
The City of Buffalo's historic growth in the late 19th and early 20th centuries was spurred by the establishment of major shipping routes via the Erie Canal and other Great Lakes connections afforded by its location at the eastern end of Lake Erie. As a major shipping economy, the city altered much of its natural shorelines to accommodate ship navigation, docking and the transfer of goods. Today, some of those alterations still exist in the landscape. A portion of Buffalo's shipping past is still active in certain sections of the waterfront as well.

Figure 2.22: Historic Image of the Foot of Main Street, City of Buffalo (circa 1910)

Presently the Buffalo River from its mouth at Lake Erie upstream 5.5 miles to the Mobile Oil and the Buckeye Terminals is an official navigation channel. Federal navigation channels are the responsibility of the U.S. Army Corps of Engineers to provide safe, reliable, efficient, and environmentally sustainable waterborne transportation systems. Large portions of the Buffalo River in this section have hardened

[21] http://www.dec.ny.gov/docs/permits_ej_operations_pdf/northaccesspipe42017.pdf

Figure 2.23: Highway and Railway Bridges



shoreline and docking areas mixed in with reinforced concrete and steel grain elevators that sit immediately adjacent to the water. The City Ship Canal is another navigational channel that runs off of the Buffalo River along the other side of Kelly Island. The City Ship Canal sees shipping traffic as far south as the Sand Products company located off of Fuhrmann Boulevard. Buffalo Harbor is a deep draft commercial harbor with over 4.5 miles of breakwater structures and confined disposal facility adjacent to the south entrance of the channel. The Black Rock Canal begins where Lake Erie meets the Niagara River and continues up the City of Buffalo's shoreline, ending at the US Army Corp of Engineers lock located at the northern end of Unity Island. The canal connects Buffalo Harbor and Tonawanda Harbor. This navigation channel hosts more recreational boaters than shipping vessels these days.

There are three additional navigation channels north of the City of Buffalo: Niagara River Channel, Tonawanda Channel, and Tonawanda Creek. The Tonawanda Channel continues from where the Black Rock Channel ends and continues north within the East Branch of the Niagara River along the shoreline of the Tonawandas before changing names to the Niagara River Channel near North Tonawanda. The Niagara River navigation channel continues north north-east around the Western side of Grand Island in the East Branch of the Niagara River. Due to dangerous currents near Niagara Falls the Niagara River navigation channel ends at the break walls off of Buckhorn Island State Park at the Northern tip of Grand Island. The navigation channel of Tonawanda Creek exists from its mouth at the Niagara River all the way upstream to where it splits off from the Erie Canal in the Town of Pendleton. This portion of the Creek is considered part of the Erie Canal and is overseen by the NYS Canal Corporation.

South of the City of Buffalo there are several harbors with federal navigational channels that require regular maintenance dredging and break wall maintenance. Sturgeon Point Marina is a harbor of refuge located on Lake Erie, 29 miles southwest of Buffalo in the Town of Evans. It is a shallow draft commercial/recreational harbor with 840 feet of breakwater structures and 580 feet of shoreline revetment. Cattaraugus Harbor is a harbor of refuge located at the mouth of Cattaraugus Creek. The recreational harbor has 2,450 feet of breakwaters and is located between the Seneca Nation and the Town of Hanover. Further southwest is Dunkirk Harbor in the City of Dunkirk. This deep draft harbor of refuge has over 1.3 miles of breakwater structure with the North breakwater structure requiring major repair. Barcelona Harbor is also a harbor of refuge in the Town of Westfield and is the last harbor in New York on Lake Erie heading southwest. It is protected by 1730 feet of breakwater structure.[22]

Aside from the main navigation channels there are several areas of the watershed where major shipping infrastructure exists. Buffalo's Outer Harbor hosts four main shipping canals, some of which can be utilized for docking major great lakes shipping freighters and barges. Farther south on Lake

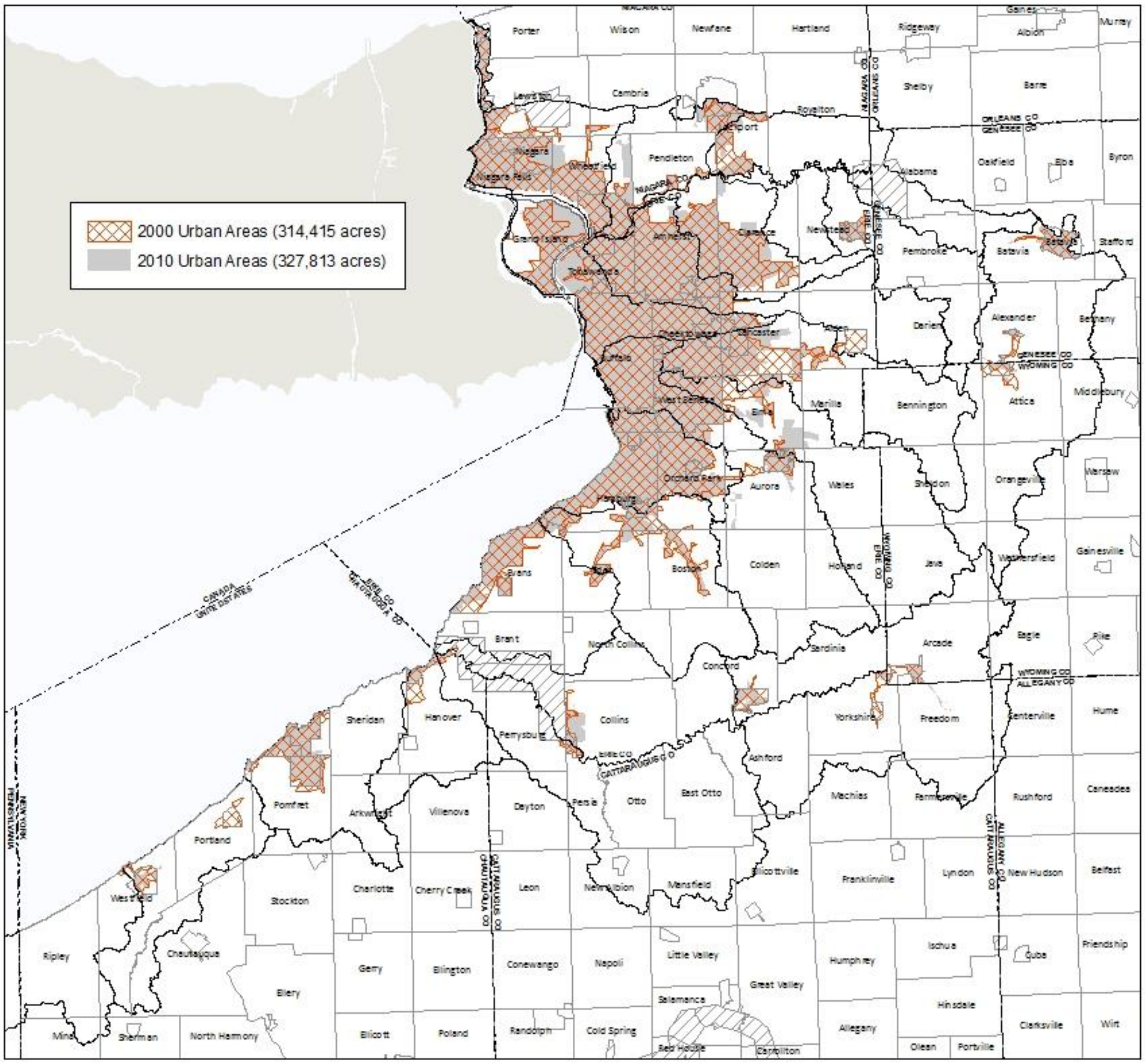
[22] http://www.lre.usace.army.mil/Portals/69/docs/Navigation/FY2015/mar19factsheets.pdf

Erie, the City of Lackawanna has remediated and is reinvesting in the Lackawanna Canal, a major freighter docking facility. Only a few other opportunities exist for large ship docking in the watershed, including docks at the former Huntley Power Plant, Riverworld, and United Refinery on the Niagara River in the Town of Tonawanda. Dunkirk Harbor can also accommodate large vessels associated with the now closed NRG Power Plant. Major railroad infrastructure in the watershed is often found co-located with these major port areas as well, specifically along the City of Lackawanna and Town of Tonawanda waterfronts, Buffalo's Inner and Outer Harbor, the City Ship Canal, along the Buffalo River and along the Lake Erie waterfront including Dunkirk.

Chapter 3: Population & Development in the Watershed

Population and land use characteristics are important indicators of current and future watershed health when assessed together. The way land is used directly affects how water moves throughout the entire watershed, influencing whether it supports water quality, quantity, and ecosystem functions or threatens them.

Figure 3.1: Urbanized Area Change within the Niagara River/Lake Erie Watershed (2000-2010)



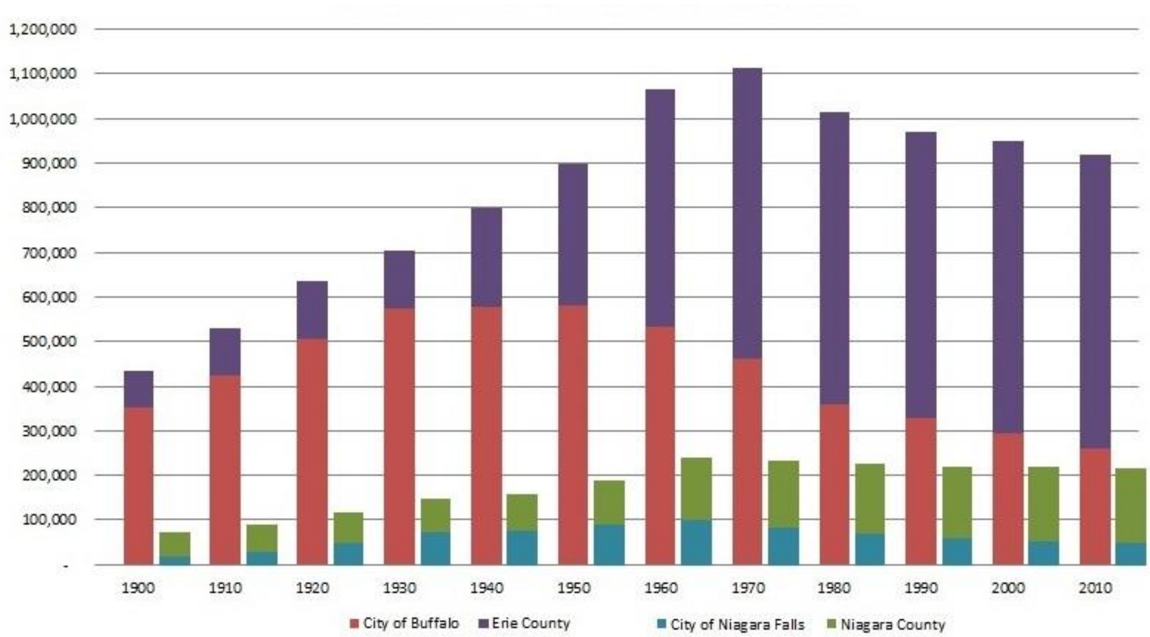
Population Characteristics of the Watershed

In 2010, the Niagara River/Lake Erie Watershed had a total population of roughly 1,193,327 people throughout its 1,523,515 acres.[1] While the watershed is spread across eight counties (Allegany, Cattaraugus, Chautauqua, Erie, Genesee, Niagara, Orleans, and Wyoming), much of the watershed's population is concentrated along the Niagara River and eastern shoreline of Lake Erie, in and around the Cities of Buffalo, Dunkirk, and Niagara Falls as shown in Figure 3.1. There are a number of smaller populated areas in the cities of Batavia and Lockport and the villages of Akron, Arcade, Attica, Brocton, Delavan, East Aurora, Gowanda, Silver Creek, Springville, and Westfield within more rural townships. The "Urban Areas" on the map are defined by the U.S. Census Bureau and include both urbanized areas of 50,000 or more people, as well as urban clusters of 2,500 to less than 50,000 people.

Historic & Current Population Trends

Chart 3.1: Population Figures as part of County Totals (1900-2010)

City of Buffalo & City of Niagara Falls, New York

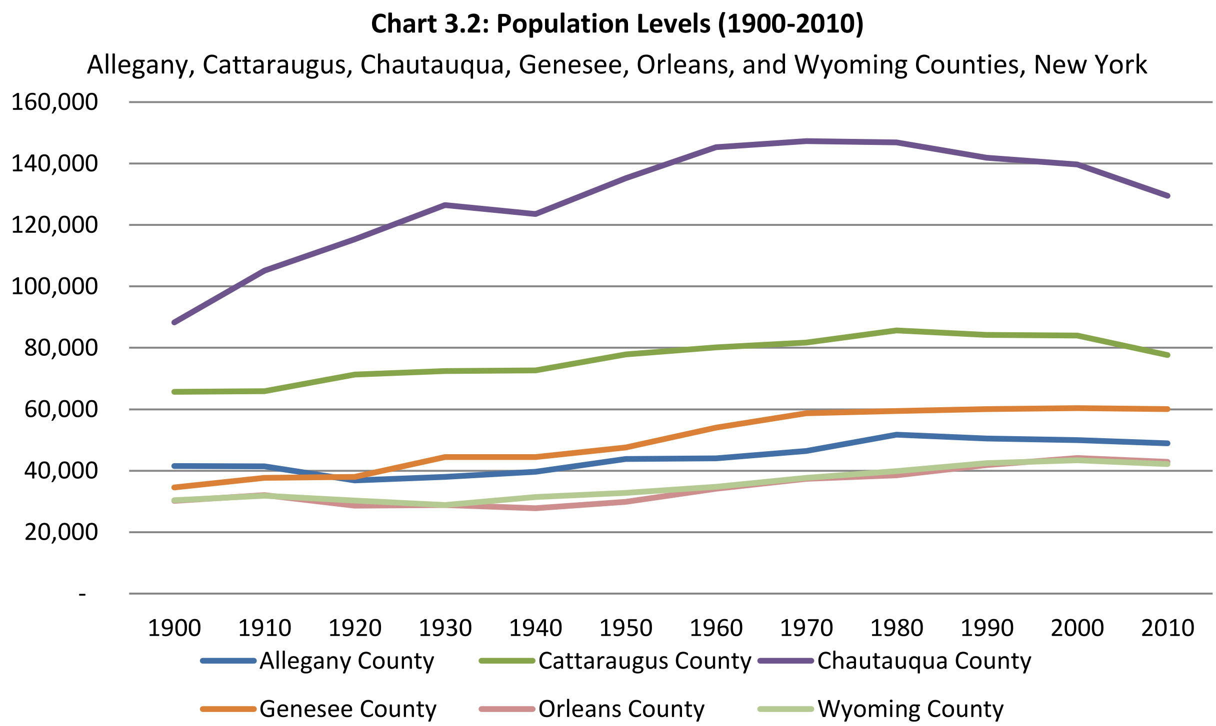


From 1900-1940, the Buffalo-Niagara metropolitan area experienced a population boom where the combined population of Erie and Niagara Counties increased by 88% from 509,000 to 958,000.[2] A majority of this growth occurred within the Cities of Buffalo, Niagara Falls, and Lackawanna, the centers of industry and employment for the region. Between 1940 and 1970 the region continued to

[1] Calculated based on the watershed boundary using ESRI and ArcGIS Software with US Census Data and is an estimate of the population using a uniform population assumption throughout census blocks: Census 2010 Summary File 1.
[2] Erie-Niagara Framework for Regional Growth.

grow, but population and development shifted to the suburbs, which was typical for the post-WWII urban environment. It was during this outward migration that the cities began their decline, and by 1980 declining population trends were observed in the Erie-Niagara region as a whole. This population loss trend is still continuing in the twenty-first century, with the cities experiencing the most loss (Chart 3.1).[3] To illustrate the severity of population loss, the City of Buffalo's population was 261,310 in 2010, which was less than half of its 1950 peak. For Niagara Falls, the city's population peaked at 102,394 in 1960, and has since lost over 52,201 people.[4]

Historically the rural counties in the Watershed tell a different population story than their urban counterparts, one that is much more stable and consistent (Chart 3.2).[5] From 1900 through 2010, Allegany, Cattaraugus, Chautauqua, Genesee, Orleans, and Wyoming Counties have generally experienced very conservative population growth. The Southern Tier (Allegany, Cattaraugus, and Chautauqua counties) has shown population losses since the 1980s and 1990s. By the 2010 Census, however, all six counties experienced population losses ranging from 0.5% to 7.5% over the previous decade.



According to Cornell University's Program on Applied Demographics, population figures for Watershed counties are expected to continue their decline. Cornell's figures, which incorporate birth, death, and migration rates into their estimates, project Erie County will lose 40,965 people between

[3] US Census Bureau: 1900-2010 Decennial Census Population Figures
[4] 2010 Census.
[5] US Census Bureau: 1900-2010 Decennial Census Population Figures & County Population Projections from Cornell University's Program for Applied Demographics [online].

2010 and 2020, another 48,390 people by 2030, and 60,289 more people by 2040. The percentage of losses is expected to grow for all of the Watershed counties ranging from .3% to 4.5% population losses between 2010 and 2020, and increasing to population losses of 4.3% to 9.7% from 2030 to 2040 in each county.[6]

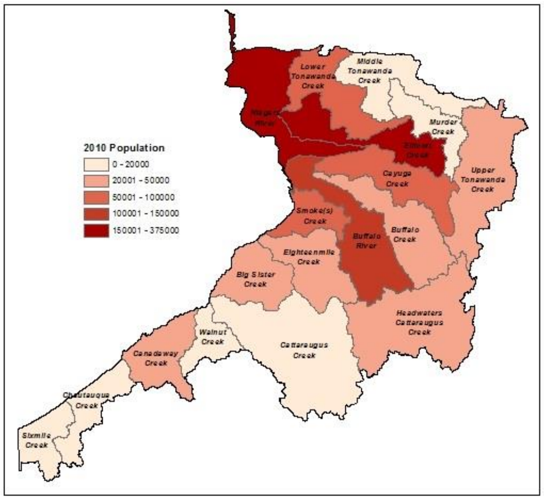


Figure 3.2: Sub-watershed Populations

Population Density

On the sub-watershed level, the Niagara River Sub-watershed hosts the highest population, while the Sixmile Creek Sub-watershed (NY portion only) hosts the least (Figure 3.2). However, population density (Table 3.1) is a much better indicator of increased watershed stressors than population alone. Higher densities typically warrant a more expansive built environment, higher percentages of impervious surfaces, and additional grey infrastructure, such as water and sewer lines (sanitary & storm), utility corridors, roads and sidewalks, all of which influence the natural movement of water and directly contribute to non-point source pollution.

Ellicott Creek Sub-watershed has rather high population density considering its more suburban/rural nature (Figure 3.2). Smoke(s) Creek Sub-watershed also has a relatively high population density, but includes the City of Lackawanna and is almost entirely urbanized, whereas several other sub-watersheds that include urbanized areas also include more rural headwater areas, such as the Buffalo River Sub-watershed.

A comparison of sub-watershed population densities between 2000 and 2010 is a good indicator of which sub-watersheds are experiencing development pressures and which sub-watersheds have populations that are thinning out, sometimes despite an already established built environment. Population thinning is most prevalent in the Buffalo River and Cattaraugus Creek sub-watersheds. In the Cattaraugus Creek Sub-watershed, population losses appear to be spread throughout the area based on census block comparisons. In the Buffalo River Sub-watershed, population losses are noticeable in the City of Buffalo, as well as somewhat in the Village of East Aurora area. Please note that the Niagara River sub-watershed 2010 square miles increased (as shown in the square with a red mark in Table 3.1) because the 2010 Census Block polygons were drawn to include areas into Lake Erie and the Niagara River and likely contributed to the decrease in population density calculation.

[6] Based on County Population Projections from Cornell University's Program for Applied Demographics. https://pad.human.cornell.edu/counties/projections.cfm

Table 3.1: 2000 & 2010 Population and Population Density Change by Sub-Watershed[7]

	POPULATION						POPULATION DENSITY (PERSONS PER SQ. MILE)	
Subwatershed	**2000**	**2010**	**Population Change**	**% Change**	2000 SQ MILES	2010 SQ MILES	**2000**	**2010**
Big Sister Creek	23,988	22,846	-1,141	-4.76%	97	97	247	234
Buffalo Creek	27,249	26,449	-800	-2.94%	146	146	187	182
Buffalo River	162,507	145,813	-16,694	-10.27%	165	165	988	886
Canadaway Creek	31,992	31,524	-468	-1.46%	101	101	318	313
Cattaraugus Creek	22,311	19,998	-2,313	-10.37%	309	309	72	65
Cayuga Creek	73,593	73,974	382	0.52%	127	127	579	582
Chautauqua Creek	10,210	9,250	-960	-9.41%	80	80	128	115
Eighteenmile Creek	25,382	26,662	1,281	5.05%	120	120	211	222
Ellicott Creek	183,907	184,310	403	0.22%	120	120	1,532	1,535
Headwaters Cattaraugus Creek	21,773	21,366	-407	-1.87%	251	251	87	85
Lower Tonawanda Creek	87,386	95,520	8,134	9.31%	123	123	710	776
Middle Tonawanda Creek	18,107	19,842	1,736	9.59%	124	124	147	161
Murder Creek	9,629	9,216	-413	-4.29%	73	73	132	126
Niagara River	397,882	373,719	-24,162	-6.07%	153	161	2,593	2,326
Sixmile Creek (NYS Portion ONLY)	3,386	3,137	-249	-7.35%	68	68	50	46
Smoke(s) Creek	92,040	91,593	-447	-0.49%	62	62	1,492	1,483
Upper Tonawanda Creek	30,770	31,686	916	2.98%	199	199	155	159
Walnut Creek	6,939	6,420	-519	-7.48%	56	56	123	114
Grand Total of all 18 Sub-Watersheds	**1,229,048**	**1,193,327**	**-35,722**	**-2.91%**	**2,373**	**2,381**	**518**	**501**

Data Source: U.S. Census Bureau Census Block data (2000 and 2010). Methodology: Population calculated and totalled for portions of census blocks within each Sub-Watershed using ArcGIS 10.4.

On the other hand, population densities have increased in the Lower and Middle Tonawanda Creek sub-watersheds. Areas in the Towns of Amherst, Clarence, Lockport, and Wheatfield have experienced population density increases as shown by census block data. These areas have also seen more development since 2000.

Development Trends

With each decade of population loss documented by the U.S. Census, the Buffalo-Niagara region has also continued to develop and expand its built environment. Figure 3.1 compares the watershed's 2000 & 2010 Urbanized Areas and Clusters as identified by the U.S. Census Bureau as part of the U.S. Census Bureau's urban-rural classification system, which identifies areas with higher concentrations of population and vast human-built environments. The difference seen between the Urbanized Area Boundaries is a good indicator of the level of sprawl the watershed is experiencing. Sprawl is a common land-use planning term used to describe the outward spread of development into areas that

[7] Sub-watershed population data is estimated using U.S. Census Block Data and assumes an even population density throughout the boundaries. These numbers are only estimates.

were previously considered rural or undeveloped. Between 2000 and 2010 the Niagara River/Lake Erie Watershed counties added another 13,398 acres of urbanized areas, while at the same time losing 35,722 people.[8]

Framed in other terms, sprawl refers to the slow decentralization of human occupancy, or population redistribution. That is, communities are requiring more land and space to supply the same given population with homes, workplaces, shopping locations and recreation spaces.[9] Sprawl occurring in conjunction with extreme population loss is not sustainable, and contributes greatly to stressors on natural resources and regional ecosystems.

The most visible consequence of sprawling trends is the large-scale loss of natural forests, fields, wetlands, and other undeveloped land. However, sprawl also:

- increases non-point source pollution through the creation of new roads and increased automotive traffic;
- aggravates the effects of drought by directing stormwater runoff to drainage channels, reducing opportunities for infiltration;
- strains productive working lands, by fragmenting and isolating agriculture and forest lands;
- increases taxes and the cost of public services by extending infrastructure across a much larger geographic area; and,
- degrades and restricts wildlife habitat, and creates barriers along wildlife corridors.

Between 2005 and 2017, the watershed counties added almost 272 miles of new roads[10] and at least 25,651 new residential structures[11]. Much of this expansive development has occurred within the first and second ring suburbs of the Cities of Buffalo and Niagara Falls (Chart 3.3),[12] specifically the Towns of Amherst, Hamburg, Clarence, Lancaster and Wheatfield.

Some communities have made attempts to limit the pace of development through local laws and regulations, keeping growth in check. For example the Town of Orchard Park restricts the number of subdivisions they approve to three over a ten-year period, while the Town of Elma's lack of public water and sewer infrastructure limits both new residential and commercial development.

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[8] U.S. Census Bureau Census Block Data 2000 & 2010.

[9] Cornell University, Department of Development Sociology.

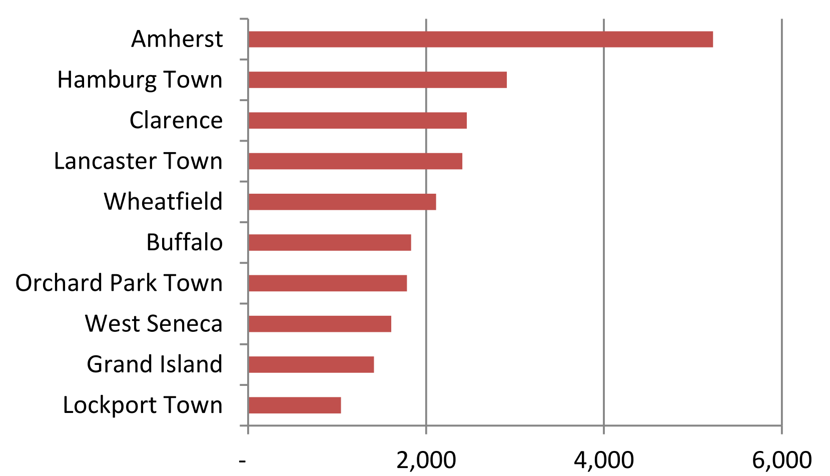
[10] Derived from the streets GIS layers from the NYS Office of Cyber Security from 2005 through 2017 when methodology was consistent.

[11] https://socds.huduser.gov/permits/ from 2001 through 2016. Not all watershed municipalities were included in this data set. Only municipalities in Erie and Niagara counties were listed. Though calls to municipalities elsewhere do not indicate numbers that surpass these.

[12] See footnote 9.

In some cases, issues with existing infrastructure, such as contaminated or dried-up water wells and failing septic systems, necessitates the need to expand water and sewer service lines to existing development. While this type of development can be beneficial to water quality, it can also encourage additional development in these areas, which may be environmentally sensitive. For example, the Town of Ripley is extending water and sewer lines on Route 5, near the Lake Erie shoreline, from Shortman Road to the Pennsylvania state line. The North Chautauqua Water District has also been created to extend water service through the Towns of Sheridan, Dunkirk, Pomfret, Portland, and the Village of Brocton. This may encourage more development in the area. It is important for municipalities to plan for the possibility of additional development and encourage green infrastructure to minimize stormwater and flooding impacts from the development, as well as consider impacts on existing septic systems where there is now increased water availability. These can have large impacts on water quality.

Chart 3.3: Municipal Top Ten New Residential Building Permits 2001-2016



Excessive growth is not occurring equally across the watershed either, but rather is concentrated in a few sub-watersheds, specifically the Lower Tonawanda Creek, Smoke(s) Creek, and Niagara River Sub-watersheds. Development pressures on the Niagara River Sub-watershed from residential development in Grand Island and Wheatfield are the most alarming, in that this sub-watershed already is highly urbanized with limited undeveloped or natural areas remaining. Continued loss of wetlands, farmland, and woodlands in the Niagara River Sub-watershed can further degrade water quality, reduce habitat, and limit the functional health of this sub-watershed. The same can be said for the Smoke(s) Creek Sub-watershed, which is the smallest in size and encompassed almost entirely by the Towns of Hamburg, Orchard Park, and the City of Lackawanna, the former of which is experiencing heavy residential and commercial growth. In Lower Tonawanda Creek Sub-watershed continued rural-residential development and its impacts go beyond general water quality and habitat conditions, to intensify flooding and drainage issues downstream.

Meanwhile, in Allegany, Cattaraugus, Chautauqua, Genesee, Orleans, and Wyoming counties, development is occurring at a much slower rate. As Table 3.2 shows, Erie and Niagara counties have a much higher number of residential building permits than the other counties. These numbers are for the entire counties and not just for the watershed area. As housing needs arise due to business development in areas such as Dunkirk, more residential units are expected to develop to meet the demand. While the Town of Dunkirk has had one residential building permit since 2010 and the City of Dunkirk has had 11 residential building permits in total for the years 2001-2016, as many as 30 new units could be developed in the next few years to attract new employees to the Athenex Biotech Plant nearby.[13]

Table 3.2: Number of New Residential Building Permits by County 2001-2016

County	TOTAL
Allegany	1,244
Cattaraugus	2,095
Chautauqua	3,249
Erie	25,455
Genesee	1,178
Niagara	6,204
Orleans	695
Wyoming	804

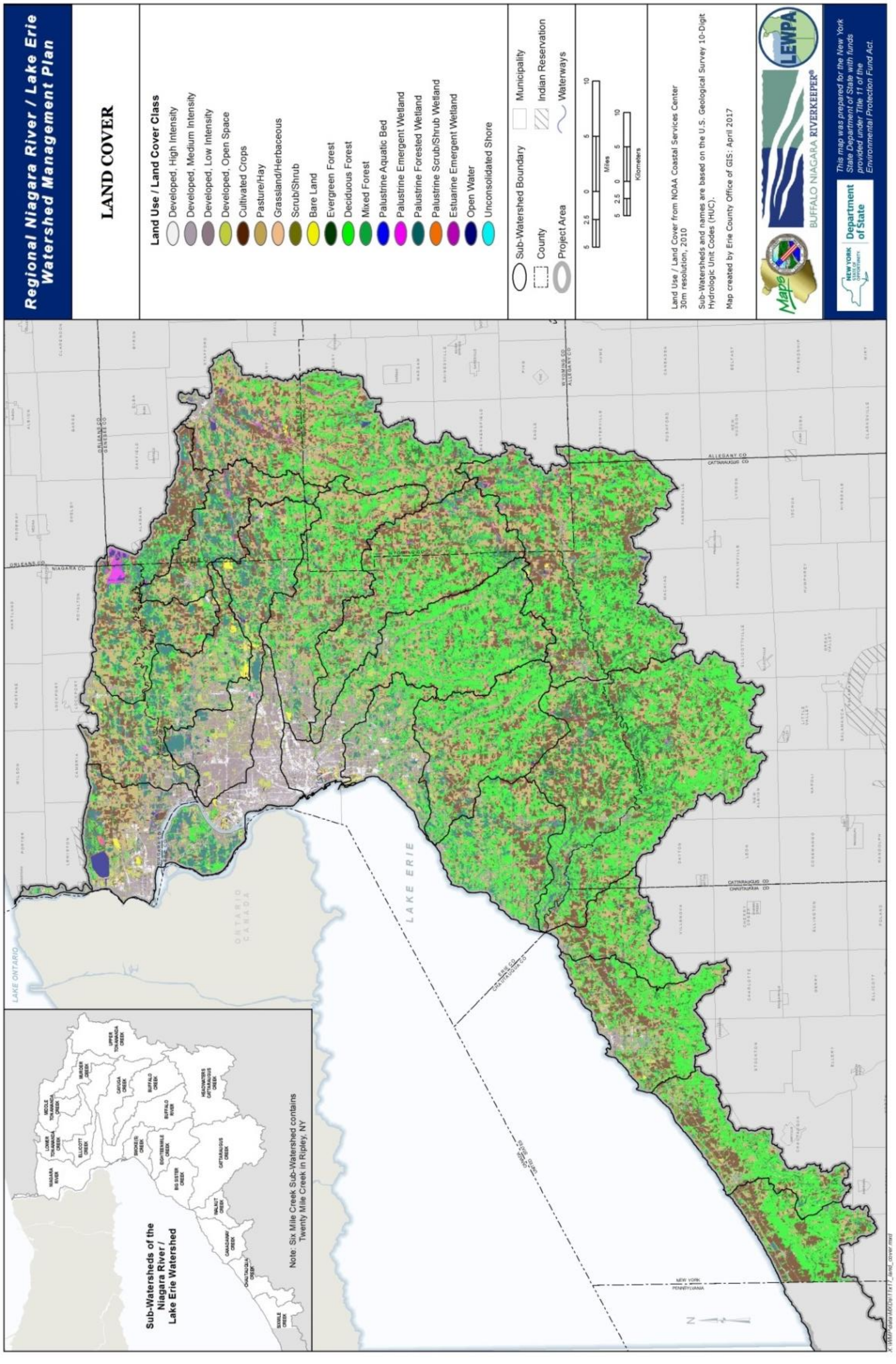
Aside from population, land cover and land uses have long been proven to directly affect watershed health; as how we use land and to what extent we build upon it directly affects the chemical, physical, and biological characteristics of our water resources.[14] Land Cover is a breakdown of both the natural features of a landscape, such as mature forest, grass land, crop land, or wetlands, as well as man-made features, such as roads, buildings, and sidewalks (Table 3.3). Table 3.3, Figure 3.3, and Figure 3.4 showcase the watershed's land cover classifications according to the National Oceanic and Atmospheric Administration (NOAA) Coastal Service Center's 2010 Land Use/Land Cover Data Set.[15] A full list of the NOAA land cover classifications and how they are defined is included in Appendix A.

[13] From conversation with Edward Hayes, Deputy Director of Planning and Development, City of Dunkirk and http://www.observertoday.com/news/page-one/2017/05/zoning-board-approves-battery-point-housing-development

[14] Snyder, M. N., Goetz, S. J. and Wright, R. K. (2005), STREAM HEALTH RANKINGS PREDICTED BY SATELLITE DERIVED LAND COVER METRICS. JAWRA Journal of the American Water Resources Association, 41: 659–677. doi: 10.1111/j.1752-1688.2005.tb03762.x

[15] Please note that the classifications are based upon pixels representing 30m x 30m areas with the dominant land cover for that 900m^2 area categorized. These pixels have then been transferred to acres, which accounts for the discrepancy in total acreage due to rounding.

Figure 3.3: Land Cover of the Niagara River/ Lake Erie Watershed



Watershed Land Cover

The top four land cover classifications have been highlighted in Table 3.3. When the land cover classifications are grouped together, forested areas (deciduous, evergreen, and mixed) make up 37.8% of the watershed while working agricultural lands (pasture/hay and cultivated crops) make up 36% of the watershed. These are the most prevalent land cover classifications within the Niagara River/Lake Erie Watershed. Wetlands only make up 8.6% of the watershed. Developed land makes up 13.5% of the watershed, with most developed lands located in and around the cities of Niagara Falls, Lockport, Batavia, North Tonawanda, Tonawanda, Buffalo, Lackawanna, and Dunkirk, as well as some developed clusters in village centers.

Table 3.3: Watershed Land Cover/Land Use Breakdown

Land Cover Classification	Acres	Percentage
Developed, High Intensity	19,067	1.24%
Developed, Medium Intensity	36,239	2.36%
Developed, Low Intensity	109,074	7.12%
Developed, Open Space	43,410	2.83%
Cultivated Crops	256,147	16.71%
Pasture/Hay	295,635	19.29%
Grassland/Herbaceous	12,097	0.79%
Deciduous Forest	473,013	30.86%
Evergreen Forest	52,880	3.45%
Mixed Forest	53,859	3.51%
Scrub/Shrub	29,240	1.91%
Palustrine Forested Wetland	107,100	6.99%
Palustrine Scrub/Shrub Wetland	7,442	0.49%
Palustrine Emergent Wetland	17,677	1.15%
Estuarine Emergent Wetland	2	0.00%
Unconsolidated Shore	425	0.03%
Bare Land	5,550	0.36%
Open Water	13,674	0.89%
Palustrine Aquatic Bed	69	0.00%
TOTALS	1,532,598	100.00%

Based on the concentration of built environment, much of the land cover classified as "developed" in the watershed is considered low-intensity, defined as, "suburban-rural in nature and consisting of 21-49% constructed materials as well as substantial amounts of vegetation." While this type of land-use can have a lower impact on water quality than heavily developed (downtown core) urban areas, low-density sprawl also expands the amount of land consumed by development than otherwise would be for the current population. Moving populations back to the core developed areas and "inner-ring" suburbs will leave more land for conservation, habitat, nutrient filtering, flood management, and more in the headwater areas.

Land Cover by Sub-watershed

A land cover assessment at the sub-watershed level (Figure 3.3) is useful in identifying the primary stressors for each individual sub-watershed and can assist in pinpointing specific management actions. For example, the Buffalo River, Ellicott Creek, Lower Tonawanda Creek, Niagara River, and Smoke(s) Creek Sub-watersheds are more highly urbanized and will face more stressors associated with urbanization, such as limited water infiltration, increased roadway run-off pollution, higher bacteria levels from combined sewer overflows, and legacy contamination from industrial land uses, than other sub-watersheds.

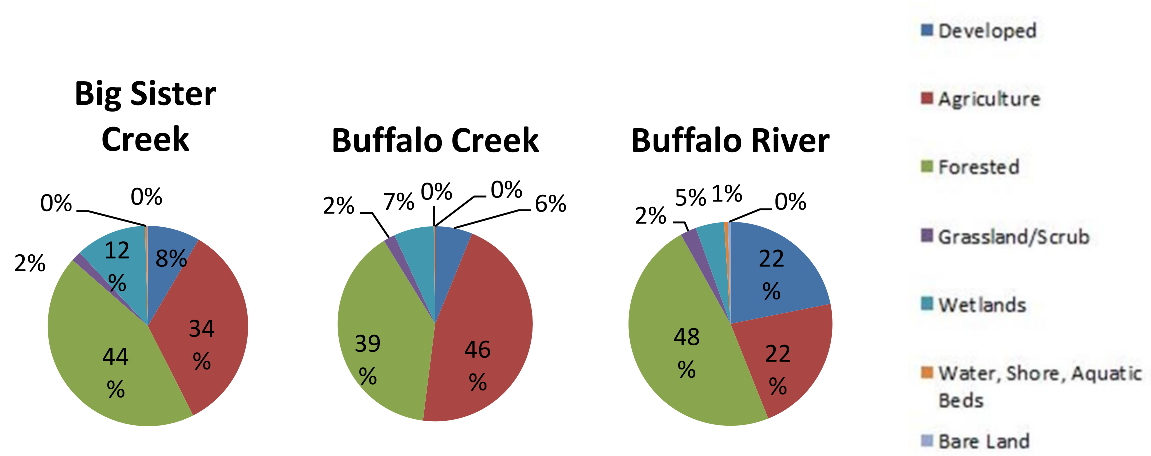
The assessment also highlights which sub-watersheds have significant concentrations of land cover features important in maintaining water quality, such as wetlands and forested areas. Ellicott Creek, Lower and Middle Tonawanda Creeks, and Murder Creek Sub-watersheds all have over 15% of the land cover within the sub-watersheds as wetlands; while existing wetlands are 5% or less of land cover in the Buffalo River, Buffalo Creek, Canadaway Creek, Cattaraugus Creek, Chautauqua Creek, Eighteenmile Creek, Headwaters Cattaraugus Creek, Sixmile Creek, and Walnut Creek Sub-watersheds. In the case of the southernmost sub-watersheds, the steep terrain may impact the existence of wetlands. This makes maintaining those limited wetlands very important for their many benefits.

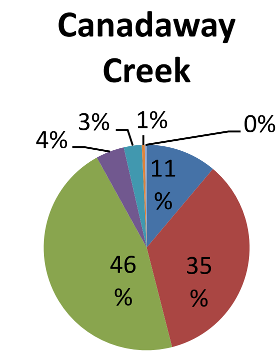
Nine of the eighteen sub-watersheds have developed land plus agricultural land as the majority of land use:

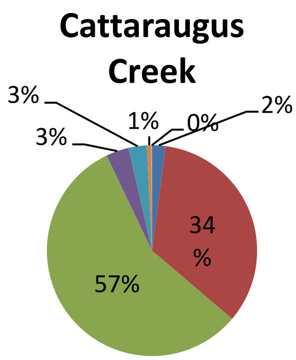
- Buffalo Creek
- Cayuga Creek
- Ellicott Creek
- Lower Tonawanda Creek
- Middle Tonawanda Creek
- Murder Creek
- Niagara River
- Smoke(s) Creek
- Upper Tonawanda Creek

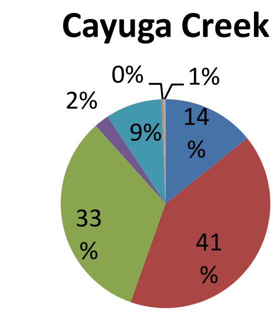
The other nine sub-watersheds have more unaltered land uses making up a majority of the overall land use percentage.

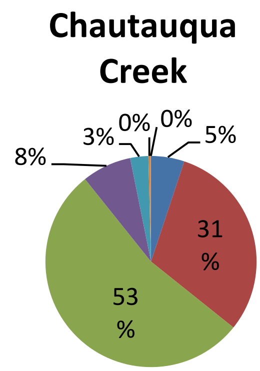
Figure 3.4: Land Cover Breakdown by Sub-watershed

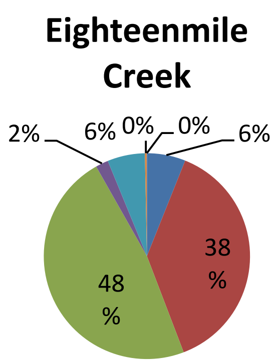


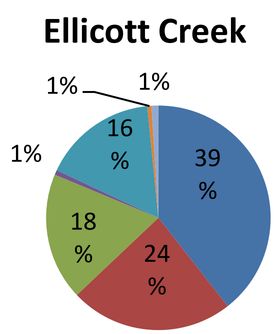

Canadaway Creek
4%
3%
1%
0%
11 %
35 %
46 %

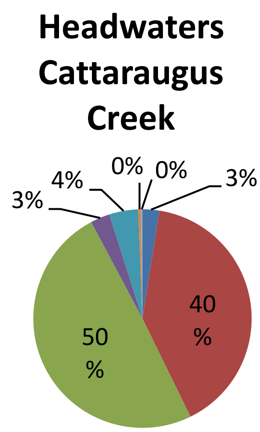

Cattaraugus Creek
3%
3%
1%
0%
2%
34 %
57%

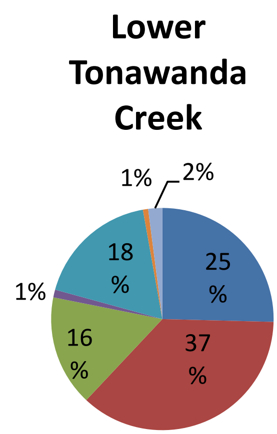

Cayuga Creek
2%
0%
1%
9%
14 %
33 %
41 %

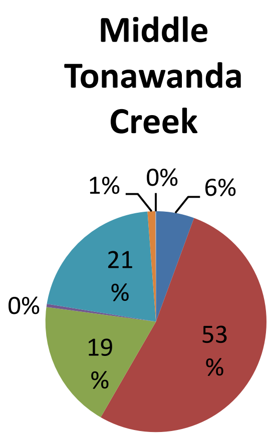

Chautauqua Creek
8%
3%
0%
0%
5%
31 %
53 %

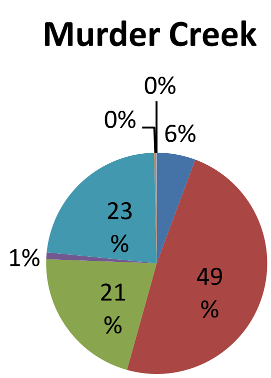

Eighteenmile Creek
2%
6%
0%
0%
6%
38 %
48 %

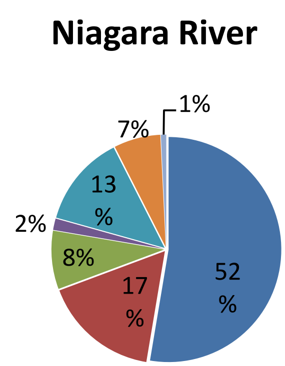

Ellicott Creek
1%
1%
1%
16 %
39 %
18 %
24 %

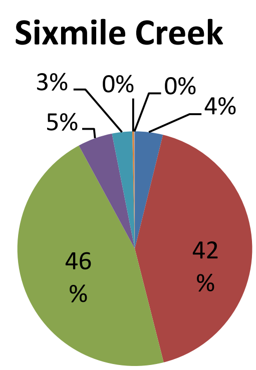

Headwaters Cattaraugus Creek
3%
4%
0%
0%
3%
40 %
50 %

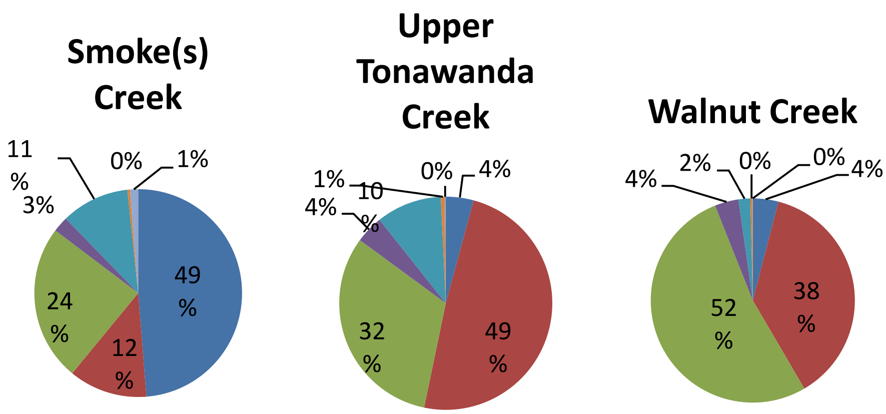

Lower Tonawanda Creek
1%
2%
1%
18 %
25 %
16 %
37 %


Middle Tonawanda Creek
1%
0%
6%
0%
21 %
19 %
53 %


Murder Creek
0%
0%
6%
1%
23 %
21 %
49 %


Niagara River
1%
7%
2%
13 %
8%
17 %
52 %


Sixmile Creek
3%
0%
0%
4%
5%
46 %
42 %



Impervious Cover

According to the U.S. Environmental Protection Agency, water quality can begin to degrade at 10% impervious cover, while higher percentages generally equal a completely altered watershed environment, changing pre-development infiltration, evaporation, and runoff rates.[16] These are discussed in Table 3.4.

To determine the impervious cover existing within the watershed, land cover and population density data were incorporated into NOAA Coastal Services Center's *Impervious Surface Analysis Tool* to establish the average percentage (i.e. coefficient) of impervious cover for each land cover classification. The coefficients were then used to calculate the actual acreage of impervious cover within each sub-watershed based on their land cover. The analysis followed a similar methodology outlined by the Center for Watershed Protection's *A User's Guide to Watershed Planning in*

Table 3.4: Sub-watershed Impervious Cover (IC) Thresholds & Corresponding Conditions

Category	IC%	Conditions
Sensitive	<10%	Streams are of high-quality and are typified by stable channels, excellent habitat structure, good to excellent water quality, and diverse communities of both fish and aquatic insects.
Impacted	10-25%	Streams show clear signs of degradation due to watershed urbanization; greater storm flows have begun to alter the stream geometry; both erosion and channel widening are evident. Stream banks become unstable, and physical habitat in the stream declines noticeably. Stream biodiversity declines to fair levels, with the most sensitive fish and aquatic insects disappearing from the stream.

[16] https://www3.epa.gov/npdes/pubs/nps_urban-facts_final.pdf

Non-Supporting	26-60%	Streams essentially become a conduit for conveying stormwater flows, and can no longer support a diverse stream community. Channel becomes highly unstable, and many stream reaches experience severe widening, down-cutting and stream bank erosion. The water and biological quality is considered poor, and dominated by pollution tolerant insects and fish.
Urban Drainage	>60%	In the highly developed sub-watersheds, streams are often piped underground, or consist of concrete channels that do not support any aquatic life and serve only to convey flows.

Source: Center for Watershed Protection. http://fosc.org/PDF/mncppc2.pdf

Maryland, and takes into account unbuildable lands and transportation infrastructure.[17] Tables 3.5 and 3.6 outline the percentages of impervious cover for the entire Niagara River/Lake Erie Watershed and each sub-watershed.

Table 3.5: Impervious Cover for the Niagara River/Lake Erie Watershed by Land Cover Classification[18]

Land Cover Classification	Total Acreage	Total Percentage	Impervious Cover Coefficient	Impervious Cover Acreage	% Watershed Impervious Cover
Developed, Low Intensity	109,074.07	7.12%	0.31	33,812.96	2.21%
Developed, Medium Intensity	36,239.27	2.36%	0.63	22,830.74	1.49%
Developed, High Intensity	19,067.04	1.24%	0.86	16,397.65	1.07%
Cultivated Crops	256,147.00	16.71%	0.03	7,684.41	0.50%
Pasture/Hay	295,634.57	19.29%	0.02	5,912.69	0.39%
Deciduous Forest	473,013.48	30.86%	0.01	4,730.13	0.31%
Developed, Open Space	43,409.95	2.83%	0.1	4,340.99	0.28%
Evergreen Forest	52,879.97	3.45%	0.06	3,172.80	0.21%
Mixed Forest	53,858.73	3.51%	0.03	1,615.76	0.11%
Palustrine Forested Wetland	107,100.32	6.99%	0.01	1,071.00	0.07%
Palustrine Emergent Wetland	17,676.84	1.15%	0.06	1,060.61	0.07%
Bare Land	5,549.64	0.36%	0.16	887.94	0.06%
Scrub/Shrub	29,239.61	1.91%	0.02	584.79	0.04%
Grassland/Herbaceous	12,096.51	0.79%	0.03	362.90	0.02%
Palustrine Scrub/Shrub Wetland	7,442.00	0.49%	0.04	297.68	0.02%
Open Water	13,673.51	0.89%	0.01	136.74	0.01%
Unconsolidated Shore	424.77	0.03%	0.28	118.94	0.01%
Palustrine Aquatic Bed	69.16	0.00%	0.09	6.22	0.00%
TOTALS	**1,532,596.45**	**100.00%**		**105,024.96**	**6.85%**

[17] For a full outline of the methodology used, see Appendix B. The same procedure was used for Phase 2 with updated information on new sub-watersheds.
[18] Estuarine Emergent wetland comprises 2 acres in the Buffalo River Sub-watershed and is not accounted for in this table.

The Niagara River/Lake Erie Watershed consists of an estimated 105,025 acres of impervious cover or approximately 6.85%. Based on the impervious cover thresholds for sub-watersheds (Table 3.6), the Niagara River, Smoke(s) Creek, Ellicott Creek, and Buffalo River Sub-watersheds fall within the "Impacted" range. All the remaining sub-watersheds are considered "Sensitive", ranging from 2.8-9.39%, with Lower Tonawanda Creek Sub-watershed nearing the 10% threshold to be considered Impacted in the future (Table 3.6).

Table 3.6: Impervious Cover by Sub-Watershed[19]

Sub-watershed	Total Acreage	Impervious Cover Acreage	% Sub-watershed Impervious Cover
Niagara River	102,830.11	24,480.59	23.81%
Smoke(s) Creek	39,521.59	7,314.05	18.51%
Ellicott Creek	76,835.25	11,761.62	15.31%
Buffalo River	105,387.21	12,301.73	11.67%
Lower Tonawanda Creek	78,795.22	7,401.33	9.39%
Cayuga Creek	81,372.55	5,465.74	6.72%
Canadaway Creek	64,541.03	3,521.45	5.46%
Big Sister Creek	62,365.12	2,569.65	4.12%
Buffalo Creek	93,161.49	3,714.19	3.99%
Middle Tonawanda Creek	79,096.34	2,941.00	3.72%
Eighteenmile Creek	76,842.37	2,750.99	3.58%
Murder Creek	46,676.48	1,669.20	3.58%
Upper Tonawanda Creek	127,246.64	4,464.10	3.51%
Chautauqua Creek	51,274.95	1,689.63	3.30%
Sixmile Creek	52,450.53	1,651.38	3.15%
Walnut Creek	36,027.77	1,107.29	3.07%
Headwaters Cattaraugus Creek	160,625.23	4,689.89	2.92%
Cattaraugus Creek	197,546.58	5,531.13	2.80%
TOTAL	**1,532,596.45**	**105,024.96**	**6.85%**

The excessive spreading of low-intensity development in the Western New York region is reflective in the findings of the Impervious Cover Analysis as well. Low-intensity development is the largest contributor to impervious cover within the overall watershed. This is also generally true on the sub-watershed level. Exceptions include the Buffalo and Niagara River Sub-watersheds, where medium and high-intensity development patterns surpass impervious cover attributed to low-intensity development. As we move south in the watershed, Headwaters Cattaraugus Creek and Sixmile Creek sub-watersheds have the largest impervious cover due to cultivated crops, while the Cattaraugus Creek sub-watershed has impervious cover from cultivated crops, evergreen forest, and mixed forest surpassing impervious cover from low-intensity development.

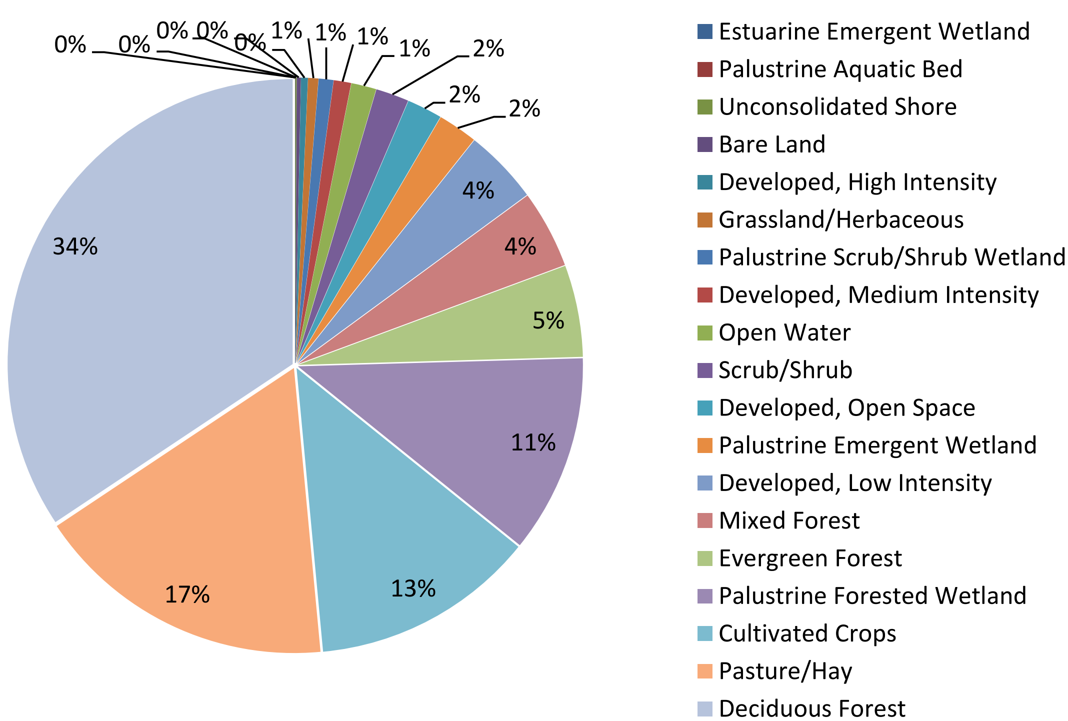
[19] Estuarine Emergent wetland comprises 2 acres in the Buffalo River sub-watershed and is not accounted for in this table.

Riparian Lands Assessment

Having connected green space is critical for maintaining wildlife habitat, but having connected green space along riparian corridors can also have the added benefit of flood control and resiliency benefits, as well as pollution reduction. Trees and shrubs absorb nutrients and other potential pollutants, trap sediment and water, and can reduce erosion along waterways.

Through geo-spatial analyses, the 2010 NOAA Land Cover/Land Use data set was also used to evaluate the current composition of riparian lands within the watershed. Chart 3.4 depicts the breakdown of land cover for all lands within 100 meters of waterways in the entire watershed, accounting for over 410,000 acres. Overall findings indicate that forested (44%), agricultural lands (30%), and wetlands (14%) constitute the greatest share of riparian land cover overall. This indicates the importance of installing riparian buffers on cropland and pastureland to reduce non-point source

Chart 3.4: Land Cover within 100 meters of Water Features



pollution to waterways from agricultural land. While developed areas (8%) can benefit from riparian buffers, the 30% of the riparian land in the Niagara River/Lake Erie Watershed that is pasture, hay, or cultivated crops is a good place to focus efforts. Organizations such as the National Resource Conservation Service and county Soil and Water Conservation Districts have programs to assist agricultural land owners with installing buffers. Other programs, such as the NYSDEC Trees for Tribs

Table 3.7 Riparian Woodland Tracts in the Niagara River Watershed (50+ Acres)

Subwatershed	# of Tracts	Total Acreage
Buffalo Creek	44	24,371.7
Buffalo River	31	38,622.4
Cayuga Creek	42	20,757.5
Eighteenmile Creek	28	20,531.2
Ellicott Creek	26	14,362.8
Lower Tonawanda Creek	24	8,274.4
Middle Tonawanda Creek	31	14,490.2
Murder Creek	25	11,631.0
Niagara River	15	9,249.1
Smokes Creek	22	3,912.0
Upper Tonawanda Creek	66	29,762.5
Total	**354**	**195,964.8**

Source: Niagara River Regional Habitat Conservation Strategy

or "Buffer in a Bag" programs and the Lake Erie Watershed Protection Alliance riparian buffer program can assist additional types of land owners as well.

Upon further evaluation, the *Niagara River Regional Habitat Conservation Strategy* (2014) pinpointed large tracts (over 50 contiguous acres) of forested cover within 100 meters of water courses within the Niagara River Watershed only. The Habitat Conservation Strategy utilized this data to identify contiguous forested parcels for future conservation efforts and found that over 354 large contiguous tracts exist in the Niagara River Watershed unprotected, accounting for over 195,960 acres.

From the assessment findings and land cover transition trends, it seems large riparian forest tracts are most rare and vulnerable within the Niagara River, Smoke(s) Creek, and Lower Tonawanda Creek Sub-watersheds. While the greatest number of opportunities for protection of forested riparian buffers exist in the headwaters of the Tonawanda Creek (Upper Tonawanda Creek Sub-watershed). This assessment was not expanded for the new territory added to complete the Niagara River/Lake Erie Watershed due to a lack of resources.

Watershed Land Uses/ Property Classes

Land Use data differs from Land Cover data in that it assigns a single, primary use to each property such as residential, agriculture, industrial, or commercial activities. Each land use type (and the concentration of those land use types) can have varying effects on neighboring water resources. For example, in predominantly agricultural areas there's a greater potential for non-point source pollution with high concentrations of nutrients from fertilizers, pathogens from untreated animal wastes, and chemicals from pesticides. While in high-density commercial and residential areas, non-point source pollution generally has higher concentrations of road-way contaminants, nutrients from lawn fertilizers, debris, and garbage.

Land use classifications are established by the New York State Office of Real Property Services' Property Type Classification Codes, which assign a primary use to parcels during municipal tax assessments. According to NYS's Office of Real Property Service, the Niagara River/Lake Erie Watershed has land uses that fall within nine main categories (Table 3.8).

Table 3.8 Land Use Classifications[20]

Agriculture	Property used for the production of crops or livestock. Includes dairy farms, orchards, poultry farms, field crops, nurseries, fish & game preserves, etc.
Residential	Property used for human habitation. Includes single-family, two-family, and multi-family residences, mobile home parks, and seasonal residences, etc.
Vacant Land	Property that is not in use, is in temporary use, or lacks permanent improvement. Includes vacant industrial, residential, commercial, rural or public utility lands, etc.
Commercial	Property used for the sale of goods and/or services. Includes hotels, restaurants, bars, auto service centers, storage facilities, gas stations, retail shopping, banks, junkyards, etc.
Recreation & Entertainment	Property used for groups for recreation, amusement, or entertainment. Includes fairgrounds, amusement parks, social clubs, camp grounds, stadiums, gyms, golf courses, ski resorts, beaches, marinas, etc.
Community Services	Property used for the well-being of the community. Includes libraries, schools, colleges, hospitals, civic buildings, museums, cemeteries, etc.
Industrial	Property used for the production and fabrication of durable and non-durable man-made goods. Includes manufacturing, mining, wells, etc.
Public Services	Property used to provide services to the general public. Includes, water treatment, telecommunications, roads, railroads, airports, bridges, landfills, waste-water treatment, utilities, transmission, etc.
Wild, Forested, Conservation Lands & Public Parks	Reforested lands, preserves, and private hunting and fishing clubs. Includes forest land, state owned land, wetlands, conservation easements, and special taxing districts for environmental purposes.

Table 3.9 on the following page illustrates the land uses for the entire Niagara River/ Lake Erie Watershed, according to these land use classifications. New York State parcel centroid point data from November 2017 was used to determine the property class of each parcel and the parcel acreage was used to calculate the overall acreage of each property land use classification in the watershed. Note: the center of the parcel determined in which sub-watershed the parcel was placed. Parcels were not split along watershed or sub-watershed boundaries.

[20] *NYS Office of Real Property Services' Assessor's Manual: Data Collection and Maintenance of Property Inventories –RFV. Property Type Classification and Ownership Codes (September 2006).*

Upon comparing land use or property class to land cover characterization for the watershed, it's apparent a much larger percentage of land is currently in residential use than is considered developed (Table 3.9). While only 164,380 acres of land are classified as developed under land cover classifications, 541,220 acres, or over a third of the Niagara River/Lake Erie Watershed, are classified as residential in land use classifications. While it is true that some of the residential parcels in more rural areas may be characterized as forested, open space, or another land cover classification, the long-term viability of forested or agricultural land is hindered when encroaching residential development isolates these parcels making the land more likely to be converted to other uses, such as adding residential units, in the future. Community programs and policies should focus on mitigating sprawling development patterns and low-intensity residential development by addressing how land is converted to residential uses (i.e. conservation, subdivision, site design regulations) and protecting natural lands.

Table 3.9: Acreage of Land Use Classifications

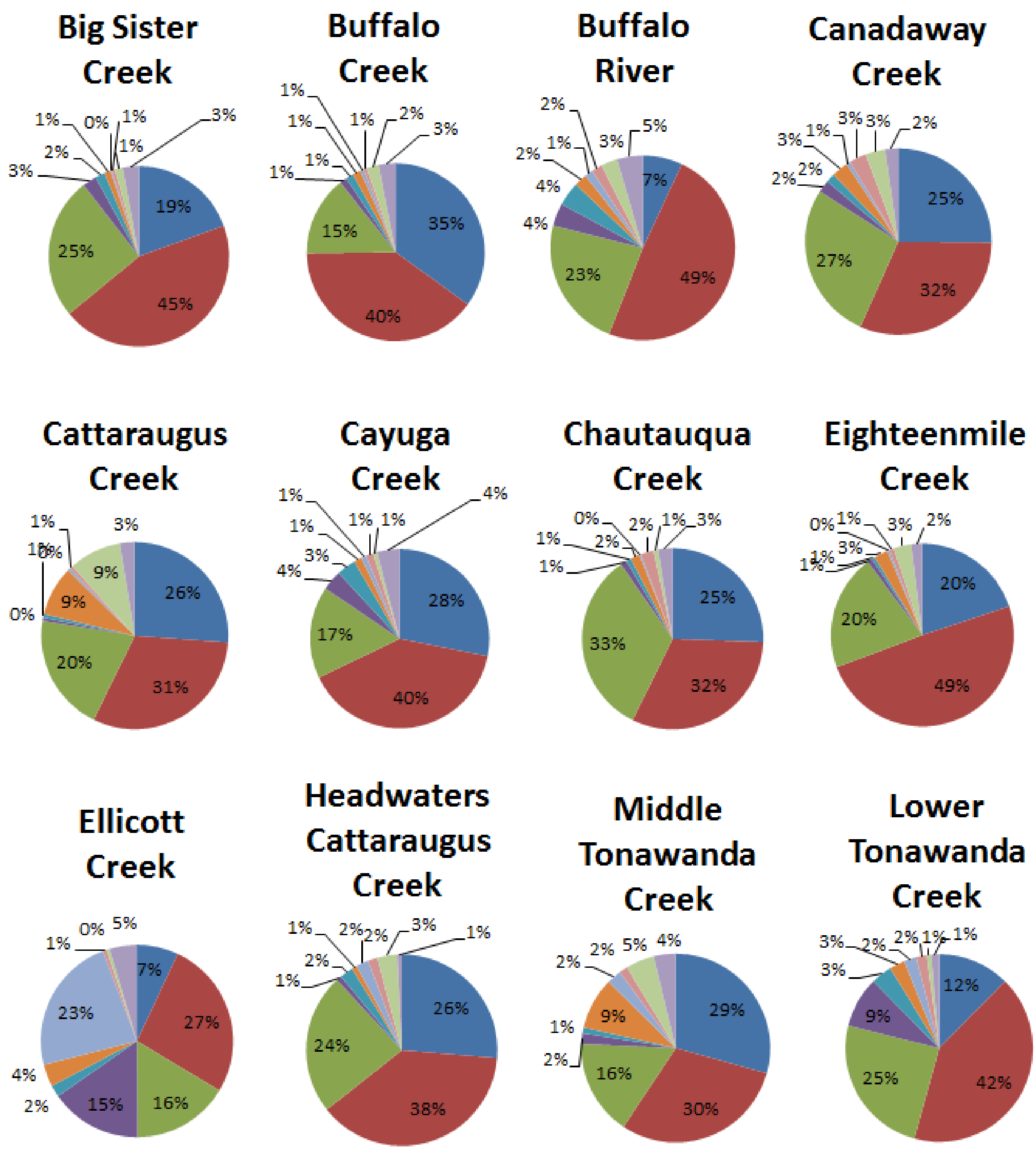
Land Use Classification	Acreage Totals	Percentage of Watershed
Agriculture	340,741	23%
Residential	541,220	36%
Vacant Land	311,120	21%
Commercial	53,109	4%
Recreation & Entertainment	27,300	2%
Community Services	57,504	4%
Industrial	53,542	4%
Public Services	25,891	2%
Wild, Forested, Conservation Lands & Public Parks	48,230	3%
Undefined	49,419	3%
Total	**1,508,077**	**100%**

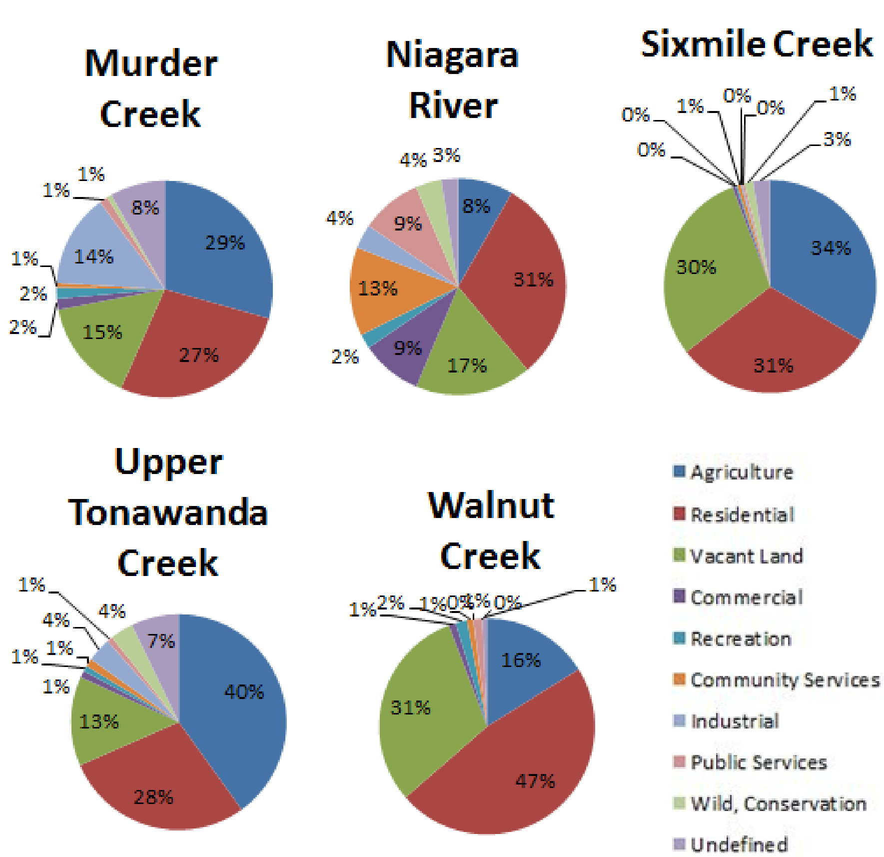
While vacant lands do constitute a large percentage of the watershed's overall property classification, this is misleading since nearly 80% of these lands are considered vacant-residential properties, meaning they are either located within primarily residential areas or have minor residential improvements upon them (garages). Vacant land and former industrial and commercial properties do offer opportunities to improve watershed protections by re-establishing wetlands, floodplains and riparian buffers, or implementing green infrastructure during future redevelopment or conservation efforts.

Land Use by Sub-watershed

The pie charts in Figure 3.5 portray the land use breakdown within each sub-watershed, based on the percentage of land uses defined by 2017 New York State parcel centroid point data. Two of the most

Figure 3.5: Land Use Breakdown by Sub-watershed





striking things found in this data are the extreme lack of land currently classified as "Wild, Conservation, or Public Parks" as a whole across the watershed, and the large percentage of land classified as "Vacant" in each sub-watershed. In every sub-watershed "Wild, Conservation or Public Parks" make up 5% or less of the total land use acreage, which is grossly inadequate for long-term protection of water resources and important aquatic habitats. Buffalo Niagara Riverkeeper's *Niagara River Regional Habitat Conservation Strategy* (2014) identified 30 sites prioritized for future protection/conservation based on what would be most beneficial for sub-watershed and habitat health.

Vacant land uses are substantial in the overall watershed and range between 13-33% within each sub-watershed. These properties may be considered vacant residential or vacant commercial and offer an opportunity for redevelopment. Vacant land reuse should aim to remedy poor site design elements to preserve and improve natural features that support watershed health however.

It is also important to note that parcel data may list properties as residential, but they may have agriculture or other uses on the premises as well. Only one land use is listed per parcel.

Other Adverse Land Uses, Sites or Facilities

The Niagara River/Lake Erie Watershed Atlas and Bibliography associated with this plan also includes a number of mapped Geographic Information System data sets that assist in identifying potential threats from other adverse land uses not necessarily reflected in parcel data.[21] This information includes:

- State Inventory of Dams
- Highway and Railway Bridges
- State Permits for Large and Medium Concentrated Animal Feeding Operations (CAFOs)
- State Regulated Oil, Brine & Storage Wells
- State Regulated Gas Wells
- State Pollution Discharge Elimination System (SPDES) permitted facilities
- State Regulated Remediation Sites (i.e. Brownfields)
- Resource Conservation and Recovery Act (RCRA) Transporters & RCRA Hazardous Waste permitted facilities
- Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Superfund Sites
- EPA Regulated Treatment, Storage & Disposal Facilities
- EPA National Priorities List Sites (NPL)
- EPA Toxic Release Inventory (TRI) Sites
- National Pollution Discharge Elimination System (NPDES) permitted facilities
- Combined Sewer Overflows (CSOs)
- EPA Regulated Large & Small Quantity Generators

Because many of the issues and potential threats associated with these land uses, sites and facilities are outlined in other chapters of this plan, Table 3.10 offers a brief summary of the sub-watersheds with the highest concentrations[22] of these facilities. Sub-watersheds not listed did not show high concentrations of these facilities. Many of these land uses and facilities are located in the most urbanized sub-watersheds, Niagara River, Buffalo River, and Ellicott Creek, where industry and infrastructure are most concentrated. The Cattaraugus Creek sub-watershed also shows high concentrations of these facilities, though due to the number of state regulated wells and dams.

[21] http://www2.erie.gov/environment/sites/www2.erie.gov.environment/files/uploads/pdfs/ECS_June%202017%20Final%20Draft%20Atlas%20and%20Bibliography%20compressed.pdf

[22] Sub-watersheds with the number of each type of facility over the 75th percentile for that type in the watershed were considered highest concentrations.

Table 3.10 High Concentrations of Land-uses, Sites, and Facilities with Potential Impacts to Water Quality by Sub-watershed

Sub-watershed	Facilities of High Concentration
Niagara River	State & National Pollution Discharge Elimination System (S/NPDES) permitted facilities, State Regulated Remediation Sites, Bridges, National Priority List (NPL) Sites, Permit Compliance System Sites, Superfund Sites, Combined Sewer Overflows (CSOs), U.S. EPA Small & Large Quantity Generators, Toxic Release Inventory Sites, Resource Conservation and Recovery Act (RCRA) Transporters & Hazardous Waste Facilities, and Treatment, Storage, and/or Disposal Facilities.
Buffalo River	State Regulated Storage & Unlisted Wells, State Regulated Remediation Sites, Dams, Bridges, Superfund Sites, RCRA Hazardous Waste Facilities, Toxic Release Inventory Sites, U.S. EPA Small & Large Quantity Generators, S/NPDES permitted facilities, and Permit Compliance System Sites.
Ellicott Creek	State Regulated Gas Wells, Bridges, U.S. EPA Large & Small Quantity Generators, RCRA Hazardous Waste Facilities, S/NPDES permitted facilities, State Regulated Remediation Sites, and Permit Compliance System Sites.
Cattaraugus Creek	State Regulated Gas, Oil, Storage, & Unlisted Wells, National Priority List Sites, and Dams.
Smokes Creek	U.S. EPA Large & Small Quantity Generators, CSOs, State Regulated Remediation Sites, RCRA Hazardous Waste Facilities, Permit Compliance System Sites, and Toxic Release Inventory Sites.
Upper Tonawanda Creek	Dams, Concentrated Animal Feeding Operations (CAFOs), and State Regulated Brine Wells.
Buffalo Creek	CAFOs and State Regulated Unlisted Wells.
Canadaway Creek	State Regulated Gas & Unlisted Wells.
Headwaters Cattaraugus Creek	CAFOs and Dams.
Cayuga Creek	CSOs.
Chautauqua Creek	State Regulated Gas Wells.
Eighteenmile Creek	State Regulated Unlisted Wells.
Lower Tonawanda Creek	Bridges.

Lands Protected from Development

Land conservation has been identified in a number of studies as a primary tool in preserving water quality, reducing public-water supply treatment costs, and managing stormwater. Protecting certain areas can have an even larger impact on water quality. For instance, protecting wetlands provides for increased water filtration to occur. Wetlands act as the natural filters of the watershed and can have tremendous beneficial impact on downstream water quality. Protecting native vegetated areas with deep root systems can also absorb large amounts water and avoid stormwater runoff to waterways. This not only allows for the water to be filtered before reaching water sources, but also reduces the erosion of stream banks, which in turn reduces the amount of sediment and nutrient pollution to waterways.

Additional land protection benefits include conserved fish and wildlife habitat for increased biodiversity, improved recreational opportunities, reduced air pollution, carbon storage to offset climate change, and increased flood resiliency through protected floodplains.

Table 3.11: Total Acres Protected from Development by Sub-watershed

Sub-Watershed	Total Protected Acres	Percent of Sub-watershed Acres Protected
Big Sister Creek	10,544.20	16.91%
Buffalo Creek	7,301.80	7.84%
Buffalo River	8,294.70	7.87%
Canadaway Creek	3,963.60	6.14%
Cattaraugus Creek	31,829.50	16.11%
Cayuga Creek	4,995.70	6.14%
Chautauqua Creek	2,215.90	4.32%
Eighteenmile Creek	3,625.00	4.72%
Ellicott Creek	10,211.20	13.29%
Headwaters Cattaraugus Creek	11,605.90	7.23%
Lower Tonawanda Creek	14,712.00	18.67%
Middle Tonawanda Creek	23,299.80	29.46%
Murder Creek	11,324.10	24.27%
Niagara River	12,780.60	12.43%
Sixmile Creek	1,534.40	3.52%
Smoke(s) Creek	4,344.10	10.99%
Upper Tonawanda Creek	19,980.30	15.70%
Walnut Creek	1,158.70	3.22%
Total	**183,721.50**	

Source: http://www.nypad.org, as well as state and federal wetlands.

At this time approximately 12% of the 1,523,515 acres in the Niagara River/ Lake Erie Watershed is considered protected through a variety of mechanisms, including conservation easements, fee title acquisition, regulatory protections on environmental features (i.e. wetlands), reservations, and land under governmental jurisdiction (parks, forests, trails, canals) according to the 2014 NYS Natural Heritage Program.

Figure 3.6 illustrates how scattered and limited the watershed's protected lands are as of 2010, especially within the southern portion of the watershed. Presently, Middle Tonawanda Creek Sub-watershed hosts the largest percentage of protected lands at approximately 29.5% of its total acreage, while Walnut Creek Sub-watershed hosts the least at 3.2% of its total acreage. There are a few large tracts of protected land throughout the watershed such as the Iroquois National Wildlife Refuge and the Carlton Hill State Forest. While the Cattaraugus, Tonawanda, and Tuscarora reservations are listed, they are considered to have no known public/private institutional mandates or legally recognized easements.

It is interesting to note that many of the sub-watersheds with the least percentage of protected land also have the least percentage of impervious cover as shown by comparing Table 3.6 to Table 3.11. These areas also tend to have lower population density and fewer urban stressors. It is important to note is that should sprawl pressures increase in these areas, large parcels may be subdivided for residential or commercial use as there are few formal protections in place.

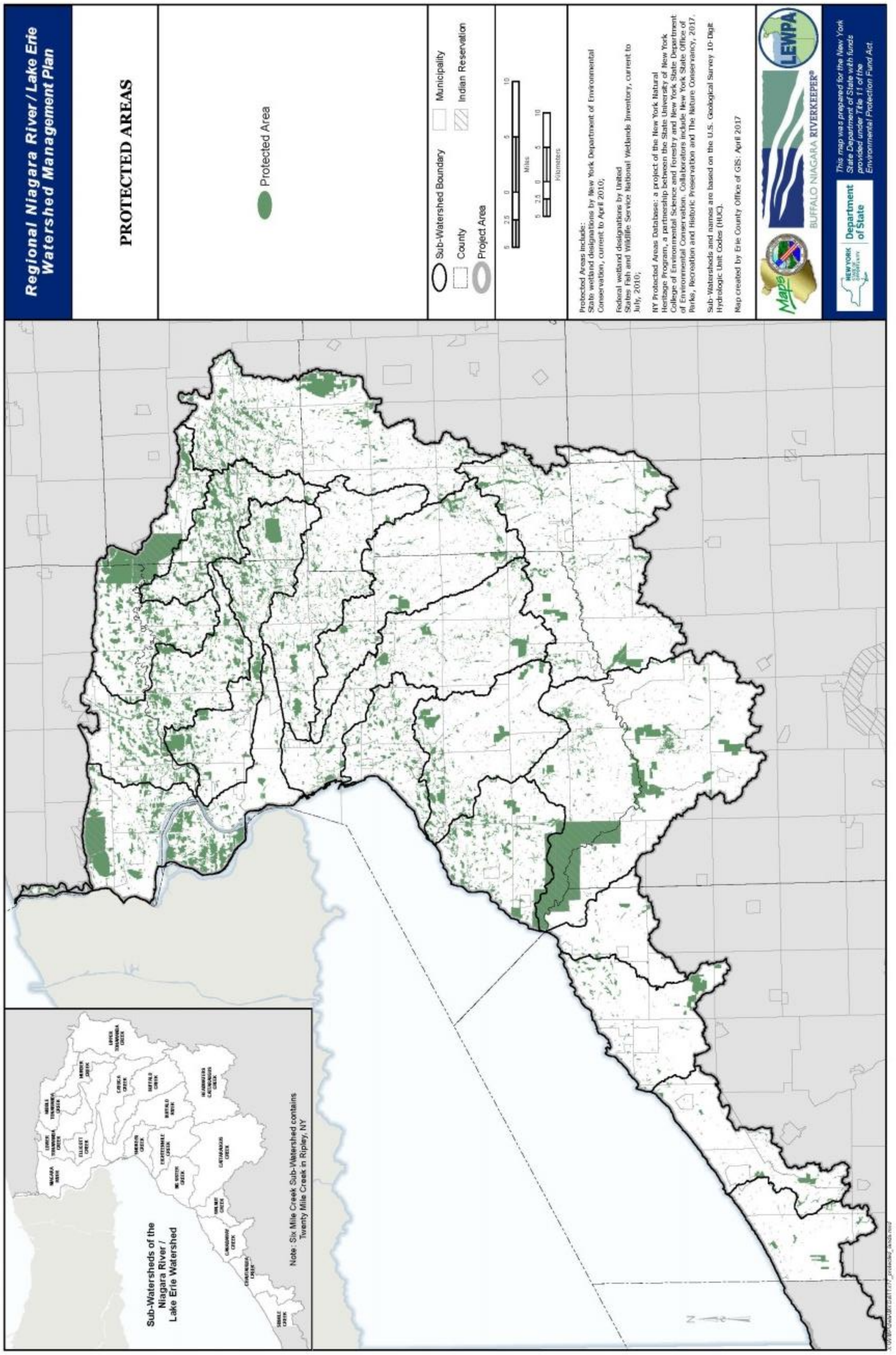
In order to offer the most benefits for watershed function, the Center for Watershed Protection recommends land conservation focus on protecting:

- critical habitat for plants and wildlife;
- aquatic corridors where land and water meet;
- hydrological reserves (undeveloped areas, such as forests and agricultural lands, that sustain the hydrological responsiveness of the watershed); and,
- features of land that could contribute pollutants to natural waters (if developed).

By preserving the features listed above and employing effective land use and floodplain regulations throughout the watershed, an integrated network of Living Infrastructure[23] can be established.

[23] Living Infrastructure refers to an interconnected network of green space and natural systems (waterways, wetlands, forests, meadows, and other natural areas) that support native species, maintain natural ecological processes, sustain air and water resources, and contribute to the health and quality-of-life for communities.

Figure 3.6: Protected Land of the Niagara River/ Lake Erie Watershed



Chapter 4: Water Quality

Clean water is an essential human need and one whose value will increase as global climates change. The Niagara River and Lake Erie's tremendous water supply supports everything from daily living needs (drinking, bathing, cooking) to recreation (swimming, fishing, boating) and local economies (industry, tourism, shipping). Presently, the Great Lakes and their connecting tributaries provide drinking water to 40 million people in the United States and Canada[1], and support more than 1.5 million U.S. jobs that generate $62 billion in wages, including over 157,000 jobs in New York State.[2]

According to the World Health Organization, more than 2 billion people in the world do not have access to safe drinking water at home, yet we are privileged to have about 20 percent of the world's surface fresh water located at our doorstep in the Great Lakes.

While certain areas of the watershed have improved considerably since the enactment of the Clean Water Act in 1972 (i.e. Buffalo River), there are a number of areas within the watershed with poor and impacted water quality stemming from various types of pollution, existing storm-water management practices, adverse land uses and development trends, and other stressors that threaten our freshwater resources.

Water Classification & Quality Assessment

There are several mechanisms by which water quality is evaluated in New York State. One of the primary methods includes classifying water resources based upon their best uses and determining whether or not the water quality is in line with those uses.[3] For example, a water body used for drinking water has lower thresholds for contaminants or pollutants than a water body used solely for recreation. All waters in New York State are classified into various categories based on their best "beneficial uses" and the state establishes standards by which the resources should be maintained and protected (i.e. Anti-degradation policies). Table 4.1 outlines the various Water Quality Classifications for surface and ground waters in New York State.

[1] First Triennial Assessment of Progress on Great Lakes Water Quality, November 28, 2017.
[2] Vital to Our Nation' Economy: Great Lakes Jobs 2011 Report, http://www.miseagrant.umich.edu/wp-content/blogs.dir/1/files/2018/02/11-203-Great-Lakes-Jobs-report.pdf.
[3] NYS Water Quality Standards Program (overseen by the US EPA.)

Use classifications are applied according to water bodies or water course segments. For the Niagara River/ Lake Erie Watershed there are a total of 5,064 segments provided, with 936 designated as Class A, 1,165 designated as Class B, 2,948 designated as Class C, and 15 designated as Class D. Figure 4.1 identifies each segment's classification as well as segments designated as trout and trout spawning waters.

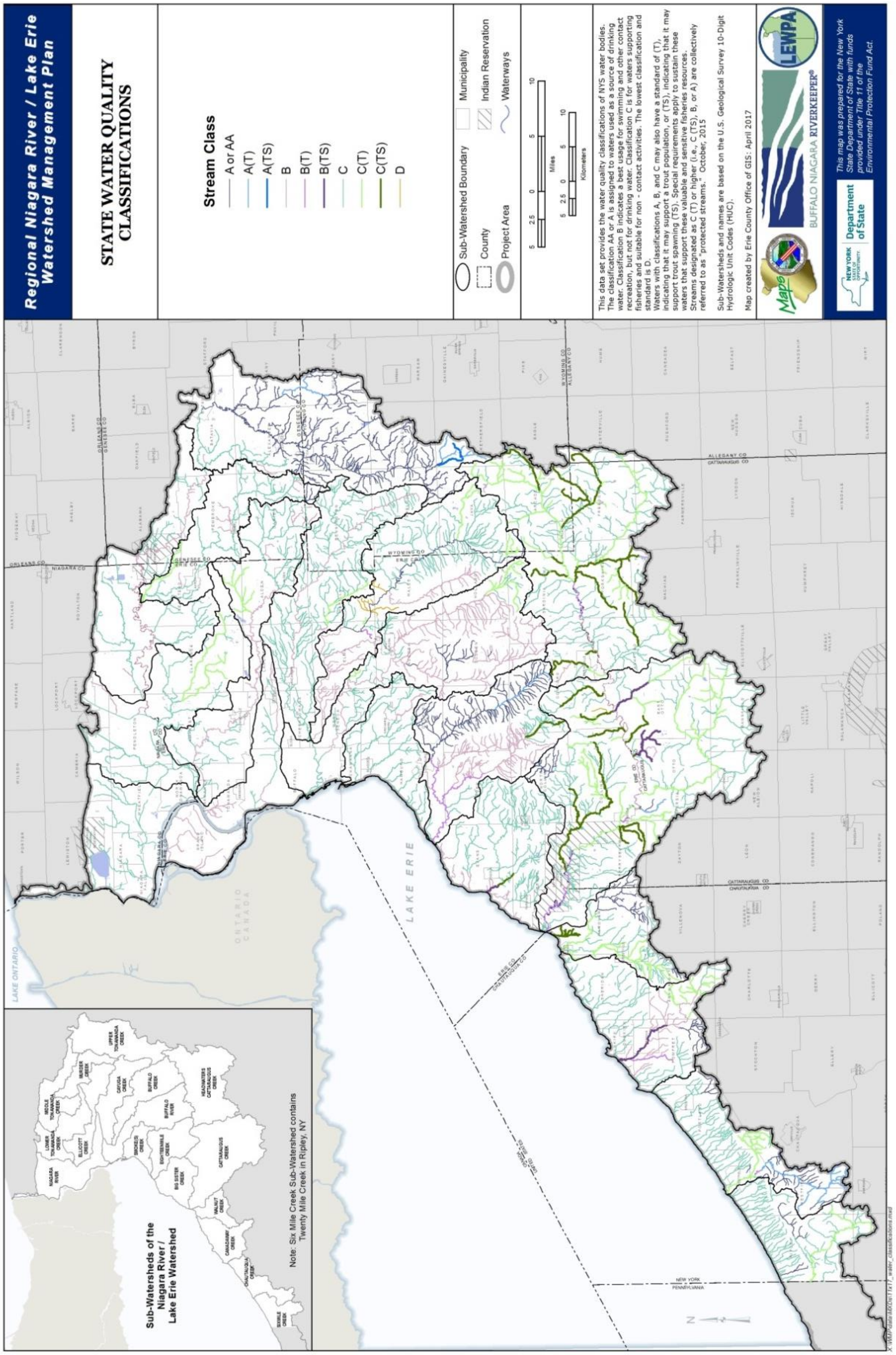
Table 4.1 NYS Water Quality Classifications

Class	Water Type	Best Usages
N	Fresh Surface Water	Suitable for the enjoyment of water in its natural condition (most restrictive) and, where compatible, as drinking water or culinary purposes; bathing; fishing; fish propagation; and recreation. Suitable for fish, shellfish, and wildlife propagation and survival.
AA-Special, A-Special, AA & A	Fresh Surface Water	Suitable for drinking water, culinary or food processing purposes; primary and secondary contact recreation; and fishing; fish, shellfish, and wildlife propagation and survival (A-Special: International Boundary Waters, AA & A: drinking water with disinfection/treatment).
B	Fresh Surface Water	Suitable for primary and secondary contact recreation and fishing; suitable for fish, shellfish, and wildlife propagation and survival.
C	Fresh Surface Water	Suitable for fish, shellfish, and wildlife propagation and survival; primary and secondary contact recreation, although other factors may limit the use for these purposes.
D	Fresh Surface Water	Due to such natural conditions as intermittency of flow, water conditions not conducive to propagation of game fishery, or stream bed conditions, the waters will not support fish propagation. These waters shall be suitable for fish, shellfish, and wildlife survival. The water quality shall be suitable for primary and secondary contact recreation, although other factors may limit the use for these purposes.
GA	Fresh Groundwater	As a source of potable water supply (all fresh groundwater resources are classified GA).

Note: Saline Water Resource Classifications are not included in this table.

Source: NYS DEC 6 NYCRR Part 701

Figure 4.1: State Water Quality Classifications of the Niagara River/Lake Erie Watershed



NYS Waterbody Inventory & Priority Waterbodies List

New York State's Waterbody Inventory and Priority Waterbodies List (WI/PWL) is an inventory of the state's surface waters. This data set provides a summary of general water quality conditions, tracks the degree to which a waterbody supports its designated uses, and monitors progress toward the identification and resolution of water quality problems, pollutants, and sources. The assessments are conducted every five years as part of DEC's *Rotating Integrated Basin Studies (RIBS)* and categorize each segment as either **Impaired**, waters with **Minor Impacts**, **Threatened** waters, waters with impacts **Needing Verification**, waters having **No Known Impacts**, or **Un-assessed waters** (Table 4.2).

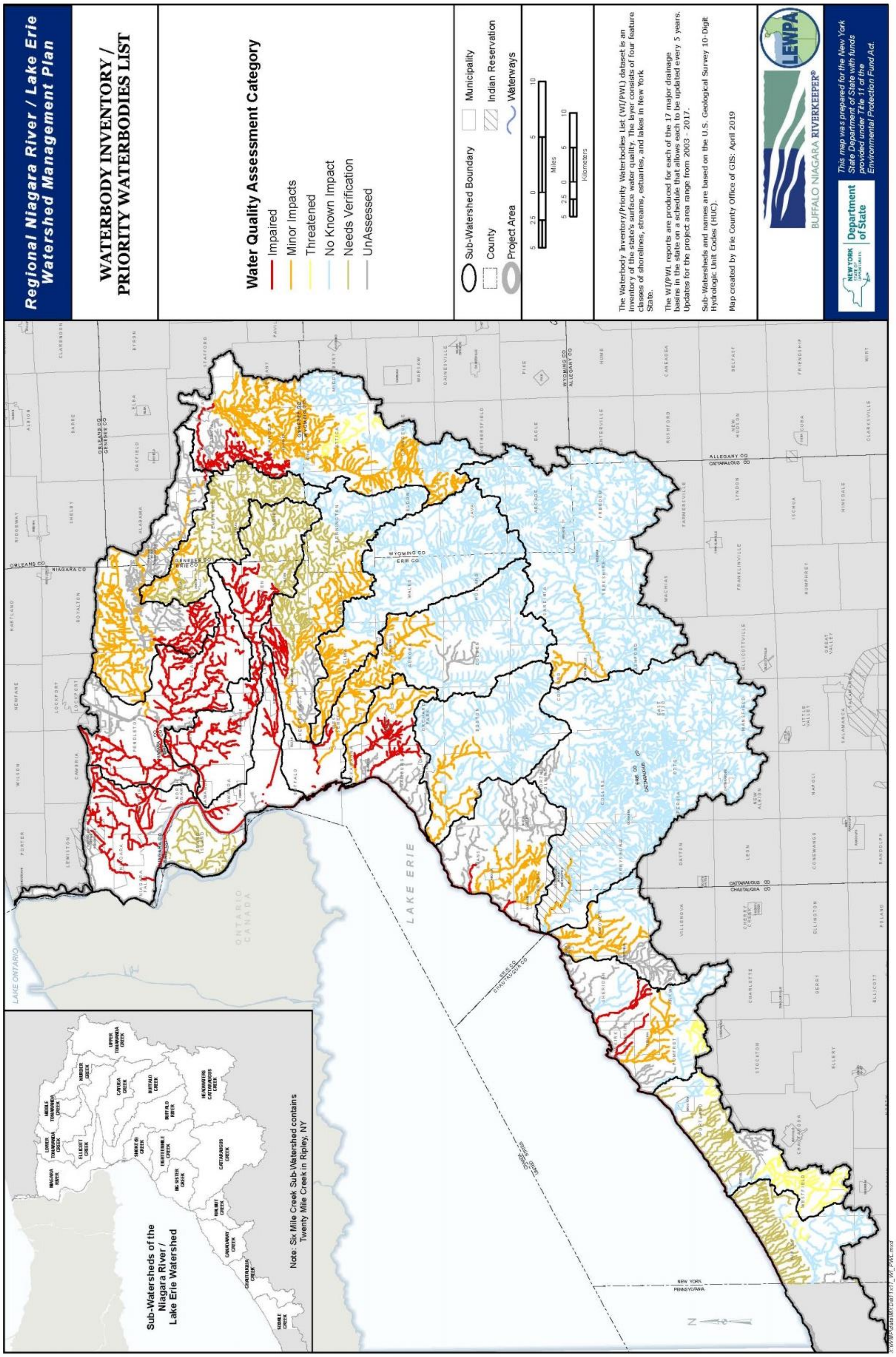
Table 4.2 NYS Water Quality Assessment Categories

Impaired Waters	Waterbodies with well documented water quality problems.
Waters with Minor Impacts	Waterbodies where less severe water quality impacts are apparent, but classification uses are considered fully supported.
Threatened Waters	Waterbodies for which uses are not restricted and no water quality problems currently exist, but where data suggests declining water quality trends or specific land uses or other changes in the surrounding watershed are known to be threatening water quality.
Waters having no Known Impacts	Waterbodies where monitoring data and information indicate that there are no use restrictions or other water quality impacts, threats or issues.
Waters with Impacts Needing Verification	Waterbodies that are thought to have water quality problems, but for which there is not sufficient or definitive documentation. These waterbodies need additional monitoring to determine whether uses are restricted or threatened.
Unassessed Waters	Waterbodies where there is no available water quality information to assess the support of designated uses.

Source: NYS DEC - CALM Section 305(b) Assessment Methodology (May 2009)

The data collected and provided as part of NYS's WI/PWL is submitted to the U.S. Environmental Protection Agency and comprises New York State's *Clean Water Act Section 305(b) Water Quality Report*. Segments that do not meet the standards for their use classification are categorized as either Threatened, Waters with Minor Impacts, or Impaired Waters and are included in the state's Priority Waterbodies List. Waters identified as "Impaired" and requiring Total Maximum Daily Load (TMDL) limits are also provided directly to the U.S. EPA as part of the *Clean Water Act Section 303(d) Impaired Waters List*. Waters included on the NYS Priority Waterbodies List or U.S. Environmental Protection Agency's 303(d) List are the focus of remedial/corrective and resource protection actions, as well as priorities for funding resources. The Priority Waterbodies List for the Niagara River/Lake

Figure 4.2: NYS Waterbody Inventory and Priority Waterbodies List – Status of Water Quality for the Niagara River/Lake Erie Watershed



Erie Basin was reviewed and updated with sampling done in 2015-16 and issued in 2017. The data is collected and maintained by the New York State Department of Environmental Conservation (NYSDEC).

Of the watershed's total 5,543 miles of waterways[4], approximately 481 stream miles have not been assessed. The NYS WI/PWL includes approximately 605 miles of impaired waterways with another 1,015 miles of waterways with minor impacts. Just over 626 miles of waterways need verification of possible impacts, while approximately 102 miles of waterways are considered threatened. About 2,501 miles of waterways, shown in blue on Figure 4.2, have no known impacts.

Historical or legacy contamination issues are well documented in this data. The Niagara River Sub-watershed has a number of impaired stream segments with a variety of toxic substances identified (PCBs, PAHs, Dioxins) as known pollutants. Impairments in this sub-watershed are also quite comprehensive and include impacts/limits on fish consumption, public bathing, aquatic life, recreation, habitat/hydrology modification, and aesthetics. In the Buffalo River Sub-watershed many of the past industrial uses were centered along a portion of the Buffalo River within the City of Buffalo, and again many of the impairments identify toxic or contaminated sediments as the known or suspected cause to the river's beneficial use impairments: fish consumption, aquatic life, and recreation[5]. In addition, during extreme weather events, contaminated sediments may be stirred up and deposited on land in the floodplains. The Smoke(s) Creek Sub-watershed also has legacy toxic contamination of PCBs along the Lake Erie shoreline due to past industrial uses. Additionally, the Lake Erie shoreline and several Lake Erie harbors, including Barcelona Harbor in Westfield and Dunkirk Harbor in Dunkirk, have toxic/contaminated sediment as a source of impairment. There are a few remaining areas within the watershed that have impairments from known or suspected contaminants, and include the more urban/suburban areas of the Canadaway Sub-watershed, Cattaraugus Headwaters Sub-watershed, Cayuga Creek Sub-watershed, Eighteenmile Creek Sub-watershed, Ellicott Creek Sub-watershed, Sixmile Creek Sub-watershed, Smoke(s) Creek Sub-watersheds, and Lower, Middle, and Upper Tonawanda Creek Sub-watersheds (see Table 4.3).

Aside from the historical contamination still present in the watershed, the remaining water quality issues are quite diverse, stemming from various sources of point and non-point source pollution. Many of the known or suspected impairments are attributed to agricultural activities, hydrological modification, sanitary discharges, stormwater run-off, streambank erosion, and failing on-site septic systems, which create aesthetic issues, nutrient (phosphorus) loading, pathogens, sedimentation, and lower dissolved oxygen levels.

[4] According to the U.S. Geological Survey Hydrography Data Set

[5] Please note, public bathing is not evaluated in the Buffalo River, even though unauthorized swimming does occur. Because no public swimming areas have been designated, contaminants that would restrict public bathing are not sampled nor evaluated for the level of threat to public health.

Table 4.3 Niagara River/Lake Erie Watershed - Water Quality Summary Conditions by Sub-watershed (WI/PWL Data)

ID number	Waterbodies/Segments	Length/Size	Water Quality Category	Stream Class	Impacted Uses or Conditions Evaluated & Severity**	Pollutants**	Pollutant Sources**
Niagara River Sub-watershed							
Ont 158 (portion 1)	Niagara River, Lower, Main Stem	12.0 miles	IMPAIRED	A-Special	Fish Consumption - Impaired, Habitat/Hydrology - Impaired	Priority Organics (Dioxin, PCBs, PAHs), Pesticides (mirex, Org.Chlor.Pest/HCB)	Tox/Contaminated Sediment, Habitat Modification
Ont 158 (portion 2)	Niagara River, Upper, Main Stem	24.8 miles	IMPAIRED	A-Special	Fish Consumption - Impaired, Aquatic Life - Stressed, Habitat/Hydrology - poor	Priority Organics (PCBs, PAHs), Pesticides (Org. Chlor. Pest/HCB), Water Level/Flow, Restricted Passage, Pathogens	Habitat Alteration, Tox/Contaminated Sediment, Landfill/Land Disp., Combined Sewer Overflow, Other Permitted Sanitary Discharges, Urban/Storm Runoff
Ont 158 (portion 3)	Chippewa (West) Channel	12.8 miles	IMPAIRED	A-Special	Fish Consumption - Impaired	Priority Organics (PCBs)	Tox/Contaminated Sediment, Landfill/Land Disp.
Ont 158 (portion 4)	Black Rock Canal	2.2 miles	IMPAIRED	C	Fish Consumption - Impaired, Habitat/Hydrology - Impaired	Priority Organics (PCBs)	Tox/Contaminated Sediment, Landfill/Land Disp., Habitat Modification
Ont 158 G.I.-1 thru 6	Grand Island (all tribs to Niagara River)	53.7 miles	Needs Verification	B	Habitat/Hydrology - Threatened	Silt/Sediment	Hydro Modification, Urban/Storm Runoff
Ont 158-6	Gill Creek and Tribs	12.3 miles	IMPAIRED	C	Aquatic Life - Impaired, Recreation - Impaired, Aesthetics - Stressed	Aesthetics (debris), Unknown Toxicity, Priority Organics (dioxin)	Urban/Storm Runoff, Tox/Contaminated Sediment
Ont 158-6-Pla	Hyde Park Lake	28.1 acres	IMPAIRED	B	Public Bathing - Impaired, Aquatic Life - Stressed, Recreation - Impaired	Algal/Weed Growth, Nutrients (phosphorus), D.O./ Oxygen Demand	Urban/Storm Runoff
Ont 158-8	Cayuga Creek and minor Tribs	21.6 miles	IMPAIRED	C	Fish Consumption - Precluded, Aquatic Life - Impaired, Recreation - Impaired, Aesthetics - Stressed	Priority Organics (dioxin), Unknown Toxicity, Metals (nickel, zinc), Pesticides (DDE, DDD), Algal/Weed Growth	Tox/Contaminated Sediment, Urban/Storm Runoff
Ont 158-8-1	Bergholtz Creek and Tribs	33.1 miles	IMPAIRED	C	Fish Consumption - Impaired, Aquatic Life - Impaired, Recreation - Impaired, Aesthetics - Stressed	Priority Organics (PCBs) Nutrients (phosphorus), Pathogens, Metals, Pesticides	Tox/Contaminated Sediment, Urban/Storm Runoff
Ont 158-13	Two-mile Creek and Tribs	7.1 miles	IMPAIRED	B	Public Bathing - Impaired, Aquatic Life - Impaired, Recreation - Impaired, Aesthetics - Fair	Aesthetics (odors, floatables), Low D.O./Oxygen Demand, Pathogens, Nutrients, Priority Organics	Municipal Discharges (Kenmore/Town of Tonawanda), Urban/Storm Runoff, Industrial, Other Non-Permitted Sanitary Discharge, Tox/Contaminated Sediment
Ont 158-15	Scajaquada Creek, Upper and Tribs	15.1 miles	IMPAIRED	B	Public Bathing - Impaired, Aquatic Life - Impaired, Recreation - Impaired	Nutrients (phosphorus), Low D.O./Oxygen Demand, Pathogens, Silt/Sediment	Urban/Storm Runoff, Other Non-Permitted Sanitary Discharges
Ont 158-15	Scajaquada Creek, Middle and Tribs	8.3 miles	IMPAIRED	C	Aquatic Life - Precluded, Recreation - Impaired, Habitat/Hydrology - Fair, Aesthetics - Fair	Aesthetics (floatables), Low D.O./Oxygen Demand, Nutrients (phosphorus), Pathogens, Priority Organics, Silt/Sediment	Habitat Alteration, Urban/Storm Runoff, Other Non-Permitted Sanitary Discharges, Tox/Contaminated Sediment

Ont 158-15	Scajaquada Creek, Lower and Tribs	0.3 miles	IMPAIRED	B	Public Bathing - Precluded, Aquatic Life - Precluded, Recreation - Impaired, Habitat/Hydrology - Stressed, Aesthetics - Stressed	Aesthetics (odors, floatables), D.O./Oxygen Demand, Pathogens, Nutrients (phosphorus), Priority Organics, Silt/Sediment	Combined Sewer Overflow, Urban/Storm Runoff, Habitat & Hydro Modification, Tox/Contaminated Sediment
Ont 158-15-P25	Delaware Park Pond (Hoyt Lake)	1.3 acres	IMPAIRED	B	Public Bathing - Impaired, Fish Consumption - Impaired, Recreation - Impaired	Algal/Weed Growth, Nutrients (phosphorus), D.O./Oxygen Demand, Priority Organics (PCBs)	Tox/Contaminated Sediment, Urban/Storm Runoff
Lower Tonawanda Creek Sub-watershed							
Ont 158-12 (portion 1)	Tonawanda Creek, Lower, Main Stem	11.9 miles	IMPAIRED	C	Fish Consumption - Impaired, Aquatic Life - Stressed, Recreation - Stressed	Priority Organics (PCBs), Nutrients, Silt/Sediments	Tox/Contaminated Sediment, Urban/Storm Runoff, Other Sanitary Discharge, Streambank Erosion
Ont 158-12-3	Bull Creek and Tribs	48.6 miles	IMPAIRED	C	Aquatic Life - Impaired	Unknown Toxicity, D.O./Oxygen Demand, Nutrients	Unknown Source, Municipal, Urban/Storm Runoff
Ont 158-12-6	Ransom Creek, Lower and Tribs	49.5 miles	IMPAIRED	C	Aquatic Life - Impaired, Recreation - Impaired, Aesthetics - Stressed	D.O./Oxygen Demand, Pathogens, Aesthetics (odors), Nutrients, Silt/Sediment	On-Site/Septic System (Clarence Hollow), Private Comm/Institutional (various residential), Urban/Storm Runoff
Ont 158-12-6	Ransom Creek, Upper and Tribs	44.2 miles	IMPAIRED	C (T)	Aquatic Life - Impaired, Recreation - Impaired, Aesthetics - Stressed	D.O./Oxygen Demand, Pathogens, Aesthetics (odors), Nutrients, Silt/Sediment	On-Site/Septic System (Clarence Hollow), Private Comm/Institutional (various residential), Urban/Storm Runoff
Ellicott Creek Sub-watershed							
Ont 158-12-1	Ellicott Creek, Lower and Tribs	112.0 miles	IMPAIRED	B	Public Bathing - Stressed, Aquatic Life - Impaired, Recreation - Impaired	Nutrients (phosphorus), Pathogens, Silt/Sediment, Pesticides (chlordane)	Urban/Storm Runoff, Other Non-Permitted Sanitary Discharge, Tox/Contaminated Sediment
Ont 158-12-1	Ellicott Creek, Upper and Tribs	112.1 miles	Needs Verification	C*	Aquatic Life - Stressed (possible), Recreation - Stressed (possible)	Silt/Sediment	Agriculture
Middle Tonawanda Creek Sub-watershed							
Ont 158-12 (portion 2)	Tonawanda Creek, Middle, Main Stem	49.3 miles	**Minor Impacts**	B	Public Bathing - Impaired, Aquatic Life - Stressed, Recreation - Stressed	Silt/Sediment, Pathogens, Nutrients	Agriculture, Streambank Erosion
Ont 158-12-8	Mud Creek and Tribs	113.5 miles	IMPAIRED	C	Aquatic Life - Impaired, Recreation - Impaired	Nutrients (phosphorus), Pathogens	Agriculture
Ont 158-12-9	Beeman Creek and Tribs	43.7 miles	IMPAIRED	C	Aquatic Life - Impaired, Recreation - Impaired	D.O./Oxygen Demand, Nutrients (phosphorus), Pathogens	
Murder Creek Sub-watershed							
Ont 158-12-11	Ledge Creek and Minor Tribs	28.9 miles	**Minor Impacts**	C (T)	Aquatic Life - Stressed	Silt/Sediment, Nutrients	Agriculture, Streambank Erosion
Ont 158-12-11-1	Murder Creek, Lower and Tribs	75.5 miles	Needs Verification	C*	Aquatic Life - Impaired, Recreation - Stressed	Silt/Sediment, Nutrients (phosphorus)	Streambank Erosion, Agriculture, On-Site/Septic Systems
Ont 158-12-11-1	Murder Creek, Upper and Tribs	106.2 miles	Needs Verification	C*	Aquatic Life - Impaired	Silt/Sediment, Nutrients	Agriculture, Streambank Erosion
Ont 158-12-11-1-P13	Tribs to Akron Reservoir	5.5 miles	No Known Impact	A	Water Supply - Threatened (possible)		
Ont 158-12-11-1-P13	Akron Reservoir	47.4 acres	No Known Impact	A	Water Supply - Threatened (possible)		

Upper Tonawanda Creek Sub-watershed							
Ont 158-12 (portion 1)	Tonawanda Creek, Lower, Main Stem	11.9 miles	**IMPAIRED**	C	Fish Consumption - Impaired, Aquatic Life - Stressed, Recreation - Stressed	Nutrients, Silt/Sediment, Priority Organics (PCBs)	Other Sanitary Discharge, Streambank Erosion, Urban/Storm Runoff, Tox/Contaminated Sediment
Ont 158-12 (portion 3)	Tonawanda Creek, Middle, Main Stem	11.7 miles	**IMPAIRED**	C	Aquatic Life - Impaired, Recreation - Impaired, Aesthetics - Stressed	Nutrients (phosphorus), D.O./Oxygen Demand, Silt/Sediment	Other Sanitary Discharge, Streambank Erosion, Urban/Storm Runoff, Agriculture, Municipal (Batavia WWTP), On-Site/Septic System (East Pembroke)
Ont 158-12 (portion 4)	Tonawanda Creek, Upper and minor Tribs	255.1 miles	**Minor Impacts**	A	Water Supply - Stressed, Recreation - Stressed, Aquatic Life - Stressed	Silt/Sediment, Nutrients, D.O./Oxygen Demand, Thermal Changes	Agriculture, Streambank Erosion, Hydro Modification, Municipal (Attica WWTP), Other Sanitary Discharge
Ont 158-12-28	Bowen Brook and Tribs	60.6 miles	**IMPAIRED**	C*	Aquatic Life - Impaired, Recreation - Impaired	D.O./Oxygen Demand, Nutrients (phosphorus), Pathogens	
Ont 158-12-32	Little Tonawanda Creek, Lower and Tribs	52.8 miles	**Minor Impacts**	A	Water Supply - Stressed, Public Bathing - Stressed, Recreation - Stressed	Silt/Sediment, Nutrients, D.O./Oxygen Demand	Agriculture, Streambank Erosion
Ont 158-12-32	Little Tonawanda Creek, Upper and Tribs	54.8 miles	No Known Impact	A (T)	No Uses Impaired		
Ont 158-12-41	Tannery Brook and Tribs	14.7 miles	No Known Impact	A	No Uses Impaired		
Ont 158-12-46	Crow Creek and Tribs	20.3 miles	Threatened	A	Water Supply - Threatened	Pathogens	Agriculture
Ont 158-12-46-P20	Attica Reservoir	11.3 acres	**Minor Impacts**	A	Water Supply - Threatened, Public Bathing - Stressed, Recreation - Stressed	Nutrients (phosphorus), Problem Species (Eurasian milfoil), Algal/Weed Growth, Pathogens	Agriculture
Ont 158-12-46-P20a	Attica Water Supply Reservoir	173.4 acres	Threatened	A	Water Supply - Threatened	Pathogens	Agriculture
Cayuga Creek Sub-watershed							
Ont 158..E-1-6	Cayuga Creek, Lower and Tribs	13.5 miles	**Minor Impacts**	C	Recreation - Stressed, Aquatic Life - Stressed	Nutrients, Silt/Sediment, Metals, priority organics (PAHs), Pathogens	Streambank Erosion, Urban/Storm Runoff, Other Non-Permitted Sanitary Discharge
Ont 158..E-1-6	Cayuga Creek, Middle and minor Tribs	116.6 miles	Needs Verification	B	Aquatic Life - Stressed (unconfirmed), Recreation - Stressed (unconfirmed)	Nutrients, Pathogens, Silt/Sediments	On-Site/Septic Systems (Cowlesville), Streambank Erosion, Other Non-Permitted Sanitary Discharges
Ont 158..E-1-6	Cayuga Creek, Upper and Tribs	57.3 miles	No Known Impacts	B	No Uses Impaired		
Ont 158..E-1-6-6	Plumb Bottom Creek and Tribs	27.2 miles	**IMPAIRED**	C	Aquatic Life - Impaired	Unknown Toxicity, D.O./Oxygen Demand, Nutrients	Unknown Source, Municipal, Urban/Storm Runoff
Ont 158..E-1-6-7	Little Buffalo Creek and Tribs	74.4 miles	**Minor Impacts**	C*	Habitat/Hydrology - Stressed	Silt/Sediment	Streambank Erosion
Ont 158..E-1-6-30	Right Branch/Gillett Creek and Tribs	30.1 miles	No Known Impacts	C	No Uses Impaired		
Buffalo Creek Sub-watershed							
Ont 158..E-1*	Buffalo Creek, Lower, and Minor Tribs	63.5 miles	**Minor Impacts**	B	Aquatic Life - Stressed, Recreation - Stressed	Silt/Sediment, Nutrients, Pathogens	Streambank Erosion, Urban/Storm Runoff, Agriculture
Ont 158..E-1*	Buffalo Creek, Upper, and Minor Tribs	285.1 miles	No Known Impacts	A	No Uses Impaired		

Erie/Buffalo River Sub-watershed							
Ont 158-E (portion 2)	Lake Erie (Outer Harbor, North)	7.3 shoreline miles	**IMPAIRED**	B	Fish Consumption - Impaired	Priority Organics (PCBs)	Tox/Contaminated Sediment
Ont 158-E (portion 3)	Lake Erie (Outer Harbor, South)	1.9 shoreline miles	**IMPAIRED**	C	Fish Consumption - Impaired	Priority Organics (PCBs)	Tox/Contaminated Sediment
Ont 158..E-1	Buffalo River, Main Stem	8.6 miles	**IMPAIRED**	C	Fish Consumption - Precluded, Aquatic Life - Stressed, Recreation - Stressed	Priority Organics (PCBs), D.O./Oxygen Demand, Pathogens, Silt/Sediment	Tox/Contaminated Sediment, Habitat & Hydro Modification, Urban/Storm Runoff, Combined Sewer Overflows
Ont 158..E-1-4	Cazenovia Creek and Tribs	51.7 miles	**Minor Impacts**	B	Public Bathing - Stressed Recreation - Stressed Aquatic Life - Threatened	Pathogens	Other Non-Permitted Sanitary Discharges, Urban/Storm Runoff
Ont 158..E-1-4-14	East Branch Cazenovia, Lower and Tribs	33.9 miles	**Minor Impacts**	B	Aquatic Life - Stressed, Recreation - Stressed	Nutrients (phosphorus), Unknown Toxicity	Urban/Storm Runoff
Ont 158..E-1-4-14	East Branch Cazenovia, Upper and Tribs	93.7 miles	No Known Impacts	B	No Uses Impaired		
Ont 158..E-1-4-15	West Branch Cazenovia, Lower and Tribs	25.0 miles	No Known Impacts	B*	No Uses Impaired		
Ont 158..E-1-4-15	West Branch Cazenovia, Upper and Tribs	73.8 miles	No Known Impacts	B	No Uses Impaired		
Ont 158..E-1-4-15-10-P	Orchard Park Reservoir	23.1 acres	**Minor Impacts**	A	Water Supply - Threatened, Public Bathing - Stressed, Recreation - Stressed	Nutrients (phosphorus), Silt/Sediment	Urban/Storm Runoff
Erie/Smoke(s) Creek Sub-watershed							
Ont 158-E (portion 4)	Lake Erie (Northeast Shoreline)	2.8 shoreline miles	**IMPAIRED**	C	Fish Consumption - Impaired	Priority Organics (PCBs)	Tox/Contaminated Sediment
Ont 158-E (portion 5)	Lake Erie (Northeast Shoreline)	9.0 shoreline miles	**IMPAIRED**	B	Fish Consumption - Impaired, Public Bathing - Impaired, Recreation - Impaired	Priority Organics (PCBs), Pathogens	Tox/Contaminated Sediment, Urban/Storm Runoff
Ont 158..E-2	Smoke Creek, Lower and Tribs	7.2 miles	**Minor Impacts**	C	Aquatic Life - Stressed, Recreation - Stressed, Aesthetics - Stressed	Aesthetics (sludge banks), Nutrients (phosphorus), Silt/Sediment, Pathogens	Urban/Storm Runoff, Industrial
Ont 158..E-2	Smoke Creek, Upper and Tribs	25.2 miles	**Minor Impacts**	C	Aquatic Life - Stressed, Recreation - Stressed	Nutrients (phosphorus), Unknown Toxicity	Urban/Storm Runoff, Municipal
Ont 158..E-2-1	South Branch Smoke Creek, Lower and Tribs	27.2 miles	**IMPAIRED**	C	Aquatic Life - Impaired, Recreation - Impaired, Aesthetics - Stressed	Nutrients (phosphorus), Silt/Sediment, Aesthetics (sludge, debris)	Streambank Erosion, Urban/Storm Runoff
Ont 158..E-2-1	South Branch Smoke Creek, Upper and Tribs	4.7 miles	**Minor Impacts**	B	Aquatic Life - Stressed, Recreation - Stressed	Nutrients (phosphorus), Pathogens	Urban/Storm Runoff
Ont 158..E-2-1-P81b	Green Lake	18.6 acres	**IMPAIRED**	B	Public Bathing - Impaired, Aquatic Life - Stressed, Recreation - Impaired	Nutrients (phosphorus), D.O./Oxygen Demand	Urban/Storm Runoff
Ont 158..E-3	Rush Creek and Tribs	17.2 miles	**IMPAIRED**	C	Public Bathing - Impaired, Aquatic Life - Impaired, Recreation - Impaired, Aesthetics - Stressed	Pathogens, Aesthetics (sludge banks, odors), Oil and Grease, Nutrients (phosphorus), Unknown Toxicity	Municipal (Hamburg, Blasdell SSOs) Urban/Storm Runoff, Other Sanitary Discharge

Eighteenmile Creek Sub-watershed							
Ont 158..E-13	Eighteenmile Creek, Lower & minor Tribs	30.8 miles	**Minor Impacts**	B (T)	Fish Consumption - Stressed, Recreation - Stressed, Habitat/Hydrology - Stressed	Silt/Sediment, Priority Organics (PCBs), Pathogens	Streambank Erosion, Urban/Storm Runoff, Agriculture, Hydro Modification, Tox/Contaminated Sediment
Ont 158..E-13	Eighteenmile Creek, Middle and Tribs	49.5 miles	No Known Impacts	A	No Uses Impaired		
Ont 158..E-13	Eighteenmile Creek, Upper and Tribs	72.3 miles	No Known Impacts	A	No Uses Impaired		
Ont 158..E-13-4	South Branch Eighteenmile, Lower and Tribs	77.8 miles	No Known Impacts	B	No Uses Impaired		
Ont 158..E-13-4	South Branch Eighteenmile, Upper and Tribs	21.7 miles	No Known Impacts	C	No Uses Impaired		
Ont 158..E-13-6	Hampton Brook and Tribs	16.7 miles	**Minor Impacts**	B	Aquatic Life - Stressed	Nutrients (phosphorus), D.O./Oxygen Demand	Agriculture, Urban/Storm Runoff
Erie/Big Sister Creek Sub-watershed							
Ont 158-E (portion 6)	Lake Erie (Main Lake, North)	15.7 shoreline miles	**IMPAIRED**	A-Special	Public Bathing - Impaired, Fish Consumption - Impaired, Recreation - Impaired	Priority Organics (PCBs), Pathogens	Tox/Contaminated Sediment, Urban/Storm Runoff
Ont 158..E-19	Little Sister Creek, Lower, and tribes	4.0 miles	**IMPAIRED**	B	Public Bathing - Stressed, Aquatic Life - Impaired, Recreation - Impaired	Nutrients (phosphorus), Pathogens, D.O./Oxygen Demand	
Ont 158..E-20	Big Sister Creek, Lower, and tribes	19.5 miles	**Minor Impacts**	C*	Aquatic Life - Stressed, Recreation - Stressed	Aesthetics (floatables), Nutrients	Municipal (unknown), Urban/Storm Runoff
Ont 158..E-20-13	Rythus Creek and tribes	19.4 miles	No Known Impacts	C	No Uses Impaired		
Ont 158..E-21	Delaware Creek, Lower, and tribes	2.5 miles	**Minor Impacts**	B (TS)	Aquatic Life - Stressed, Recreation - Stressed	Nutrients, D.O./Oxygen Demand	Agriculture, On-Site/Septic System
Ont 158..E-21	Delaware Creek, Upper, and tribes	20.5 miles	**Minor Impacts**	C	Aquatic Life - Stressed, Recreation - Stressed	Nutrients, D.O./Oxygen Demand	Agriculture
Ont 158..E-22	Muddy Creek, Lower, and tribes	2.4 miles	**IMPAIRED**	B	Public Bathing - Impaired, Recreation - Impaired	Pathogens	Unknown Source, Urban/Storm Runoff, On-Site/Septic System
Ont 158..E-22	Muddy Creek, Upper, and tribes	22.3 miles	**Minor Impacts**	C	Aquatic Life - Stressed	Nutrients	Agriculture
Cattaraugus Headwater Sub-watershed							
Ont 158..E-23 (portion 4)	Cattaraugus Creek, Middle, Main Stem	13.1 miles	**Minor Impacts**	B	Habitat/Hydrology - Stressed	Silt/Sediment	Streambank Erosion
Ont 158..E-23 (portion 5)	Cattaraugus Creek, Upper, and tribes	190.3 miles	No Known Impact	C (T)	No Uses Impaired		
Ont 158..E-23-27	Connoisarauley Creek, Lower, and tribes	39.0 miles	No Known Impact	B (TS)	No Uses Impaired		
Ont 158..E-23-27	Connoisarauley Creek, Upper, and tribs	20.6 miles	No Known Impact	C (T)	No Uses Impaired		
Ont 158..E-23-32	Spring Brook and tribs	16.3 miles	**Minor Impacts**	C*	Aquatic Life - Stressed, Recreation - Stressed, Habitat/Hydrology - Stressed	Silt/Sediment, Nutrients	Agriculture. Streambank Erosion, Hydro Modification, Municipal (Springville WWTP)
Ont 158..E-23-33	Buttermilk Creek and tribs	81.1 miles	No Known Impact	C	No Uses Impaired		
Ont 158..E-23-43 thru 47	Minor Tribs to Cattaraugus Creek	68.4 miles	No Known Impact	C	No Uses Impaired		
Ont 158..E-23-48	Elton Creek, Lower, and tribs	43.4 miles	No Known Impact	C (TS)	No Uses Impaired		
Ont 158..E-23-48	Elton Creek, Upper, and tribs	82.2 miles	No Known Impact	C (T)	No Uses Impaired		
Ont 158..E-23-48-3	Lime Lake Outlet and tribs	34.5 miles	No Known Impact	C (TS)	No Uses Impaired		
Ont 158..E 23 48 3 P130	Lime Lake	159.5 acres	**Minor Impacts**	B	Public Bathing - Stressed, Recreation - Impaired, Aquatic Life - Fully Supported	Harmful Algal Blooms, Algal Plant Growth (native), Nutrients (phosphorus)	On-Site/Septic System, Urban/Storm Runoff

Ont 158..E-23-48-9-P133	Beaver Lake	18.9 acres	Needs Verification	B	Public Bathing - Stressed (possible), Recreation - Stressed (possible)	Algal Weed Growth, Nutrients	Agriculture
Ont 158..E-23-56	Clear Creek and tribs	74.2 miles	No Known Impact	C (TS)	No Uses Impaired		
Ont 158..E-23-56-11-P141	Skim Lake	18.9 acres	No Known Impact	B	No Uses Impaired		
Ont 158..E-23-56-14-P146	Moores Pond	15.6 acres	No Known Impact	C (T)	No Uses Impaired		
Ont 158..E-23-56-14-P147	Crystal Lake	33.8 acres	Needs Verification	B	Aquatic Life - Threatened, Recreation - Threatened	D.O./Oxygen Demand, Nutrients (phosphorus)	
Ont 158..E-23-P152	Java Lake	53.0 acres	**IMPAIRED**	B	Recreation - Impaired, Aesthetics - Stressed	Algal/Weed Growth, Nutrients (phosphorus)	On-Site/Septic System, Construction (residential development)
Cattaraugus Sub-watershed							
Ont 158..E-23 (portion 1)	Cattaraugus Creek, Lower, Main Stem	10.0 miles	**Minor Impacts**	B (T)	Habitat/Hydrology - Stressed	Silt/Sediment	Streambank Erosion
Ont 158..E-23 (portion 2)	Cattaraugus Creek, Middle, Main Stem	9.1 miles	No Known Impact	C (T)	No Uses Impaired		
Ont 158..E-23 (portion 3)	Cattaraugus Creek, Middle, Main Stem	21.8 miles	No Known Impact	B	No Uses Impaired		
Ont 158..E-23- 1 thru 18 (selected)	Minor Tribs to Cattaraugus Creek	151.4 miles	No Known Impact	C	No Uses Impaired		
Ont 158..E-23- 6	Clear Creek, Lower, and tribs	11.4 miles	No Known Impact	C (TS)	No Uses Impaired		
Ont 158..E-23- 6	Clear Creek, Upper, and tribs	97.5 miles	No Known Impact	C (T)	No Uses Impaired		
Ont 158..E-23- 6-4	North Branch Clear Cr, Lower, and tribs	34.8 miles	No Known Impact	C	No Uses Impaired		
Ont 158..E-23- 6-P100	Clear Lake	47.5 acres	**Minor Impacts**	A	Aquatic Life -Stressed, Recreation - Stressed	Nutrients (phosphorus), Silt/Sediment	Agriculture, Streambank Erosion
Ont 158..E-23-19	Point Peter Brook, Upper, and tribs	14.9 miles	No Known Impact	A (T)	Water Supply - Threatened (possible)		
Ont 158..E-23-19 thru 31 (selected)	Minor Tribs to Cattaraugus Creek	131.0 miles	No Known Impact	C	No Uses Impaired		
Ont 158..E-23-20	South Branch Cattaraugus, Lower, and tribs	97.5 miles	No Known Impact	C (T)	No Uses Impaired		
Ont 158..E-23-20	South Branch Cattaraugus, Upper, and tribs	80.0 miles	No Known Impact	C (T)	No Uses Impaired		
Ont 158..E-23-20-11	Mansfield Creek and tribs	93.0 miles	No Known Impact	C (T)	No Uses Impaired		
Ont 158..E-23-20-P??	Rainbow, Timber Lakes	38.8 acres	**Minor Impacts**	C (T)	Recreation - Stressed	Algal/Wed Growth, Nutrients	Agriculture, Streambank Erosion
Erie/Walnut Creek Sub-watershed							
Ont 158..E-24	Halfway Brook and tribs	6.1 miles	**Minor Impacts**	C (TS)	Aquatic Life - Stressed, Recreation - Stressed	Nutrients (phosphorus), D.O./Oxygen Demand	Agriculture
Ont 158..E-25	Silver Creek, Lower, and minor tribs	21.7 miles	**Minor Impacts**	C (T)	Recreation - Stressed, Aquatic Life - Stressed, Habitat/Hydrology - Stressed	Aesthetics (turbidity, odors), D.O./Oxygen Demand, Silt/Sediment, Nutrients	Municipal (silver Creek WWTP), Streambank Erosion, Silviculture
Ont 158..E-25	Silver Creek, Upper, and tribs	32.7 miles	No Known Impact	A	No Uses Impaired		
Ont 158..E-25- 1	Walnut Creek, Lower, and tribs	25.1 miles	**Minor Impacts**	C	Aquatic Life - Stressed, Recreation - Stressed, Habitat/Hydrology - Stressed	Nutrients (phosphorus), D.O./Oxygen Demand, Silt/Sediment	Agriculture, Streambank Erosion, Silviculture
Ont 158..E-25- 8-P??	Silver Creek Reservoir	43.7 acres	No Known Impact	A	No Uses Impaired		

Erie/Canadaway Creek Sub-watershed							
Ont 158-E (portion 7)	Lake Erie (Main Lake, South)	39.6 shoreline miles	**IMPAIRED**	A-Special	Public Bathing - Impaired, Fish Consumption - Impaired, Recreation - Impaired	Priority Organics (PCBs), Pathogens	Tox/Contaminated Sediment, Urban/Storm Runoff
Ont 158-E (portion 7a)	Lake Erie (Dunkirk Harbor)	2.8 shoreline miles	**IMPAIRED**	B	Public Bathing - Impaired, Fish Consumption - Impaired, Recreation - Impaired, Aesthetics - Stressed	Priority Organics (PCBs), Pathogens, Aesthetics	Tox/Contaminated Sediment, Urban/Storm Runoff, Other Sanitary Discharges, Unknown Source
Ont 158..E-31	Beaver Creek and tribs	14.9 miles	No Known Impact	C	No Uses Impaired		
Ont 158..E-32	Scott Creek and tribs	14.0 miles	**IMPAIRED**	C	Aquatic Life - Impaired	Unknown Toxicity, D.O./Oxygen Demand, Nutrients	Unknown Source, Municipal, Urban/Storm Runoff
Ont 158..E-36	Crooked Brook and tribs	8.1 miles	**IMPAIRED**	C	Aquatic Life - Impaired	Unknown Toxicity, D.O./Oxygen Demand, Nutrients	Unknown Source, Municipal, Urban/Storm Runoff
Ont 158..E-37	Canadaway Creek, Lower, and tribs	36.8 miles	**Minor Impacts**	B	Habitat/Hydrology - Stressed	Silt/Sediment	Streambank Erosion
Ont 158..E-37	Canadaway Creek, Upper, and tribs	30.5 miles	No Known Impact	B	No Uses Impaired		
Ont 158..E-37- 7-P160	Fredonia Reservoir	51.2 acres	**Threatened**	A	Water Supply - Threatened		
Ont 158..E-37- 7-P160-	Tribs to Fredonia Reservoir	14.2 miles	**Threatened**	A	Water Supply - Threatened		
Ont 158..E-43	Little Canadaway Creek and tribs	15.8 miles	No Known Impact	C	No Uses Impaired		
Erie/ Chautauqua Creek Sub-watershed							
Ont 158..E-44 thru 67 (selected)	Minor Tribs to Lake Erie	74.4 miles	Needs Verification	C	Aquatic Life - Stressed (possible)		
Ont 158..E-50	Slippery Rock Creek and tribs	11.3 miles	No Known Impact	C	No Uses Impaired		
Ont 158..E-50-P160k	Brocton Reservoir	17.4 acres	**Threatened**	A	Water Supply - Threatened		
Ont 158..E-50-P160k	Tribs to Brocton Reservoir	5.5 miles	**Threatened**	A	Water Supply - Threatened		
Ont 158..E-68	Chautauqua Creek, Lower, and minor tribs	6.0 miles	No Known Impact	C (T)	No Uses Impaired		
Ont 158..E-68	Chautauqua Creek, Upper and tribs	56.6 miles	**Threatened**	A (T)	Water Supply - Threatened		
Ont 158..E-68- 2-P165a	Minton Reservoir	12.7 acres	**Threatened**	A	Water Supply - Threatened		
Erie/ Sixmile Creek Sub-watershed							
Ont 158-E (portion 7b)	Lake Erie (Barcelona Harbor)	.07 shoreline miles	**IMPAIRED**	B	Fish Consumption - Impaired	Priority Organics (PCBs)	Tox/Contaminated Sediment
Ont 158..E-69 thru 95	Minor Tribs to Lake Erie	88.5 miles	Needs Verification	C	Aquatic Life - Stressed (possible)		
Ont 158..E-96	Twentymile Creek and minor tribs	53.3 miles	No Known Impact	C (T)	No Uses Impaired		
Ont 158..E-96- 3	Upper Belson Creek/Gage Gulf and tribs	12.4 miles	**Threatened**	A	Water Supply - Threatened		

*has smaller tributaries under different classification

(T) indicates Trout waters

** only known or suspected are included in this chart unless otherwise specified

This chart was updated May 2019

Lake Erie itself is experiencing rather complicated water quality issues resulting from a resurgence of algae blooms, including toxic blue-green algae; bioaccumulation of organochlorine compounds, pesticides, and mercury; shoreline erosion and sedimentation; ecosystem stresses from invasive species; and nutrient loading[6]. For more detailed information on the leading causes of water quality impairments in the watershed see the section of this chapter titled "Causes & Contributors of Water Quality Degradation."

Water Quality Monitoring for Baseline Data

The NYSDEC has contracted with the U.S. Geological Survey to conduct water quality monitoring at 19 sites throughout the Niagara River/Lake Erie Watershed for nutrients and other water quality parameters. This will help determine the nutrient loading to Lake Erie from New York State. Sampling started in the fall of 2017 and will continue through fall 2019. Sites are listed in Figure 4.3. While the report isn't due until 2020, results can be viewed online.[7] Gages are located on the following streams within the watershed: Chautauqua Creek, Canadaway Creek, Silver Creek, Walnut Creek, Cattaraugus Creek Gowanda, Cattaraugus Creek New Albion, Cattaraugus Creek Perrysburg, Big Sister Creek, Eighteenmile Creek Hamburg, Eighteenmile Creek Eden, Buffalo Creek, Cayuga Creek, Cazenovia Creek, Black Rock Canal, Black Rock Lock, Tonawanda Creek Attica, Tonawanda Creek Batavia, Tonawanda Creek Rapids, and Ellicott Creek.

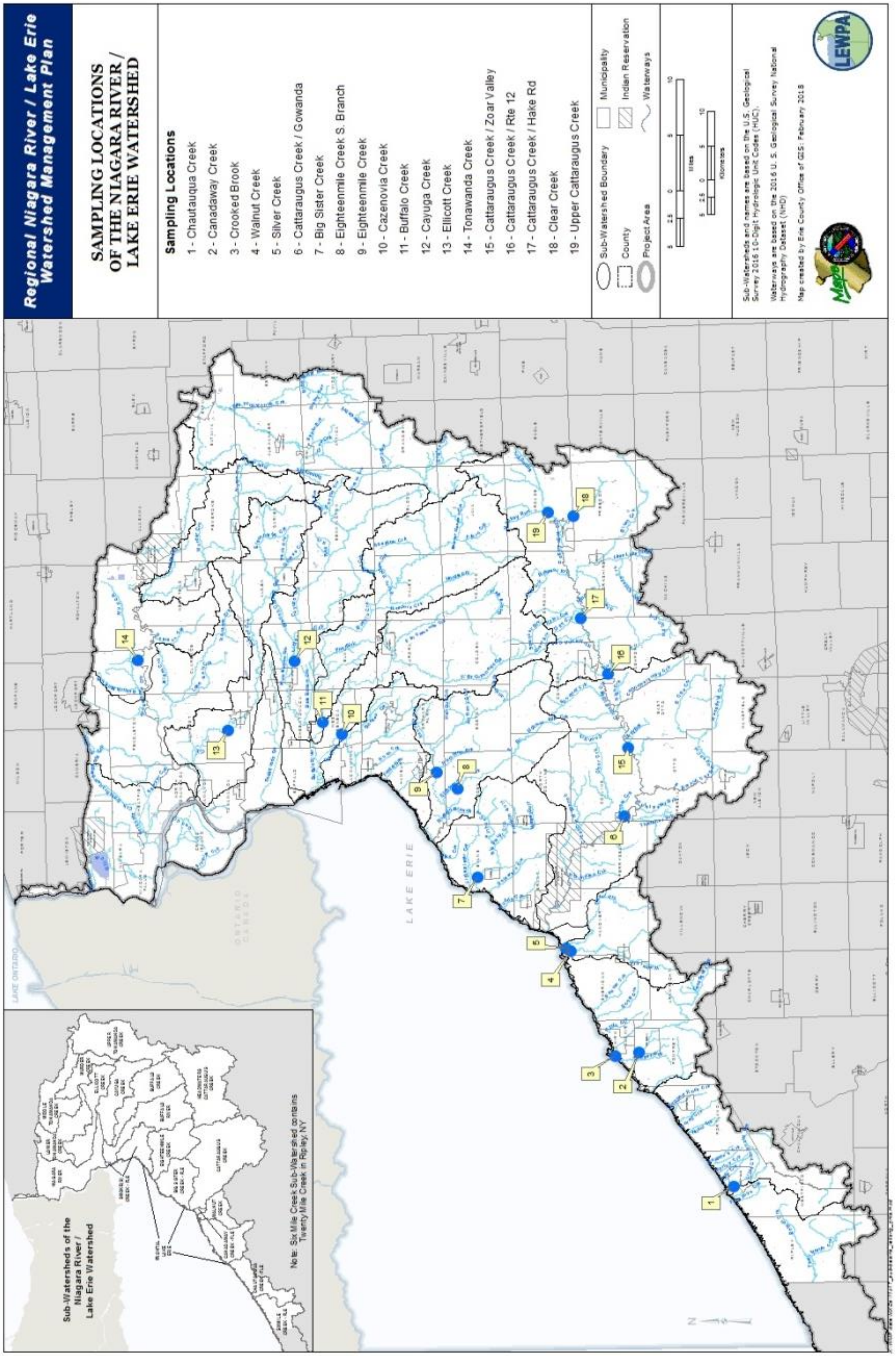
In addition, the Lake Erie Watershed Protection Alliance is sampling for bacteria at the same 19 sites. E. coli, fecal coliform, and total coliform, as well as general water quality parameters are being collected monthly from spring 2019 through spring 2020. In addition, three storm sampling events are planned as well.

Total Maximum Daily Loads (TMDLs)

Waters that do not support their classified uses and require Total Maximum Daily Load (TMDL) limits are placed on the U.S. EPA 303(d) Impaired Waters List. According to the Clean Water Act, states must consider the creation of TMDLs or another strategy to reduce the input of specific pollutants that contribute to the waters impairment. A Total Maximum Daily Load is a calculation of the maximum amount of a pollutant that a waterbody can receive and still safely meet water quality standards[8]. For TMDL development, studies are conducted to identify the source pollutant for the impairment and identify appropriate threshold limits. Upon establishing the TMDL, a timeline is established with specific strategies needed to reduce the contaminant levels and reduce pollutant levels to fall within the TMDL threshold.

[6] Myers, Donna N., et al. *Water Quality in the Lake Erie-Lake Saint Clair Drainages* (USGS 2000)
[7] https://bit.ly/2XpZr5e
[8] U.S. EPA

Figure 4.3: U.S. Geological Survey and LEWPA Sampling Locations



Most often implemented for nutrient loading impairments (phosphorus & nitrogen), TMDLs are a mechanism through which watershed managers can apply point and non-point source pollution thresholds on stream segments to address segments that are failing to meet water quality standards. The thresholds are developed by determining the levels by which pollution inputs would need to be reduced to bring stream segments back into water quality compliance. Once TMDLs are established, there are opportunities to seek additional funding for management and strategy implementation through the U.S. EPA. In the Niagara River/Lake Erie Watershed 26 out of the 41 impaired waterbodies/segments (63%) identified in the Waterbody Inventory and Priority Waterbodies List are identified as waters with "Impairments Requiring TMDL Development" (Table 4.4 below).

Table 4.4: Waters Requiring TMDL Development within the Niagara River/Lake Erie Watershed

ID number	Waterbodies/ Segments	Stream Class	Cause Pollutant	Suspected Source
Ont 158-6	Gill Creek and Tribs	C	Unknown (biological impacts)	Urban Runoff, Contaminated Sediment
Ont 158-6-Pla	Hyde Park Lake	B	Phosphorus	Urban/Storm Runoff
Ont 158-8-1	Bergholtz Creek and Tribs	C	Phosphorus, Pathogens	Urban/Storm Runoff
Ont 158-12-6	Ransom Creek, Lower and Tribs	C	Oxygen Demand, Pathogens	On-Site Waste Treatment System
Ont 158-12-6	Ransom Creek, Upper and Tribs	C (T)	Oxygen Demand, Pathogens	On-Site Waste Treatment System
Ont 158-13	Two-mile Creek and Tribs	B	Floatables, Oxygen Demand, Pathogens	Combined Sewer Overflows, Municipal
Ont 158-15	Scajaquada Creek, Upper and Tribs	B	Low D.O., Pathogens, Phosphorus	Combined Sewer Overflows, Urban Runoff
Ont 158-15	Scajaquada Creek, Middle and Tribs	C	Floatables, Low D.O., Pathogens, Phosphorus	Combined Sewer Overflows, Urban Runoff
Ont 158-15	Scajaquada Creek, Lower and Tribs	B	Floatables, Low D.O., Pathogens, Phosphorus	Combined Sewer Overflows, Urban Runoff
Ont 158-E (portion 5)	Lake Erie (Northeast Shoreline)	B	Pathogens	Urban/Storm Runoff
Ont 158-E (portion 6)	Lake Erie (Main Lake, North)	A-Special	Pathogens	Urban/Storm Runoff
Ont 158-E (portion 7)	Lake Erie (Main Lake, South)	A-Special	Pathogens	Urban/Storm Runoff
Ont 158-E (portion 7a)	Lake Erie (Dunkirk Harbor)	B	Pathogens	Urban/Storm Runoff
Ont 158..E-2-1-P81b	Green Lake	B	Phosphorus	Urban/Storm Runoff
Ont 158..E-3	Rush Creek and Tribs	C	Pathogens, Phosphorus	Combined Sewer Overflows, Urban Runoff, Municipal

None of these waters listed are scheduled for TMDL development by the NYS DEC at this time and the Niagara River/Lake Erie Watershed is currently the only area of the state that has not had any TMDLs developed. According to NYS DEC Region 9 staff this is due to a number of factors, including the lack of comprehensive baseline data existing in the region (although baseline monitoring is currently underway); the considerable expense in developing TMDLs for rivers and streams versus lakes; how some of the listed stream segments would not realistically benefit from TMDL development (other major factors at play such as non-point source pollution over point source pollution); and, how there historically hasn't been enough local support for advancing this work in the region nor adequate land use tools and regulations to do so in a "Home Rule" state. A discussion of TMDL development and other alternatives is listed in Appendix C as a deliverable of this project, put together by Buffalo Niagara Riverkeeper. A Nine-element Watershed Management Plan (9e Plan) is considered a preferable alternative to TMDL development in watersheds where non-point sources are more of a concern than point sources. Development of a 9e Plan is the course of action being pursued in the Niagara River/Lake Erie Watershed and this Watershed Characterization Report is a component of that Plan by illustrating potential pollution sources.

Aquatic Habitat - Water Quality Indicators

Figure 4.4: Macroinvertebrate Sampling

Additional resources exist to assist in categorizing the quality of our waters that pay special attention to aquatic habitat. The NYS DEC Priority Waterbodies List includes data generated from the state's Stream Biomonitoring Program (SBP) Assessment. This assessment is also performed throughout the state on a rotating basis. One element of the program uses the presence or absence of aquatic macroinvertebrates to determine the quality of ecosystem health using the Biotic Assessment Profile (BAP). The BAP scores water quality in a tributary by taking into consideration several indices including species richness, community balance, and presence of pollution-tolerant species to calculate a single score. A higher score demonstrates better quality of aquatic habitat and water quality in general. The map provided in Figure 4.5 contains BAP scores from 3 different years of sampling (2001, 2005, 2010) ranked by the assessment score (2013 NYSDEC data). Scores ranging from 0-2.5 fall under the "poor" category, 2.5-5 are "fair, 5-7.5 are "good," and 7.5-10 are "very good."

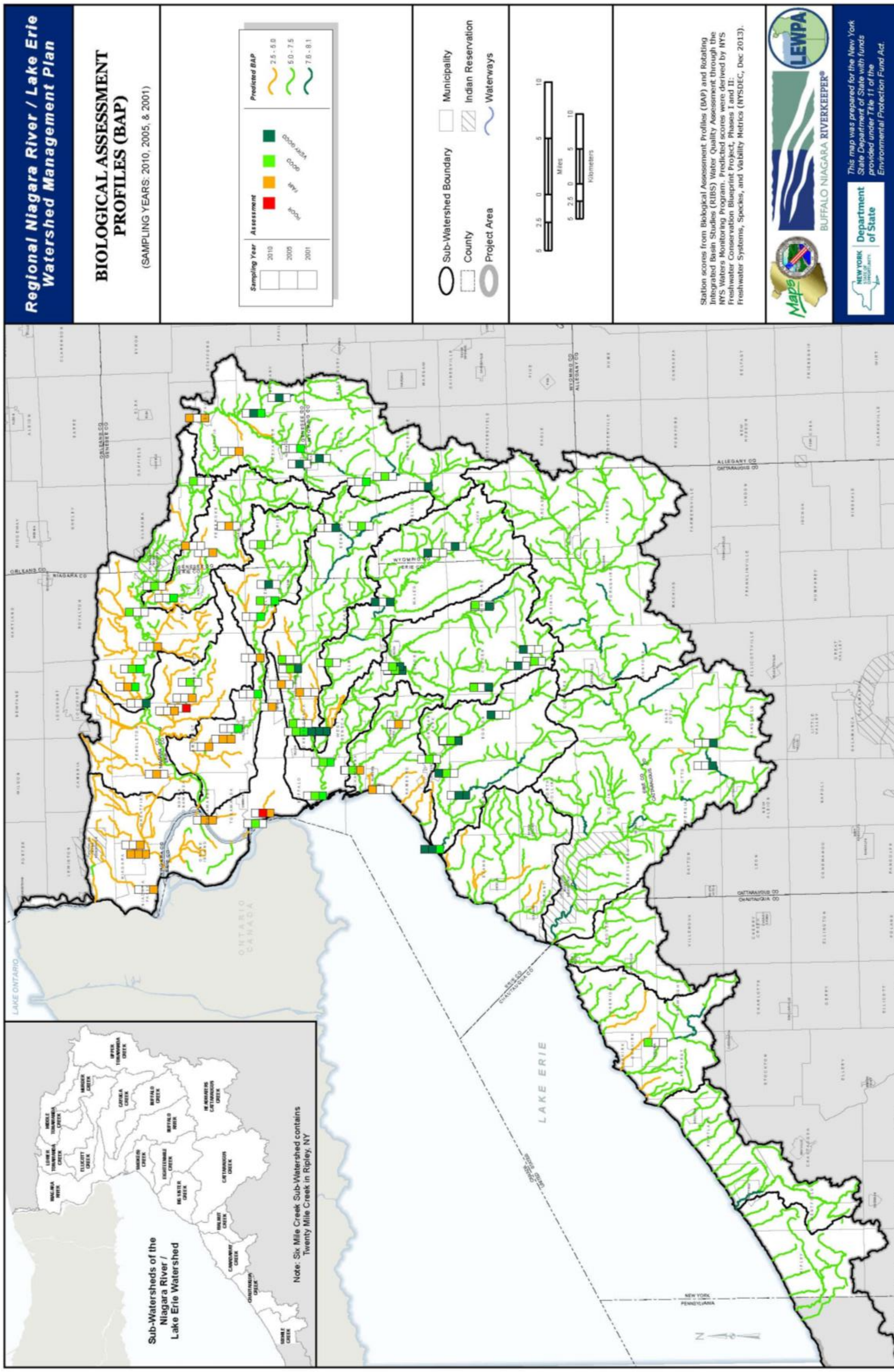
Predicted BAP scores are also displayed on the map for each stream segment using the same color coding scheme referenced in the point data. Predicted BAP scores were developed by The New York Natural Heritage Program's New York State Freshwater Conservation Blueprint Project. This analysis used the highest BAP score at each sampling location and applied a regression modeling tool in order to show how the observed data related to a number of other environmental variables. The variables included 146 local and regional attributes that apply to stream segments inducing stream velocity, land cover, geology, precipitation, stream order, and temperature. The regression model then used the importance and correlation of each attribute relative to the known BAP scores to extrapolate a predicted score for all of the streams in the watershed. The BAP scores (point & predicted) show similar findings to the overall RIBS data set, which indicates poorer water quality conditions in the more urbanized and downstream areas of the watershed, especially in the northern sub-watersheds.

Predicted BAP scores by percentage of waterways within each sub-watershed are displayed in Table 4.5 for comparison purposes. The total shows that the majority of the waterways in the Niagara River/Lake Erie Watershed are considered to be in good condition. The four sub-watersheds in green font have the highest percentage of waterways within their limits at the "very good" category. Those in orange font have the highest percentage of waterways within their limits at the "fair" category. None of the waterways are categorized as "poor." While Cayuga Creek Sub-watershed has a relatively high percentage of waterways categorized as "very good," there is still a higher percentage categorized as "fair" in that watershed. Unfortunately, biological assessment data collection isn't occurring frequently enough or comprehensively enough in the watershed to effectively capture detailed trending at the stream segment level at this time.

Table 4.5: Predicted BAP Scores in Sub-watersheds by Percentage of Waterways in Each Category

	Poor	Fair	Good	Very Good
Sub-watershed	**<2.5 Score**	**2.5-5.0 Score**	**5.0-7.5 Score**	**>7.5 Score**
Big Sister Creek	0.0%	16.9%	83.1%	0.0%
Buffalo Creek	0.0%	5.3%	91.6%	3.1%
Buffalo River	0.0%	0.0%	97.9%	2.1%
Canadaway Creek	0.0%	17.3%	74.5%	8.2%
Cattaraugus Creek	0.0%	0.3%	91.1%	8.6%
Cayuga Creek	0.0%	16.8%	72.6%	10.6%
Chautauqua Creek	0.0%	0.0%	94.9%	5.1%
Eighteenmile Creek	0.0%	0.8%	89.2%	9.9%
Ellicott Creek	0.0%	30.6%	69.4%	0.0%
Headwaters Cattaraugus Creek	0.0%	0.0%	92.4%	7.6%
Lower Tonawanda Creek	0.0%	77.4%	22.6%	0.0%
Middle Tonawanda Creek	0.0%	50.8%	49.2%	0.0%
Murder Creek	0.0%	18.7%	81.3%	0.0%
Niagara River	0.0%	88.2%	11.8%	0.0%
Sixmile Creek	0.0%	0.0%	89.0%	11.0%
Smoke(s) Creek	0.0%	22.7%	77.3%	0.0%
Upper Tonawanda Creek	0.0%	3.7%	92.2%	4.1%
Walnut Creek	0.0%	0.0%	100.0%	0.0%
Grand Total	**0.0%**	**16.4%**	**79.1%**	**4.5%**
prepared by L. Matthies-Wiza, 5/24/19				

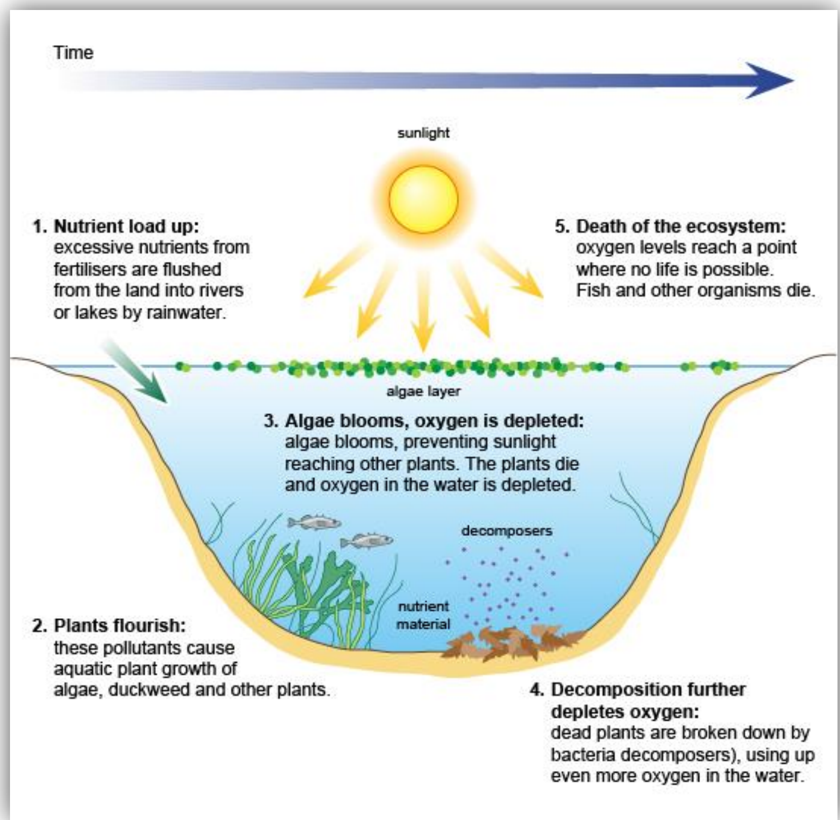
Figure 4.5: Biologic Assessment Profiles in Niagara River/Lake Erie Watershed



Water Quality of Wetlands & Smaller Lakes and Ponds

Wetland water quality monitoring is an important aspect of implementing the Clean Water Act; unfortunately New York State does not have a wetlands water quality monitoring program in effect at this time. The NYS DEC has worked towards creating standards by which wetlands water quality is assessed, but, "standards have not been adopted due to workload issues and the difficulty of smoothly incorporating wetlands protection into delivery of water quality standards."[9] According to the U.S. EPA Clean Water Act guidance, development of wetland water quality standards provides a regulatory basis for a variety of water quality management activities including, but not limited to, monitoring and assessment under Section 305(b), permitting under Sections 402 and 404, water quality certification under Section 401, and control of non-point source pollution under Section 319.

Figure 4.6: Eutrophication Diagram



Source: British Broadcasting Company, GCSE: Bitesize Science online.

Wetlands within the Niagara River/Lake Erie Watershed and their benefits to water quality are described in the Watershed Characterization in Chapter 2. Wetlands are threatened by a number of human and environmental influences. Urbanization brings new or expanding roads, schools, and housing developments which are often built on or near wetlands. This may cause shifts in vegetation types and drainage of soils in and near wetlands, thus disturbing the flow of water into and out of the wetlands. Wetlands in poor health filter fewer pollutants, capture less carbon, and provide less storm protection. Preserving and restoring wetlands, together with other water retention, provide natural flood control and healthier waters.

[9] NYS DEC New York State Wetlands Assessment

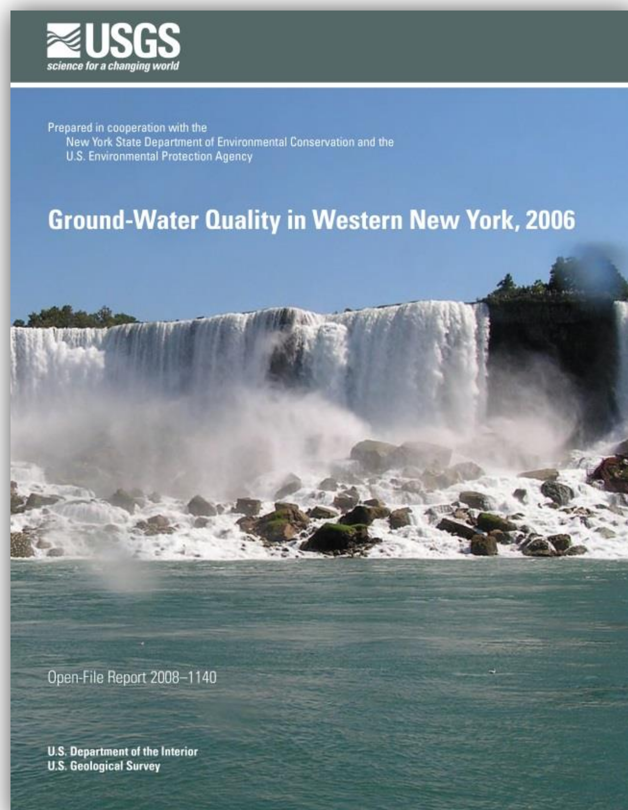
Smaller lakes and ponds within the watershed are monitored as part of the NYS WI/PWL, and drinking-water bodies are assessed by the NYS Department of Health's Source Waters Assessment Program (SWAP). The Niagara River/Lake Erie Watershed has 19 smaller lakes and reservoirs included in the NYS WI/PWL (See Table 4.3) of which Delaware Park Pond (Hoyt Lake), Green Lake, Hyde Park Lake, and Java Lake are the most degraded according to their use classifications, while Akron Reservoir, Moores Pond, Silver Creek Reservoir, Silver Lake have no known impacts. The causes for water quality impairments in the lakes, ponds, and reservoirs are very similar to the other primary watershed impairments, with data showing nutrient loading, low dissolved oxygen, and signs of eutrophication in addition to issues such as pathogens, toxic sediments, and silt/sediment.

So far, harmful algal blooms (HABs) have not played a substantial role in water quality impairments of these lakes and ponds. HABs occur when algae colonies release toxins that can have harmful effects on people, fish, mammals, and birds. With excessive or ongoing nutrient pollution, it could become a future issue. NYSDEC has a notification website where potential HABs can be reported.[10]

Groundwater Quality

In 2001, the U.S. Geological Service, in cooperation with the NYS DEC and the USEPA, began an assessment of ground water quality in NYS river basins (Ground-Water Quality in Western New York, 2006[11]). Water samples were taken from 7 production wells and 26 private residential wells across Western New York in 2006, with sixteen of the sampling wells located in the Niagara River/ Lake Erie Watershed. These samples were analyzed for five physical properties and 219 constituents that included inorganic major ions, nutrients, organic carbon, trace elements, radon-222, Volatile Organic Compounds (VOCs), phenolic compounds, pesticides, and bacteria. According to the 2006 Report, the quality of the ground water was generally considered acceptable, except where concentrations of some constituents

Figure 4.7: Ground-Water Quality in Western New York Report Cover



[10] https://www.dec.ny.gov/chemical/83310.html

[11] Eckhardt, D.A.V., Reddy, J.E., and Tamulonis, K.L., 2008, Ground-water quality in western New York, 2006: U.S. Geological Survey Open-File Report 2008–1140, 36 p., available online at http://pubs.usgs.gov/ofr/2008/1140

exceeded maximum USEPA and NYS DOH standards. The constituents exceeding standards in one or more wells were pH, sodium, chloride, sulfate, aluminum, arsenic, iron, lead, manganese, and radon-222. The report also indicates that 18 pesticides were detected in 14 of the 33 wells sampled, and 14 VOCs were detected in 12 samples, but neither of their concentrations exceeded regulatory thresholds. Total coliform bacteria were detected in 12 samples and *Escherichia coli* (*E. coli*) was detected in 2 samples. Any detection of these bacteria exceeds the NYS DOH standards.

NYSDEC and U. S. Geological Survey have partnered on 305(b) groundwater monitoring on a rotating basis. In a 2011 report, 31 wells were sampled including 6 of the same wells from the 2006 report. Sixteen of those 31 wells were in the Niagara River/Lake Erie Watershed. The results indicate that groundwater generally is of acceptable quality, although at 30 of wells, at least one of the following constituents was detected at a concentration that exceeded current or proposed Federal or New York State drinking-water standards: pH, sodium, sulfate, total dissolved solids, aluminum, arsenic, iron, manganese, radon-222, benzene, and total coliform bacteria. None of the pesticides analyzed exceeded existing drinking-water standards.[12]

Groundwater is also assessed on a site-by-site basis at inactive hazardous waste sites monitored by NYSDEC. Historic contamination from spills and dumping of industrial wastes commonly results in contamination of groundwater, which may then travel offsite in plumes and/or enter surface water and waterway sediments through river and stream banks. Groundwater recovery pumping systems are often used to reduce the migration of contaminants off-site and into waterways. Many environmental remediation projects are concentrated in urbanized areas including the cities of Buffalo, Dunkirk, Lackawanna, Lockport, Niagara Falls, North Tonawanda, and Tonawanda; the towns of Amherst, Cheektowaga, Lancaster, Lockport, Niagara, Orchard Park, Tonawanda, West Seneca, and Wheatfield; and the villages of Depew and Gowanda.[13]

It is also of note that groundwater from certain rock formations in the Niagara River/ Lake Erie Watershed naturally discharge methane. Especially in the southern portion of the Watershed, Devonian black shale deposits have methane that bubbles up from groundwater. This can be seen, for instance, at the Eternal Flame in Chestnut Ridge Park in Erie County, as well as other locations throughout the Watershed.[14] In some locations, the groundwater methane amount is over the 10mg/L action level for water wells set by the federal Office of Surface Mining, meaning the well should continue to be monitored. When levels reach 28 mg/L, the water is considered saturated with methane and as it is released in to the air, it can become explosive.

[12] Reddy, J.E., 2013, Groundwater quality in western New York, 2011: U.S. Geological Survey Open-File Report 2013–1095, 28 p., at http://pubs.usgs.gov/of/2013/1095

[13] http://www.dec.ny.gov/chemical/37554.html

[14] Dissolved methane in New York Groundwater, August 2012. https://pubs.usgs.gov/of/2012/1162/pdf/ofr2012-1162_508_09072012.pdf

Beach Water Quality Sampling

Chautauqua and Erie County Departments of Health, as well as NYS Parks, Recreation and Historic Preservation Department (NYS Parks) have beach sampling programs throughout the summer months to determine the water quality at bathing beaches for the purpose of protecting public health. These programs sample beaches for *E. coli* and results take 24-hours. Therefore closures are based upon the previous day's sample except in cases where rainfall amount, lake condition observations, or beach model results, if available, may indicate a need to close on a particular day.

Chautauqua County Department of Health monitored eight beaches in 2018; Town of Hanover, Sunset Bay Beach Club, Sheridan Bay Park, Wright Park East, Wright Park West, Main Street, Point Gratiot, and Blue Water Beach Campground Beaches, but only four of those beaches operated active swimming areas. Twelve notices of beach closures were made for a total of 12.32 days collectively based upon actual hours of operation lost. If there were multiple swim areas at a particular location and one notice was higher than the NYS Beach standard of 235 cfu/100ml, but another was below the standard, no notice was issued for the beach and swimmers were directed to the open swimming location. Wright Park East had the highest percentage of unsatisfactory monitoring results at 31.3% or 10 out of 32 samples.

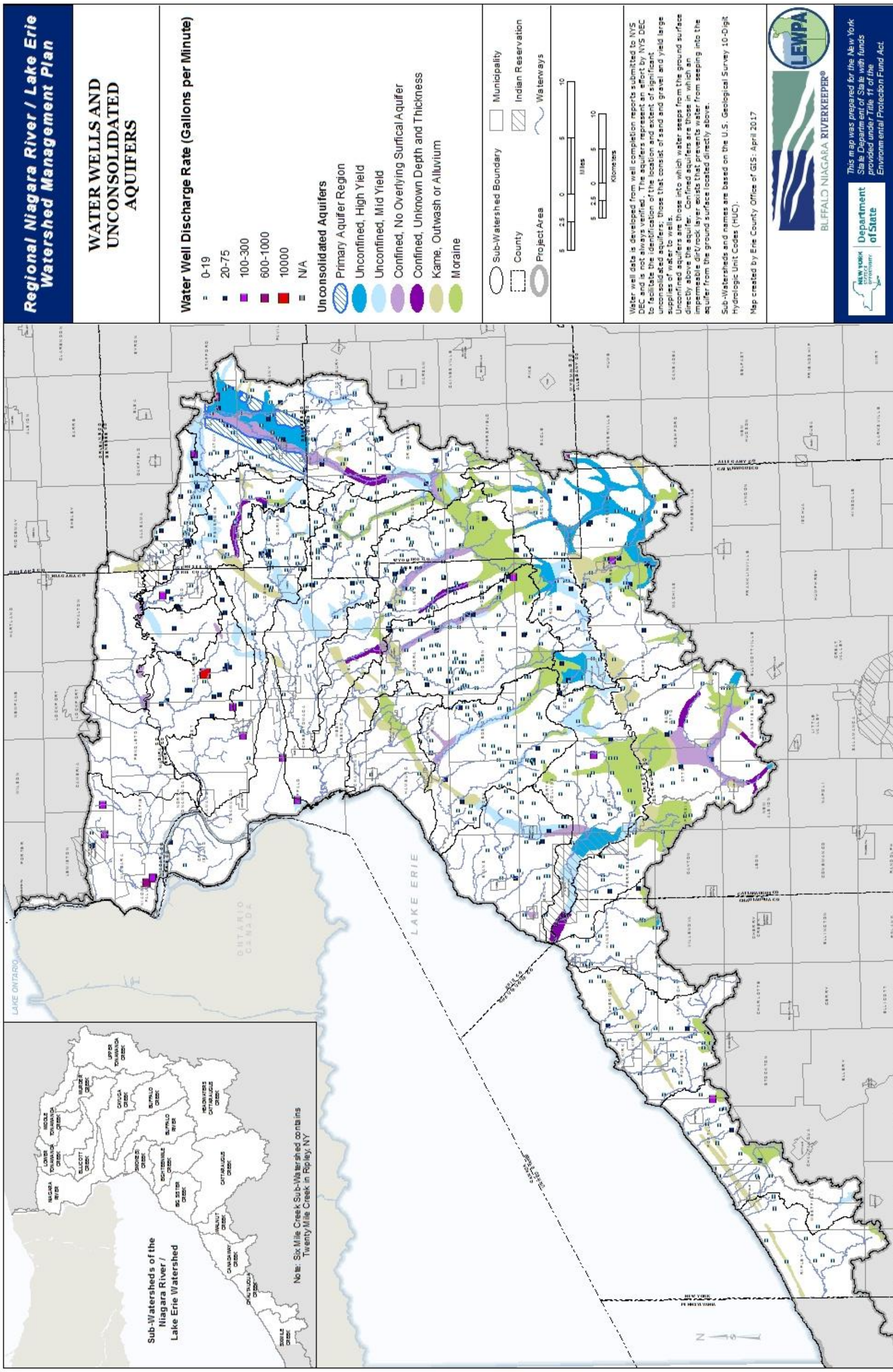
The Erie County Department of Health sampled five beaches in the 2018 season; Bennett Beach, Evans Town Park, Hamburg Beach, Lake Erie Beach, and Camp Pioneer. Thirteen percent of the samples for *E. coli* exceeded the standard of 235 cfu/100ml with Hamburg Beach having the highest number of exceedances (6). There were 38 closure notices issued, some for more than one day, resulting in 66 days of beach closures collectively. The longest closure lasted eight days. Hamburg Beach had both the highest number of closure notifications (14) and the highest number of days closed (19).

Finally NYS Parks sampled at three beaches in 2018; Evangola State Park Beach, Lake Erie State Park Beach, and Woodlawn Beach State Park. Woodlawn Beach had the highest number of closures at 22 based on a mixture of sample results, model prediction, and rainfall amounts.

Drinking Water Supplies

The largest water suppliers are the Erie County Water Authority (ECWA) and Buffalo Water Authority. As of 2016, the ECWA served 480,939 people in 35 municipalities in Erie, Genesee and Wyoming counties and the Buffalo Water Authority served 276,000 people within the City of Buffalo. Their water sources are from Lake Erie and the Niagara River. More information about these water supplies can be found in their most recent water quality reports that are included in the Appendices D and E. There are other smaller water treatment providers along Lake Erie and the Niagara River including the Ripley Water Filtration Plant, Westfield Water Treatment Plant, Brocton

Figure 4.8: Water Wells and Unconsolidated Aquifers in the Niagara River/Lake Erie Watershed



Filtration Plant, Dunkirk Water Treatment Plant, Fredonia Water Treatment Plant, Tonawanda, Water Treatment Plant, Grand Island Water Department, North Tonawanda Water Treatment Plant, and Niagara Falls Water Board.

Many of the rural communities and residents that are not supplied by these systems rely on ground water from bedrock or from surficial deposits of sand and gravel. Some smaller community water systems use surface water from small reservoirs or lakes, while others obtain water from bedrock wells. A map of the watershed's wells and aquifers is provided in Figure 4.8. Many rural residents have private wells. Shallow wells that tap sand and gravel aquifers are susceptible to contamination by several types of substances including volatile organic compounds, pesticides, deicing chemicals, and nutrients from nearby roads, and commercial, agricultural and residential areas. The movement of these contaminants to the water table can be relatively rapid. Bedrock wells in lowland areas with carbonate rock may be vulnerable to contamination from surface runoff. Aquifers can also contain elements such as sodium, chloride, methane, and radon gasses.

Areas of Concern (AOCs)

As mentioned previously, the Buffalo and Niagara Rivers each have areas designated as "Areas of Concern" due to the extent of their historical contamination. The U.S.-Canada Great Lakes Water Quality Agreement (Annex 2 of the 1987 Protocol) defines Areas of Concerns (AOC) as "geographic areas that fail to meet the general or specific objectives of the agreement where such failure has caused or is likely to cause impairment of beneficial use of the area's ability to support aquatic life." In 1987, 43 Areas of Concern were identified throughout the Great Lakes Basin; 26 within the US, 12 within Canada, and 5 shared between the US and Canada. These areas were identified based on their impairments to fourteen listed Beneficial Uses and were required to develop and implement Remedial Action Plans (RAPs). A RAP is developed in three stages: Stage I identifies and assesses use impairments, and identifies the sources of the stresses from all media in the AOC; Stage II identifies proposed remedial actions and their method of implementation; and Stage III documents evidence that uses have been restored[15]. Areas of Concern are "delisted" when all Beneficial Use Impairments (BUIs) have been restored.

Buffalo River Area of Concern

The Buffalo River Area of Concern is located in the City of Buffalo, Erie County, NY. The AOC includes the lower 6.2 miles of the Buffalo River and the adjacent City Ship Canal. The River flows westerly through the City of Buffalo and discharges into Lake Erie near the head of the Niagara River.

[15] US EPA

The Buffalo River and City Ship Canal are man-made waterways which were created to allow for increased shipping and industrialization of the area. Industrial activities led to the contamination of river-bottom sediments, poor water quality, and degradation of nearby wildlife habitat.

The Buffalo River RAP was completed in 1989 by NYS Department of Environmental Conservation (NYSDEC) in partnership with a local citizen's advisory committee. The combined Stage I and Stage II RAP included a remediation strategy of stream water quality monitoring, contaminated bottom sediment assessment and action determination, inactive hazardous waste site remediation, point and nonpoint source discharge evaluation, combined sewer overflow assessment, remedial measure implementation monitoring, fish and wildlife beneficial use restoration, and habitat protection. Between 1989 and 2003, NYSDEC coordinated the Buffalo River Remedial Action Plan process. In October 2003, the USEPA Great Lakes National Program Office (GLNPO) selected Friends of the Buffalo Niagara Rivers (FBNR)[16] to take over coordination of the RAP. With the assistance of the Remedial Advisory Committee (RAC), NYSDEC, and over 30 other governmental and non-governmental agencies and organizations, Riverkeeper is working towards the goal of delisting the Buffalo River as an Area of Concern.

Currently, the Buffalo River has 9 of the 14 BUIs listed as Impaired[17] (Table 4.6). The main impairment causes are contaminated sediments, loss of wildlife habitat, and ongoing contamination from point and non-point source pollution.

Table 4.6 Buffalo River AOC Beneficial Use Impairments

Beneficial Use Impairment Indicator		Current Status	Known or Likely Cause of Impairment
1	Restrictions on Fish & Wildlife Consumption	Impaired	PCB's and Chlordane in sediments.
2	Tainting of Fish & Wildlife Flavor	Impaired	PAHs in sediments.
3	Degradation of Fish & Wildlife Populations	Impaired	Low dissolved oxygen, river channelization, and contaminated sediments.
4	Fish Tumors and Other Deformities	Impaired	Contaminated sediments and navigational dredging.
5	Bird or Animal Deformities or Reproductive Problems	Impaired	PCBs, DDT, and metabolites in sediments.
6	Degradation of Benthos	Impaired	Contaminated sediments and navigational dredging.
7	Restrictions on Dredging	Impaired	Various contaminants in sediments.

[16] FBNR changed its name in July 2005 to Buffalo Niagara RIVERKEEPER®.
[17] https://www.dec.ny.gov/lands/98943.html

8	Eutrophication or Undesirable Algae	Not Impaired	
9	Restrictions on Drinking Water	Not Applicable	
10	Beach Closings	Not Applicable	
11	Degradation of Aesthetics	Impaired	Floatables, debris and foul odor from CSOs and upper watershed.
12	Added Cost to Agriculture	Not Impaired	
13	Degradation of Phytoplankton or Zooplankton Populations	Not Impaired	
14	Loss of Fish & Wildlife Habitat	Impaired	Physical disturbance such as bulk heading, dredging and steep slopes, and lack of suitable substrate.

Work to remediate the contaminated sediment in the Buffalo River AOC began in August of 2011. Phase I (Navigational Dredging; August 2011 – January 2012) removed 550,000 cubic yards of sediment from the center channel of the river. This work was conducted by the US Army Corps of Engineers and funded ($4.6 million) by the Great Lakes Restoration Initiative. Phase II of the project began in October 2013 and was funded ($20 million) by the Great Lakes Legacy Act Program. Phase II dredged approximately 453,000 cubic yards of contaminated sediment from the side slopes of the River and capped approximately 9 acres in the City Ship Canal with 65,000 cubic yards of clean sediment[18]. Dredging was completed in 2014, leading to significant progress towards delisting 7 of the 9 Impaired Beneficial Uses.

Figure 4.9: Phase II of Buffalo River Dredging (2013)

Restoring fish and wildlife habitat is a critical step needed to delist the Buffalo River as an AOC. As part of the Great Lakes Legacy Act Project, five in-water sites were enhanced/restored with in-water plantings and the placement of in-water structures at Ohio Street, City Ship Canal, Katherine Street Peninsula, Buffalo Color Peninsula, and Riverbend. Erie County also received funding from USEPA to enhance shoreline and upland habitat at two of their Natural Habitat Parks on the River (Red Jacket Riverfront Park and Thomas Higgins Park). Although these habitat improvements are complete, it may take years before fish advisories are less restrictive.

[18] More information on the project can be found at www.buffaloriverrestoration.org

Niagara River Area of Concern

The Niagara River Area of Concern is a bi-national AOC. The New York State portion of the AOC is located in Erie and Niagara Counties and extends from the mouth of Smokes Creek at Lake Erie north to the mouth of the Niagara River at Lake Ontario. The Niagara River AOC experienced degradation due to contaminated discharges, shoreline alteration, habitat degradation and inputs from combined sewer overflows and other point and non-point source pollution.

NYSDEC applied a phased approach in the development of this RAP. In 1989, a group of interested citizens was appointed by New York State Department of Environmental Conservation (NYSDEC) as the Niagara River Remedial Action Committee to help develop the RAP. The committee comprised 26 environmental, industrial, sports people, academic, community and local government representatives. Committee representatives and NYSDEC staff created an Executive Committee that directed RAP development. The Executive Committee established RAP goals, mapped out a work plan, defined responsibilities and reviewed draft sections of the RAP. The RAP was completed in 1993 and published as final in 1994; it addresses problems, sources, existing remediation programs and recommends remedial strategies.

Currently, the Niagara River has 6 of the 14 BUIs listed as Impaired (Table 4.7). The main causes of these impairments are contaminated sediment, contamination from hazardous waste sites, and habitat loss. Ongoing water monitoring has shown a significant decrease in the River's contaminant levels since 1987. The improvement is mainly the result of government programs that now routinely address hazardous waste sites, maintain strict limits on pollutants in wastewater discharges, reduce the number of sewer overflows and enhance control of nonpoint source pollution.

Table 4.7 Niagara River AOC Beneficial Use Impairments

Beneficial Use Impairment Indicator		Current Status	Known or Likely Cause of Impairment
1	Restrictions on Fish & Wildlife Consumption	Impaired	Hazardous waste sites, contaminated sediment
2	Tainting of Fish & Wildlife Flavor	Not Impaired	
3	Degradation of Fish & Wildlife Populations	Impaired	Loss of habitat and contamination
4	Fish Tumors and Other Deformities	Not impaired	
5	Bird or Animal Deformities or Reproductive Problems	Impaired on U.S. side/ Not Impaired on Canadian side	Hazardous waste sites, contaminated sediment. The Canadian impairment was removed in 2009.
6	Degradation of Benthos	Impaired	Hazardous waste sites, contaminated

			sediment.
7	Restrictions on Dredging	Impaired on U.S. side/ Not Impaired on Canadian side	Hazardous waste sites, contaminated sediment. The Canadian impairment was removed in 2009.
8	Eutrophication or Undesirable Algae	Not Impaired	
9	Restrictions on Drinking Water	Not Impaired	
10	Beach Closings	Not Impaired on U.S. side/ Impaired on Canadian side	Bacteria
11	Degradation of Aesthetics	Not Impaired	
12	Added Cost to Agriculture	Not Impaired	
13	Degradation of Phytoplankton or Zooplankton Populations	Not Impaired	
14	Loss of Fish & Wildlife Habitat	Impaired	Bulkheading, filling, water diversion, marine development, etc.

A total of 44 hazardous waste sites were found to be potential sources for contaminant migration to the Niagara River. Thirty-seven of these sites are fully remediated. The remaining seven sites currently have remediation under way and only two of the sites continue to contribute pollutants to the Niagara River system. Projects to address contaminated sediment have been completed at 19 locations, resulting in the removal of over 500,000 cubic yards of contaminated material. NYSDEC, the U.S. Environmental Protection Agency, U.S. Army Corps of Engineers, and U.S. Geological Survey are working together to evaluate and address remaining contaminated sediment in the River and tributaries (source areas). In 2014, the U.S. Environmental Protection Agency agreed to add portions of four tributaries (Smoke Creek, including the south branch, Scajaquada Creek, Cayuga Creek, and Gill Creek) to the Area of Concern to make them eligible for federal funding to address contaminated sediment under the Great Lakes Legacy Act. The U.S. Environmental Protection Agency is considering the addition of up to six additional tributaries that may also be sources of contaminants to the Niagara River. These include Two Mile Creek, Rattlesnake Creek, Lackawanna Ship Canal, Tonawanda Creek, Bergholtz Creek, and the Little Niagara River at Cayuga Island.

Other efforts have focused on the habitat loss and impacts to fish and wildlife. More than 40 habitat related projects are either completed or ongoing. These include eight habitat projects the New York Power Authority agreed to fund as a benefit of the 2007 Niagara Power Project relicensing. The Power Authority also agreed to provide additional funds for future projects. A regional commission has created a Greenway Plan to expand and enhance parks and conservation areas along the River, increasing public access for recreation.

The Canadian RAP is entering its final phase and is also working to delist this AOC. A bacteria track-down study completed in 2019 identified sources of bacteria that result in restrictions on swimming at one beach in the Canadian section of the AOC, and efforts are underway to design and plan implementation of remedial actions to address the issue. Future contaminant issues will be addressed through routine federal, provincial and municipal abatement and enforcement programs.

In addition, the agencies participating in the binational Niagara River Toxics Management Plan continue to monitor contaminant levels in the river in order to eventually delist the restrictions on fish consumption.

Binational Water Quality Reports

Under the Great Lakes Water Quality Agreement (GLWQA), the governments of Canada and the United States agreed to restore and maintain the chemical, physical, and biological integrity of the waters of the Great Lakes Basin Ecosystem. Lakewide Action and Management Plans (LAMPs) for each lake are developed to identify actions required to restore and protect the lakes and evaluate the effectiveness of those actions.

The Binational Nutrient Management Strategy[19] was developed in 2011 as a coordinated and strategic response from Canada and the United States to outline nutrient management actions to reduce phosphorus loading and the eutrophication of Lake Erie. It required the development of Domestic Action Plans for reducing phosphorus loading by the province of Ontario and four states draining to Lake Erie. New York State is not required to develop a Domestic Action Plan for phosphorus at this point, however nutrient monitoring is underway.

The 2019-2023 Lake Erie LAMP is still under development. The 2018 Lake Erie LAMP Annual Report[20] by the Lake Erie Partnership describes the progress toward goals set forth in the previous LAMP and other binational reports. It includes not only the Lake Erie Watershed, but also the St. Clair River, Lake St. Clair, and the Detroit River watersheds, which drain into Lake Erie. The 2108 Annual Report focused on phosphorus entering Lake Erie including the development of the Domestic Action Plans for phosphorus. In addition, this Annual Report includes updates on the progress toward cleaning up Areas of Concern (AOC), including the Buffalo River AOC and Niagara River AOC.

[19] Lake Erie LAMP. 2011. Lake Erie Binational Nutrient Management Strategy: Protecting Lake Erie by Managing Phosphorus. Prepared by the Lake Erie LAMP Work Group Nutrient Management Task Group. https://www.epa.gov/sites/production/files/2015-09/documents/binational_nutrient_management.pdf

[20] https://binational.net/2019/03/21/lear2018/

The Lake Erie Biodiversity Conservation Strategy[21] is another binational initiative. It identifies specific strategies and actions for protecting the native biodiversity of Lake Erie with the goals of assembling available biodiversity information and defining a vision for its conservation and restoration, as well as describing the ways in which conservation strategies can benefit people through ecosystem services. The high priority critical threats in the eastern basin of Lake Erie are shoreline alternations, point and non-point source pollution, invasive species, development, climate change, and contaminated sediments.

The Niagara River portion of the Niagara River/Lake Erie Watershed is located in the Lake Ontario LAMP area since connecting channels have been designated by the U.S. Environmental Protection Agency to "belong" to the Great Lake watershed to which they drain. The draft 2018-2022 Lake Ontario Lakewide Action and Management Plan[22] is out for public comment. Lake Ontario is assessed to be in "fair" condition. As the most downstream of the Great Lakes, the majority of contaminants in Lake Ontario originate from upstream sources in Lake Erie and the Niagara River.

The Niagara River Toxics Management Plan is also being used to track the chemical loading on both ends of the Niagara River at Fort Erie and Niagara-on-the Lake. The overall goal is to achieve significant reductions in toxic contaminants in the Niagara River.

Fish Consumption

Figure 4.10: Fishing on Niagara River

Because of the industrial past of the Western New York region, fish consumption advisories exist throughout a large portion of the watershed today. The NYS Department of Health issues advisories with support from the NYS DEC who performs regular testing of fish species. Presently there are many local fish species on the advisories;[23] those specifically listed include Carp, Rock Bass, Yellow perch, Burbot, Channel catfish, White perch, White sucker, Lake trout, and Brown trout. However, there are several locations within the watershed where the Department of Health has advisories for "all other fish" as well, such as the Niagara River, Lewiston Reservoir, Delaware Park (Hoyt) Lake, Cayuga Creek (Niagara County), Buffalo River, City of Buffalo Inner and Outer Harbor, and portions

[21] https://binational.net//wp-content/uploads/2015/02/LakeErieBCSen.pdf
[22] Environment and Climate Change Canada and the U.S. Environmental Protection Agency. 2018. Lake Ontario Lakewide Action and Management Plan, 2018-2022. https://binational.net/wp-content/uploads/2019/04/2018-Lake-Ontario-For-Public-Comment-APRIL-2019.pdf
[23] https://www.health.ny.gov/publications/2792.pdf

of the Erie Canal. Contaminants of concern include PCBs, Dioxins and Mirex. Advisories caution that consumption be limited to either 1-4 meals/month or not at all, depending on your demographic, with the most restrictions provided for children under the age of 15 and women of child bearing years.

Unfortunately, many of Buffalo's immigrant and refugee populations often engage in subsistence fishing on the Buffalo and Niagara Rivers, unknowingly exposing themselves to toxic chemicals. Many of these people are uninformed about the potential health risks resulting from exposure to contaminants via the degraded waterway and fish consumption. To better inform these anglers in the City of Buffalo and regional anglers overall, Buffalo Niagara Riverkeeper, in partnership with Jericho Road Ministries, developed more accessible and easily understood versions of the New York State Fish Consumption Advisory, using more symbols and illustrations to convey information to non-English speakers. Also, pamphlets detailing the risk of consumption to mother and child are translated into several languages and presently given out at family clinics; informative and aesthetically pleasing posters are hung in doctor's offices; and, pocket-sized fishing guides, also translated into different languages, are given out at fishing sites. A fish consumption sign was also installed at Broderick Park. Despite these efforts, Riverkeeper has found that additional outreach is necessary to better inform and educate these vulnerable populations.

Causes & Contributors to Water Quality Impairments

According to the NYSDEC many of the watershed's Impacted Uses identified in the RIBS data are associated with a variety of point and non-point pollution sources, including combined and sanitary sewer overflows, stormwater runoff, and historic contamination. In addition, there are other new and emerging threats affecting the watershed at this time, such as climate change, ecosystem changes, pharmaceuticals and other man-made chemical compounds.

Types of Pollution

There are five main types of pollution affecting our waters; toxic, sediment, nutrient, bacterial, and thermal. *The Protecting Water Resources through Local Controls and Practices: An Assessment Manual for New York Municipalities*[24] outlines four of the pollution types as follows:

> Water pollution can be described as the introduction of substances into a body of water that adversely affects its quality or intended use. As direct (or "point source") pollution from sewage treatment plants and industry has decreased, attention has turned to other sources of water pollution. Non-point source pollution such as rainwater and snow melt running off of

[24] Prepared by Genesee/Finger Lakes Regional Planning Council (June 2006).

roofs, parking lots, streets, lawns, agricultural lands, and construction sites has significant impacts on water quality. Point sources of pollution can often be more easily monitored and regulated using existing technologies because the pollutants enter the environment at a specific location, whereas non-point sources are more difficult to evaluate and regulate because pollutants come from a broader area. Rain water flowing over land picks up a wide array of contaminants ranging from salt used for de-icing roads, leaked motor oil and gasoline on driveways and parking lots, agricultural and lawn chemicals, and large amounts of silt from construction sites. Streams, rivers, ponds, lakes and wetlands that are polluted by stormwater runoff can suffer from such effects as salinization (high levels of dissolved salts), eutrophication (excessive nutrient levels), and siltation (large deposits of silt), to name a few.

Pollutants can be classified as being toxic, sediment, nutrient, bacterial, or thermal.

Toxic pollution includes chemicals that poison and kill organisms. When high levels of toxins accumulate in fish tissue that threaten human health, advisories to limit consumption are issued, such as those mentioned earlier. Contaminated legacy sediments from past industrial activity and hazardous waste sites are a significant issue in our urban waterways, especially within the Areas of Concern. Examples of toxic pollutants include pesticides and herbicides; gasoline, oil, and other automotive chemicals; household cleaning products; paints and solvents; battery acid; and industrial chemicals and byproducts such as radioactive materials.

Sediment pollution includes soil, sand, silt, clay, and minerals eroded from the land surface and washed into water. Sediment is typically generated from areas with exposed soils. Without vegetative cover, rainwater flows quickly off land surfaces picking up soil particles, rather than slowly soaking into the ground. Hard surfaces such as roofs, streets, and parking lots prevent rain water from slowly soaking (infiltrating) into the ground. The resulting increase in water quantity and velocity can erode stream banks leading to further sedimentation. Sediment overload causes a number of problems for aquatic organisms by increasing turbidity and blocking light. Sediment also often picks up other forms of pollution such as toxins, nutrients, or bacteria.

Nutrient pollution results from an overabundance of substances such as nitrogen and phosphorus, and is often referred to as nutrient loading. Higher nutrient levels induce the prolific growth of aquatic plants and algae. When large quantities of algae die off, bacterial decomposition uses dissolved oxygen, depriving living organisms of the oxygen they need (aka. eutrophication). The depletion of oxygen also kills the small aquatic invertebrates consumed by fish. Higher nutrient levels from the fertilizing and growth of vegetation can also make swimming, boating, and fishing difficult. Sources of nutrient pollution can include sewage treatment plant discharges, leaking septic systems, industrial discharges, and agricultural and lawn/garden care fertilizers.

Bacterial pollution occurs when an excess of harmful bacteria is present. This can cause sickness or be lethal to animals and humans that consume contaminated water. Sources of bacterial pollution include combined sewage overflows, sanitary sewer overflows, failing septic systems, leaking sanitary sewer infrastructure, and animal or wildlife wastes.

In addition to toxic, sediment, nutrient, and bacterial pollution types outlined in the Genesee/Finger Lakes Regional Planning Council Guide, thermal pollution should also be considered a major pollution type within the Niagara River Watershed. Thermal pollution is defined as the degradation of water quality by any process that changes ambient water temperature. Water temperature can be affected by many things, including natural influences and man-made influences. For example, a stream corridor's lack of overhanging trees and vegetation would be considered a natural heating process, as exposure to sunlight is causing a thermal increase in the stream. Man-made influences can include power plants and other manufacturing processes where high water volumes of heated water are discharged into a waterway.

Thermal pollution can have a negative effect on aquatic species including fish, amphibians, and macroinvertebrates by altering their metabolic rates, reducing the amount of dissolved oxygen, and increasing bacterial levels. Dissolved oxygen levels also have a direct effect on the frequency and extent of algal blooms, further impacting water ecosystems. Even with minor temperature changes, stream corridors can go from habitable to inhabitable for certain species, such as Brook Trout, Brown Trout, and Salmon.

SPDES Facilities & Other Permitted Discharges

Point source pollution comes from facilities and infrastructure that discharge directly into streams and water bodies. In the Niagara River/Lake Erie Watershed, these include National Pollution Discharge Elimination System (NPDES) permitted facilities; State Pollution Discharge Elimination Systems (SPDES) permitted facilities, Combined Sewer Overflows (CSOs), Sanitary Sewer

SPDES facilities can contribute toxic, sediment, nutrient, bacterial, and thermal pollution depending on the type of facility discharging.

Figure 4.11: State Pollutant Discharge Elimination System locations

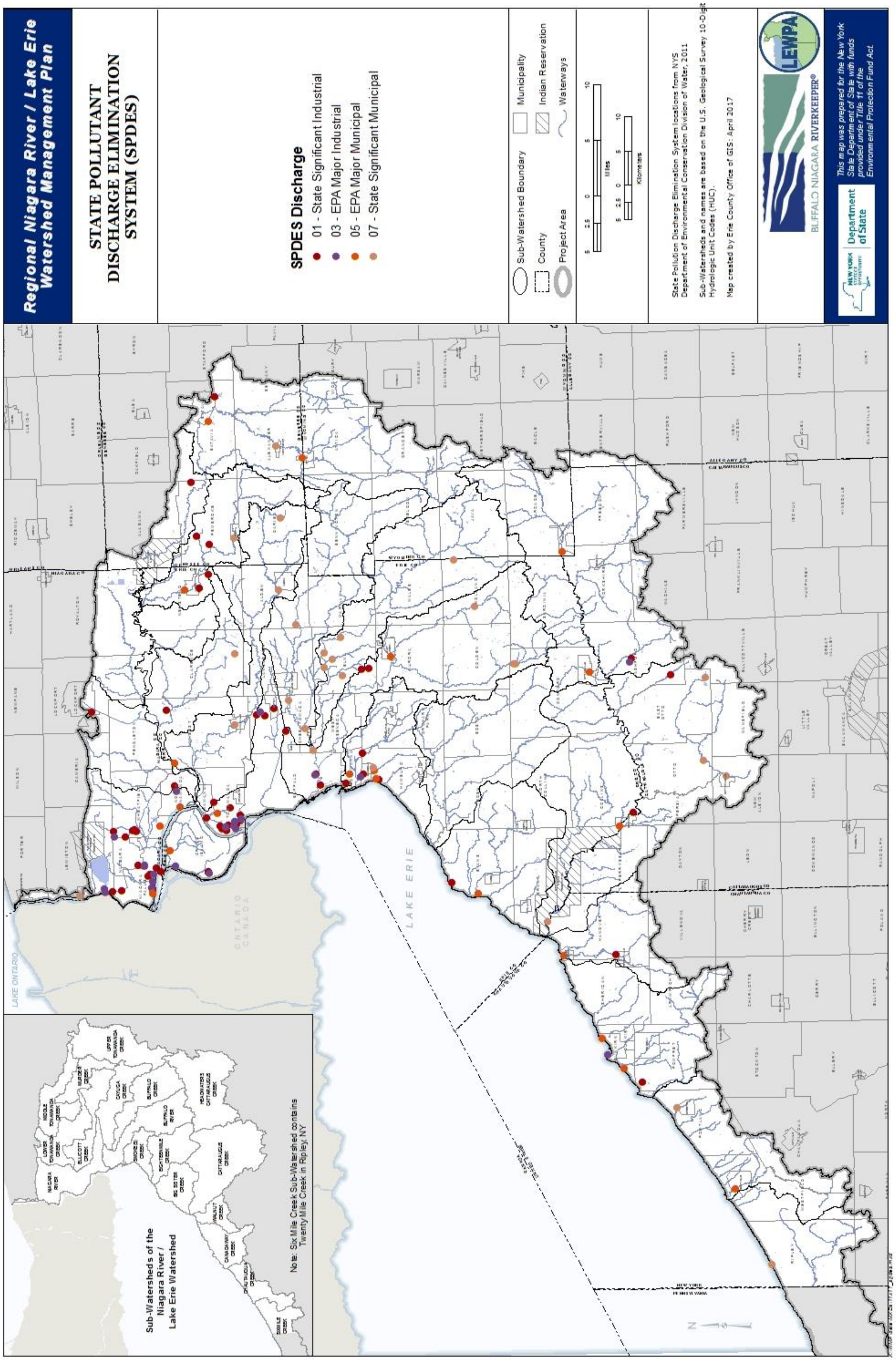


Figure 4.12: Environmental Protection Agency Regulated Facilities (1 of 2)

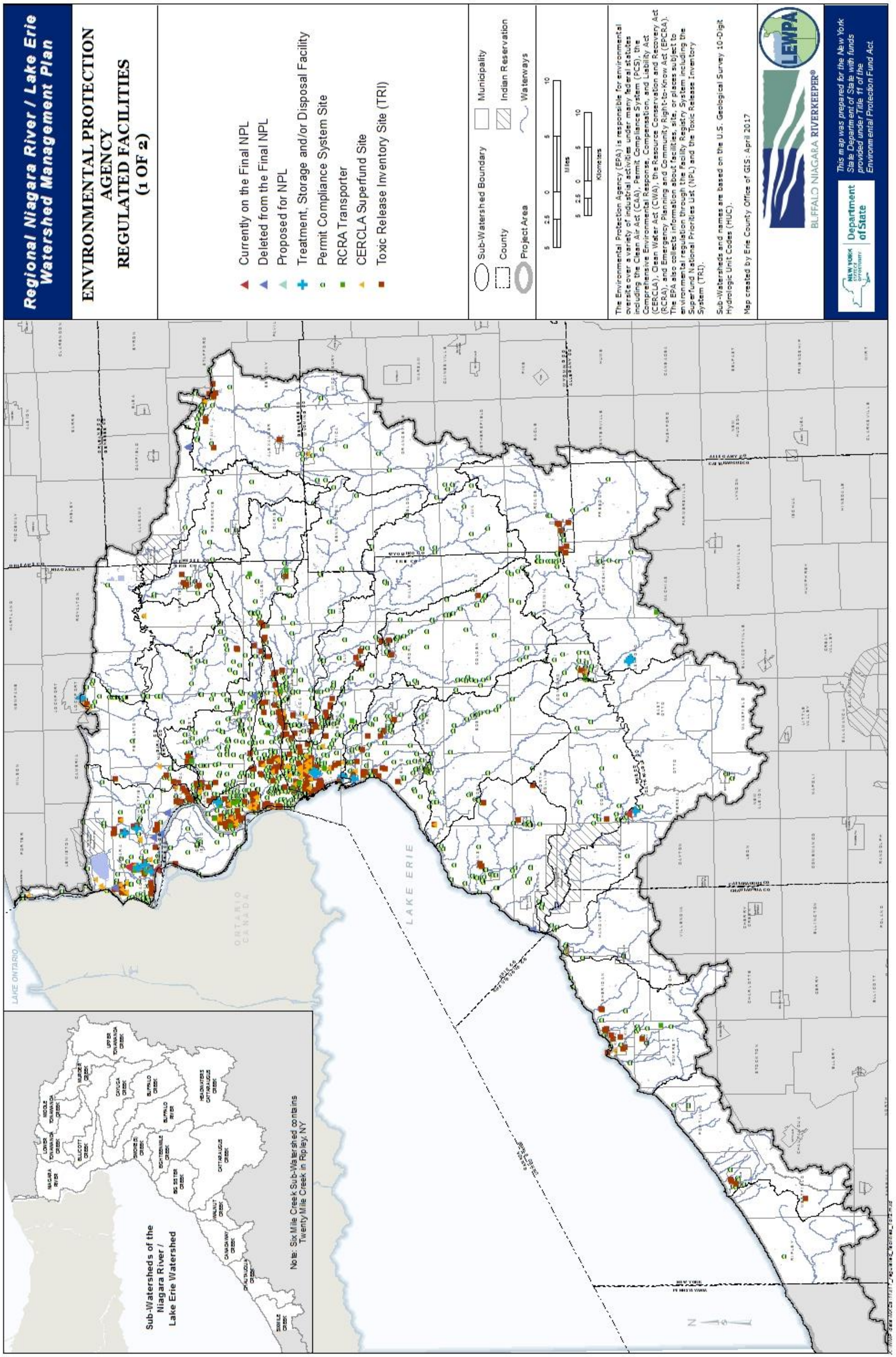
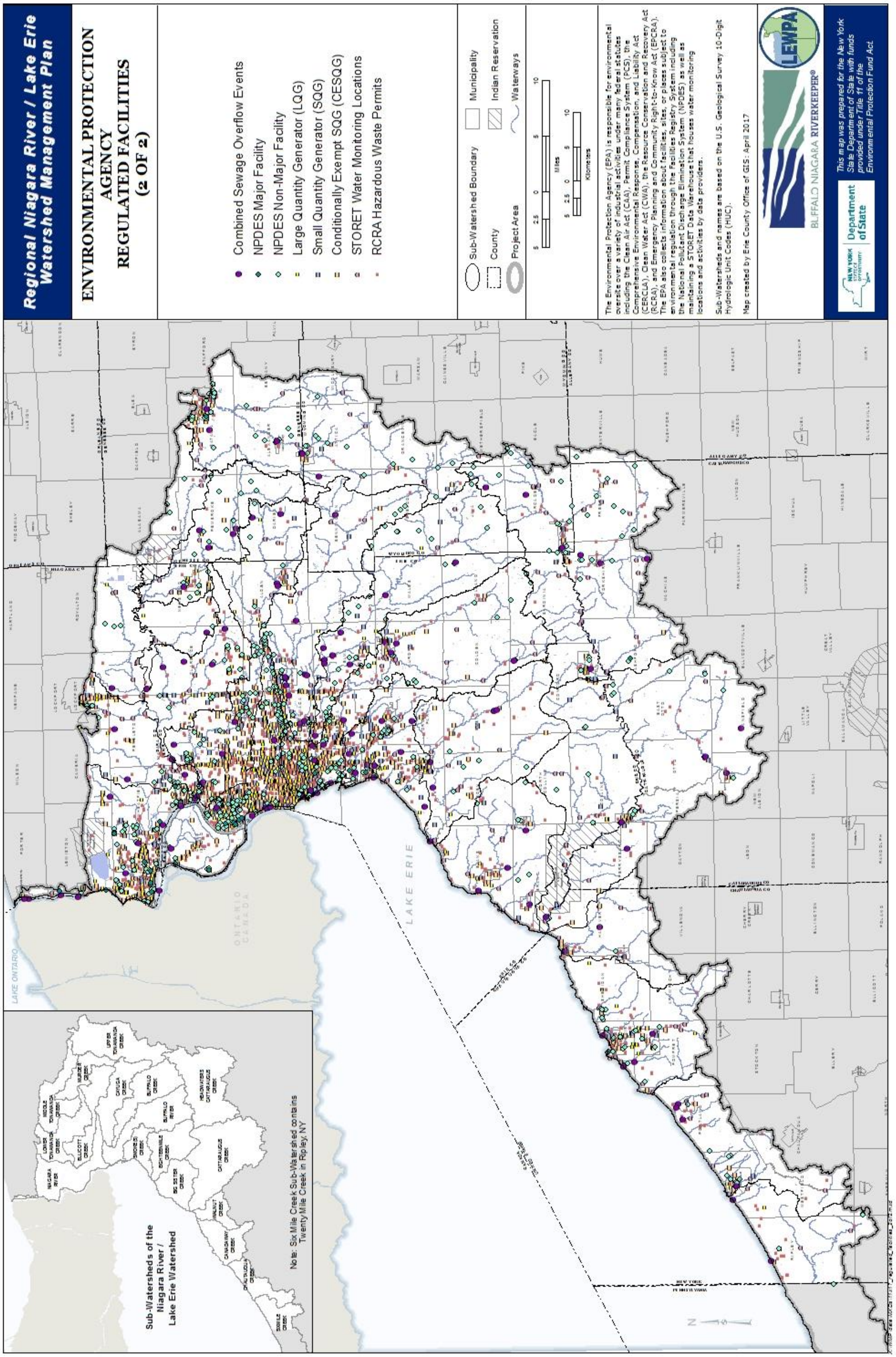


Figure 4.13: Environmental Protection Agency Regulated Facilities (2 of 2)



Overflows (SSOs), and Municipal Separate Storm Sewer Systems (MS4s).

All of these point source discharges are regulated as part of the Clean Water Act. New York State's SPDES permitting program administers all the NPDES permitting in the state and is currently broader in scope than required by the Clean Water Act, in that it controls point source discharges to ground waters, as well as surface waters. The dataset for SPDES and NPDES from NYSDEC identifies 725 permitted facilities (points) within the Niagara River/ Lake Erie Watershed. All of these facilities are provided in Figures 4.11, 4.12, and 4.13.

NYS's SPDES Program does have General Permits in place for the following activities:

- Multi-Sector General Permit (stormwater discharges from industrial activity)
- Aquatic Pesticides
- Private/Commercial/Institutional (to groundwater, 1,000 – 10,000 gpd)
- Concentrated Animal Feeding Operations (Medium or Large)
- Construction
- Vessels

Combined Sewer Overflow Systems (CSOs), Sanitary Sewer Overflows (SSOs), and Municipal Separate Storm Sewer Systems (MS4s) are discussed in detail on the following pages. The remaining facilities making up NPDES and SPDES permitted facilities include industrial operations, food processing plants, private sewer districts, and power generation facilities, to name a few. The discharges released by these types of facilities can include untreated waters that have such things as heavy metals, chemical compounds, food wastes and bi-products in them as long as the levels fall below permitted amounts. Some permits require waters to be pre-treated prior to release, but again the amount of contaminants must remain within allowable levels, as dictated by state regulations.

Combined Sewer Overflows (CSOs)

CSOs contribute toxic, sediment, nutrient and bacterial pollution.

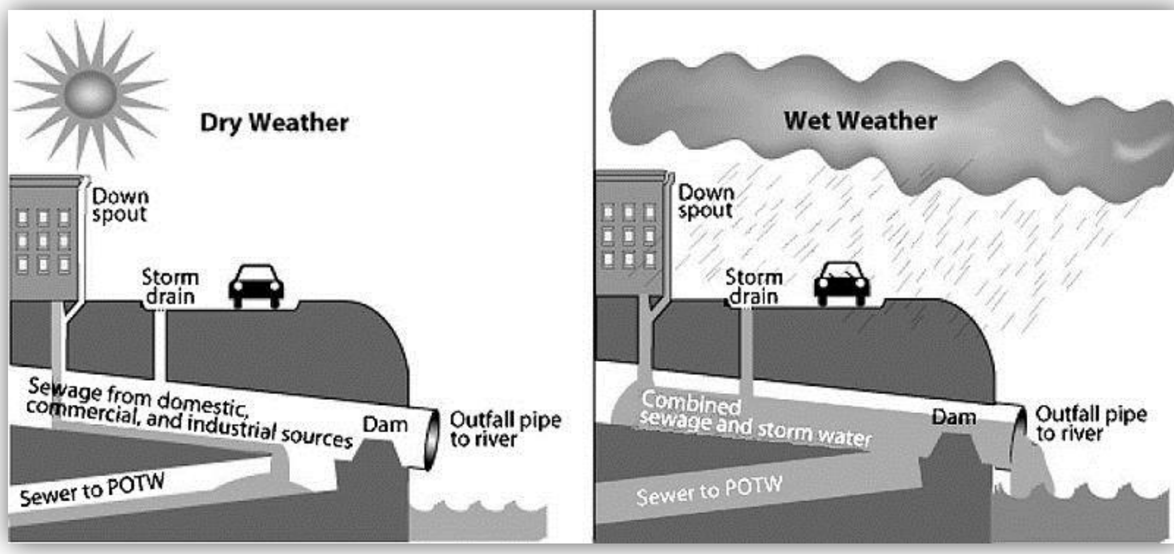
Combined Sewer Systems are conveyance systems that are designed to collect stormwater runoff, domestic sewage, and industrial wastewater in the same pipe. Most of the time, combined sewer systems transport all of the wastewater to a sewage treatment plant, where it is treated before being discharged to a local waterbody.

However, during periods of heavy rainfall or snowmelt, the total water volume in a combined sewer system can exceed the capacity of the sewer system or treatment plant. In this instance, CSOs will overflow and discharge untreated or partially treated water directly into streams, rivers, or other waterbodies in order to prevent basement back-ups and flooding (Figure 4.10).

These systems contribute to water quality issues when they overflow. Types of pollutants that can empty into local water bodies from combined sewer system overflow events are:

- Untreated human waste, which can host *E. coli* and Botulism (Type C) bacteria;
- Industrial waste;
- Litter and trash;
- Sediment and debris;
- Toxic pollutants from fertilizers and pesticides.

Figure 4.14 Combined Sewer System Outfalls in Dry and Wet Weather



Source: US EPA

In the Niagara River Lake Erie Watershed, five communities have Combined Sewer Systems: The cities of Buffalo, Dunkirk, Lockport, North Tonawanda, and Niagara Falls, the Town of Lewiston, and the Village of Lewiston.

Combined sewer overflows are regulated as point sources of pollution by the New York State Department of Environmental Conservation. The Buffalo Sewer Authority manages the largest CSO system in the watershed, having 790 miles of combined sewer lines and 52 permitted outfalls. The NYSDEC and the U.S. Environmental Protection Agency accepted Buffalo Sewer Authority's Long Term Control Plan in March 2014 through an Administrative Order. The Plan consists of green, smart, and grey infrastructure solutions and is expected to have a major positive impact on water quality in the Niagara River/Lake Erie watershed as it is implemented over 20 years.

The Buffalo system overflows into the Niagara River and four of its tributaries: the Buffalo River, the Black Rock Canal, Scajaquada Creek, and Cazenovia Creek. When implemented, the Plan is expected to reduce annual CSO volume activations from 41-69 per waterway to 2-9 per waterway and increase the wet weather flow percent capture from 91.3% to 97.4%. Buffalo Sewer Authority has already completed four Smart Sewer projects, which maximize usage of existing storage capacity in the collection system and have captured over 1,000 acres of stormwater runoff through the use of green infrastructure.

The City of Niagara Falls has significantly fewer combined sewer overflow points than the City of Buffalo, six in total. The Niagara Falls CSOs are owned and operated by the Niagara Falls Water Board, a separate water-sewer utility entity. All of the CSOs discharge to the Niagara Gorge. Several high-profile discharges have occurred recently into the Niagara River. The Water Board suspects that groundwater is infiltrating the system via cracked pipes and deteriorated pipe connections, adding to the amount of rainfall entering the system and overall number of overflow events. The Water Board is under a consent order from the NYSDEC as of December 2017. The State is contributing $20 million and the Water Board is contributing $13.5 million toward upgrades to the treatment plant.

Figure 4.15: Combined Sewer Outfall, Cazenovia Creek

The City of Lockport is divided by the Niagara Escarpment, the northern boundary of the watershed, meaning a portion of its infrastructure is located outside of the watershed, including the wastewater treatment plant. In addition, only a portion of the City of Lockport's sewer system is a combined system (approximately 30%). The city currently has 10 CSOs, 7 of which are located in the watershed. There are plans in the engineering stages to close several of the CSOs.

The City of North Tonawanda's combined sewer system includes 5 CSOs, all of which discharge to the Niagara River. The city typically only utilizes the CSOs, or old bypasses as they are referred to, during major residential flooding events, which has been few times per year, typically during snow melt or heavy rains.

The City of Dunkirk Waste Water Treatment Plant has one CSO. Any overflow is dosed with chlorine at the plant before an overflow event. Repairs and upgrades are underway at the plant to increase capacity in preparation for the new Athenex facility in Dunkirk. There are temporarily more CSO events occurring during this construction period as portions of the plant are taken offline for repair, but that is expected to decrease once construction is complete.

There are also two CSOs located in the Village and Town of Lewiston, both discharging to the lower Niagara River, one of which is near the Stella Niagara property. These each see several overflows per year based upon the intensity of rainfall or snow melt events.

SSOs contribute toxic, sediment, nutrient and bacterial pollution.

Sanitary Sewer Overflows (SSOs)

Sanitary Sewer Overflows (SSOs) fulfill a similar purpose to Combined Sewer Overflows. However, sanitary sewer systems are designed to carry domestic sanitary sewage, but not stormwater. System blockages, groundwater and stormwater infiltration into sewage pipes, or infrastructure problems can result in sanitary sewage overflow events into local waterways.

New York State has a Sewage Pollution Right to Know Law that requires treatment plants and sewer systems to publically disclose discharges. This includes sanitary sewer overflows and discharges from one sewer system to another. For instance, the Village of Kenmore does not discharge to any waterbodies, but empties to the Town of Tonawanda sewer system. There are multiple connection points and thus, many notifications are generated during each storm event. According to reporting to NYSDEC, approximately 1,710 overflow events occurred between June 13, 2018 and May 31, 2019. The volumes discharged are mostly estimated and mostly due to storm events causing infiltration into the system, although in some cases there may be a blockage, pipe breakage, illicit tie-in, or other issue with the system. Of these reported incidents, the top five communities with discharges during this timeframe are as follows:

1. Village of Kenmore = 657 reports
2. Town of Cheektowaga = 274 reports
3. City of Niagara Falls = 168 reports
4. Town of West Seneca = 160 reports
5. Town of Tonawanda = 155 reports

In this same data set where the receiving waters of the discharge were noted, Two Mile Creek was the most reported. The Village of Kenmore reports this as the discharge waterway, but the flow from Kenmore enters the Town of Tonawanda for treatment and there are fewer reports of discharges to Two Mile Creek from the Town of Tonawanda. Cazenovia Creek, Scajaquada Creek, Niagara River, and Ellicott Creek receive the most discharges in that order. In the majority of cases heavy rain events were cited as the cause, meaning old, cracked or broken infrastructure is receiving stormwater and groundwater inflows that contribute to the need to open a SSO pipe rather than inundate the wastewater treatment plants. Funding for infrastructure upgrades is critical in the Watershed, especially in older urban areas where pipes may be in a state of disrepair.

Many communities in the watershed have taken steps to identify where their inflow problems are and address them slowly with infrastructure upgrades as municipal budgets allow. However, there are some communities, such as Cheektowaga, where some of the issues may stem from poor private connections to the public sewer and with a lower-income tax base there is little desire to force tax payers to bear the burden of fixing it. In order for the SSO situation to improve at a faster rate, innovative funding mechanisms should be identified and implemented.

Stormwater Infrastructure and Municipal Separate Storm Sewer Systems

As mentioned in Chapter 2, stormwater infrastructure and Municipal Separate Storm Sewer Systems (MS4s) are a conveyance network of pipes, culverts and ditches that transport stormwater into retention ponds or area waterways. Stormwater infrastructure is the primary collector of non-point source pollution, as stormwater run-off typically picks up roadway contaminants, sediments, animal wastes, fertilizers and pesticides, and litter, amongst other things. Unlike combined sewer systems, where stormwater has the opportunity to be treated at a waste water treatment plant prior to release, stormwater conveyed through separated infrastructure is not treated.

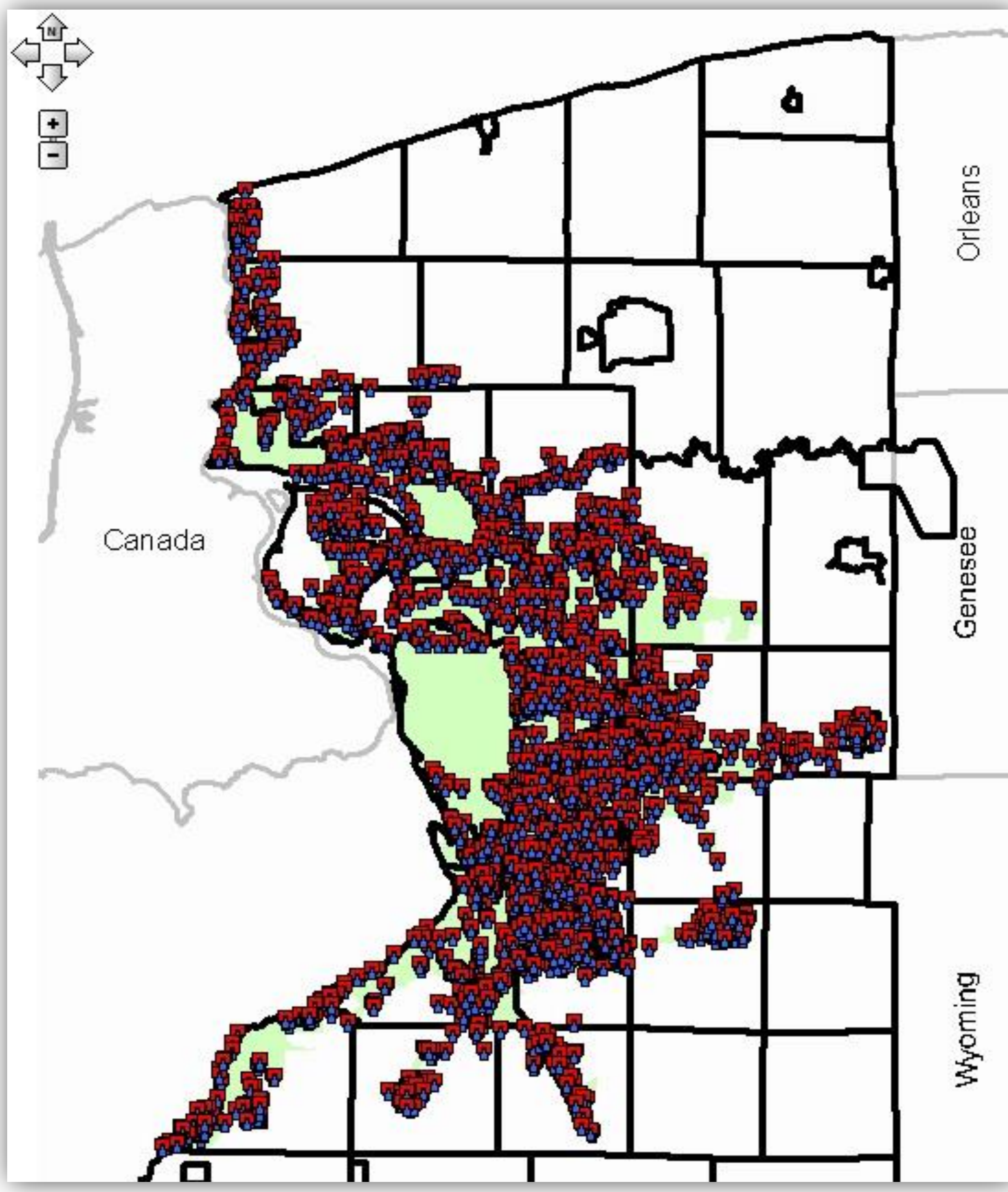
Urban and Rural Stormwater Runoff contribute sediment, nutrient, bacterial and thermal pollution to the watershed.

Water quality impacts from stormwater runoff can be significant with multiple impacts on water quality and aquatic life. Many rivers, streams and lakes are impaired and degraded due to polluted stormwater runoff. Nutrients such as phosphorus and nitrogen can cause the overgrowth of algae resulting in waterway oxygen depletion once those organisms start to die off. Toxic substances from motor vehicles and careless application of pesticides and fertilizers threaten water quality and can kill fish and other aquatic life. Bacteria from animal wastes and improper connections to storm sewer systems can make lakes and waterways unsafe for recreation and fish consumption. Eroded soil is a pollutant that clouds the waterway and interferes with the habitat of fish and plant life.

Figure 4.16: Example of MS4 Pollution

All areas of the watershed have some form of stormwater infrastructure. In more urban areas, stormwater infrastructure may be fully underground, with storm drains and pipes. In rural communities much of the stormwater network is made up of roadside ditches and retention ponds.

Figure 4.17 WNY Stormwater Coalition Outfall Locator



Suburban municipalities usually include a mixture of both types of infrastructure. The WNY Stormwater Coalition has undertaken a major mapping effort to document the stormwater infrastructure, their flow directions, and outfall locations in order to better plan and maintain this infrastructure in MS4 regulated communities. Figure 4.17 outlines the MS4 outfall locations in the watershed as documented by the WNY Stormwater Coalition[25]. Maps have been provided to MS4 communities in order to better track down contaminants and maintain stormwater infrastructure in the Watershed. More information on MS4s can be found in Chapter 2.

Increasing development and higher levels of impervious cover (as found in high-density urban areas), contribute more and more stormwater into these conveyance systems, reducing the ability for rain water and snow melt to be filtered and cleaned through groundwater infiltration because most of this infrastructure is designed to move stormwater quickly and without treatment to our waterways. Poor design can create channelized stormwater routes that funnel water rapidly to waterways causing flash flooding or intense erosion points. Un-vegetated ditches or steep slopes in ditches without check dams can direct sediment to waterways, which is a major pollutant. This redirect of waters decreases base flow in headwater streams, which often results in negative impacts on channel stability and the health of aquatic biological communities. Common problems include bank scouring and erosion, increased downstream flooding, and loss of in-stream habitat for macroinvertebrates, fish, and other organisms.

As regulatory requirements have increased for MS4 communities subject to NPDES permitting, there has been increasing interest in evolving MS4 infrastructure into "greener" systems. Opportunities exist with stormwater system designs to build in natural green infrastructure that can capture, store, and filter stormwater prior to its direct release into area waterways. In communities around the country, wetlands are being constructed as a means to filter stormwater prior to discharge into drinking water bodies. The Town of Aurora has begun considering roadside ditches and discussing best management practices with neighboring landowners as a means to reduce sediment erosion and improve filtering opportunities. In order to affect the volume of stormwater entering our waterways, as well as its quality, efforts should be undertaken to improve MS4 design and maintenance practices in the watershed to improve their support of water quality (i.e. natural filtration, buffering, reduced erosion, and increased infiltration).

Transportation Infrastructure Impacts

In addition to stormwater infrastructure along transportation infrastructure, such as ditches, road and railway bridges over waterways can cause water quality impacts. Poor culvert placement or undersized culverts can create a raised step on a waterway creating barriers to fish migration, breaking stream connectivity, and stranding aquatic life. Raised culverts can also cause erosion and pooling at the base. A crucial area of interference is the intersection of a waterway by a roadway. Without careful design, bridge abutments change the geometry of the stream bed and floodplain. They can constrict the channel, increase velocity, and cause scour around the abutments weakening the bridge's structural integrity and causing sediment to enter the waterway.

[25] http://gis2.erie.gov/HTML5/ENSSO/PublicLaunchPage.aspx

Well-designed bridges should span the entire waterway without disturbing or altering the waterway bed or banks. Culvert bottoms should be placed below the stream bed to allow for gravel substrate as aquatic habitat to continue upstream without large steps. Roadside maintenance practices are a potential source of contamination from bridge washing/ painting and can often aid the spread of invasive species as well, when groundcover is disturbed.

The North Atlantic Aquatic Connectivity Collaborative has developed common protocols to assess culverts for fish passability. It has recently been adopted locally by agencies such as U.S. Fish and Wildlife, Buffalo Niagara Riverkeeper, and local Soil & Water Conservation Districts who are assessing culverts and adding the information to the nationwide database. This information can be used by highway departments as they replace old culverts to ensure they are the correct size and placement for fish habitat. In many cases, upsizing culverts for fish passage may increase resiliency to storm impacts by allowing for more storm volume to pass through previously constricting culverts. This can reduce the number of road wash-outs as the intensity of storms increases. It is important to note that in a few cases, perched culverts may be acceptable to stop the spread of steelhead from impacting native brook trout population upstream. These are considered low priority for replacement as a result.

In addition, transportation infrastructure can contribute water quality pollution to the watershed as a result of salt application and other de-icing materials used to keep roadways safe. Both roads and airports use de-icing materials to prevent the formation of ice on surfaces, including airplanes, during the winter. Snowmelt and spring rains can cause salt and other pollutants to enter nearby waterways. Current water quality monitoring underway in the watershed measures specific conductivity. The higher the specific conductance, the more ions and/or inorganic materials dissolved in the water causing electricity to be conducted. If the results come back elevated, plans are in place to track down potential sources of ions or inorganic materials, which can include de-icing materials.

Agricultural Operations

Agriculture Districts are located throughout the Watershed for the purpose of promoting the continued use of farmland for agricultural production. Benefits include partial real property tax relief and protections against overly restrictive local laws, government funded acquisition or construction projects, and private nuisance suits involving agricultural practices.[26] For example, local laws requiring buffers or setbacks, constructing fences, and otherwise restricting land used for agricultural purposes are generally considered unreasonably restrictive.[27] Therefore, it can be difficult to require farmers to maintain buffers for water quality purposes.

[26] New York State Agriculture and Markets website https://www.agriculture.ny.gov/ap/agservices/agdistricts.html
[27] https://www.agriculture.ny.gov/AP/agservices/guidancedocuments/305-aZoningGuidelines.pdf

Agricultural Operations can impact neighboring waters in numerous ways. The 2000 National Water Quality Inventory reported that agricultural non-point source pollution is the leading source of water quality impacts on surveyed lakes and rivers, the second largest impairment to wetlands, and a major contributor to contamination of surveyed estuaries and groundwater. In the Niagara River/ Lake Erie Watershed, three of the 18 sub-watersheds have over 30% of their land use in agriculture, with another eight hosting 20-29%, and the last seven less than 19%.

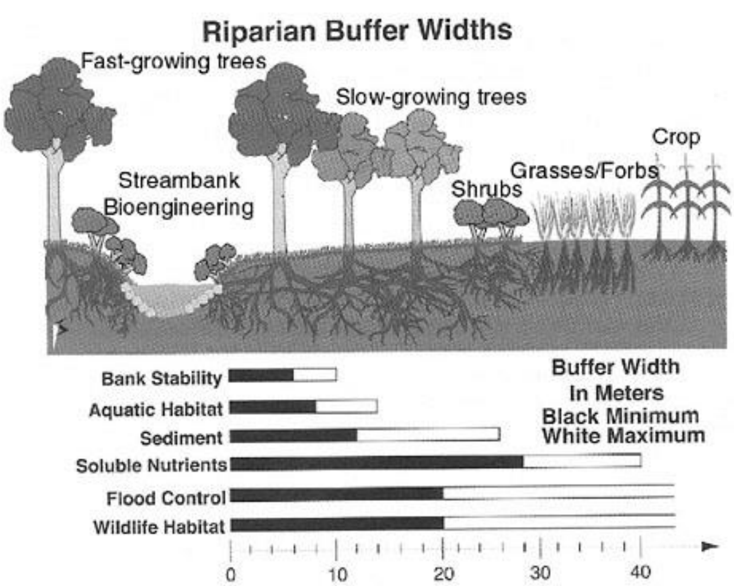
Table 4.8 Percentage of Agricultural Land Use by Sub-Watershed

Sub-watershed	% Land Use for Agriculture
Smoke(s) Creek	1%
Buffalo River	7%
Ellicott Creek	7%
Niagara River	8%
Lower Tonawanda Creek	12%
Walnut Creek	16%
Big Sister Creek	19%
Eighteenmile Creek	20%
Canadaway Creek	25%
Chautauqua Creek	25%
Cattaraugus Creek	26%
Headwaters Cattaraugus Creek	26%
Cayuga Creek	28%
Middle Tonawanda Creek	29%
Murder Creek	29%
Sixmile Creek	34%
Buffalo Creek	35%
Upper Tonawanda Creek	40%

Non-point source pollution stemming from farms and farming practices can include:

- Erosion and sedimentation from farm fields, irrigation channels and over-grazing;
- Streambank erosion and instability caused by encroachment of fields & pastures into riparian areas.
- Toxins and nutrient loading from improper pesticide and fertilizer use; and,
- Pathogens and bacteria, like E-coli, from poor animal waste management practices or allowing animals to wade in streams.

Figure 4.18: Optimal Riparian Buffer Widths

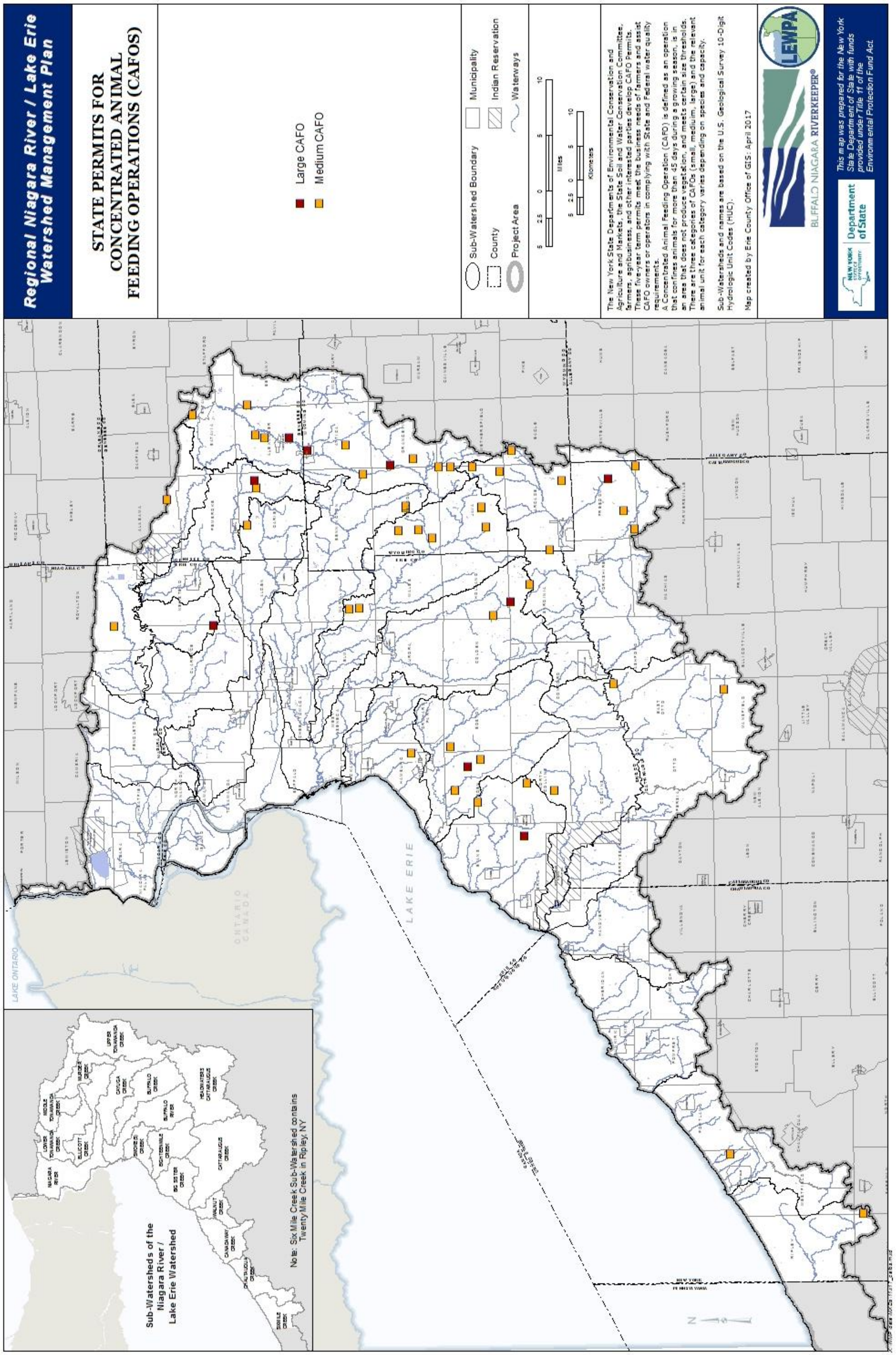


Source: The National Academies Press

Many of these causes of non-point source pollution stemming from farms can be alleviated or greatly reduced by improving farm layout and design, providing outreach and education on best management practices, as well as technical & financial assistance to install BMPs and implement management changes on farms, much of which is done by the U.S. Department of Agriculture National Resources Conservation Service and county Soil and Water Conservation Districts.

For example, maintaining a forested

Figure 4.19: Concentrated Animal Feeding Operations in Niagara River/Lake Erie Watershed



buffer of ideally 300 feet or 100 meters along a waterway can create valuable services that address the issues discussed above such as, intercepting excess nutrients, bacteria, and other pollutants, as well as minimizing erosion of streambanks by holding sediment in place and preventing animals from wading into the water. In addition forested buffers provide additional ecosystem services like controlling stream temperature for aquatic species, provide food and habitat for wildlife, allow for movement of wildlife along connected corridors, and reduce downstream flooding. Even if there is not space for a 300 foot buffer, any vegetated buffer of at least 15 feet will have some of these benefits.[28]

Agricultural Operations can contribute sediment, nutrient, bacterial, and toxic pollution to the watershed.

As part of the Clean Water Act, the U.S. Environmental Protection Agency regulates farms of a certain size, which are referred to as Consolidated Animal Feeding Operations (CAFOs) and considered a source of point source pollution. For more than 40 years, the Clean Water Act has enacted statutes, regulations and performance standards for CAFOs. NYSDEC currently regulates CAFOs under its authority as part of the State Pollution Discharge Elimination System (SPDES). Farms that are classified as a CAFO, operate under a SPDES permit that requires the farm to develop and fully implement a Comprehensive Nutrient Management Plan (CNMP) to reduce impacts to the environment. Figure 4.19 documents the large and medium-sized CAFOs in the watershed.

Animal feeding operations (AFOs) that do not meet the CAFO criteria can still complete CNMPs voluntarily with the help of county Soil and Water Conservation Districts as part of the Agricultural Environmental Management Program (AEM) or through the U. S. Department of Agriculture Natural Resources Conservation Service's Environmental Quality Incentives Program. It is estimated that over 13,000 farms in NYS participate in the AEM, however many small to medium sized farms who go through the planning process are finding it difficult to implement the plans, either from lack of funding or technical assistance available.

Emerging agricultural concerns in the watershed include the use of acid whey and biosolids. Wyoming County is currently the largest dairy producing county in the State and is host to major yogurt production facilities. Acid whey is a manufacturing byproduct of yogurt production and can be land-applied to add nutrients to soil. Also, food waste, yard waste, and wastewater treatment facility waste produces nutrient-rich organic biosolids when digested. Biosolids from anaerobic digesters in West Seneca and Wheatfield have been controversial in recent years due to concerns about a lack of testing in wastewater treatment waste for emerging contaminants, heavy metals, and pharmaceuticals. As of spring 2019, there were no wastewater treatment facilities sending sludge to

[28] https://conservationtools.org/guides/132-a-scientific-foundation-for-shaping-riparian-buffer-protection-regulations

these digesters. Only food and yard waste is currently being anaerobically digested at these facilities for eventual land application.

Acid whey and biosolids are both byproducts that have the potential for beneficial use in the agricultural industry. Acid whey has the potential to be used as a feed source for livestock and as a feedstock for anaerobic digesters, and both have the potential for use as a fertilizer product. These byproducts, like many others including commercial fertilizer, pesticides, and manure have the potential to cause detrimental effects to the environment and human health when mismanaged. Improper management of these products such as land applications above agronomic rates, poorly timed applications, and applications near sensitive areas can result in acidification of the soil and aluminum leaching, accumulation of excess nutrients and heavy metals in soil, and runoff into streams and hydrologically sensitive areas. When these products enter the aquatic system they cause nutrient loading and reduction of dissolved oxygen; bioaccumulation of toxic metals and chemicals in the food web; fish kills; the impairment of the aquatic ecosystem; and the contamination of water bodies used for municipal water supplies. Proper management, planning, education and regulatory oversight will be needed to insure the safe use of these products within the watershed.

Brownfields may contribute toxic pollution to sediments, groundwater and surface water.

Historic Contamination (Brownfields)

Properties contaminated with toxic substances (brownfields) are considered point source pollution in the watershed. Surface and ground waters can pick-up toxic substances present in soils contaminated by former land-use practices, which can then migrate contaminants off-site into streams, water bodies, and the ecosystem. Former industrial and commercial operations (i.e. gas stations, auto repair) often utilized toxic chemicals and other pollutants as part of their regular operations. Sometimes these materials were poorly handled in the past, creating opportunities for spills, dumping and other environmental exposures. Unfortunately heavy concentrations of industry were located in the cities of Buffalo, Dunkirk, Lackawanna, and Niagara Falls and along major waterways well before many of the environmental regulations we have today were in effect. Because of this, these areas of the watershed have high concentrations of brownfields. Today the U.S. Environmental Protection Agency oversees many of the most highly contaminated brownfields (National Priority List and Superfund Sites), while the remaining sites are under state jurisdiction. The EPA Regulated Facilities Maps in Figures 4.12 and 4.13 outline the following facilities, where past history or current operations pose a potential threat to the environment:

- sites or facilities that are proposed for, currently on, or removed from the U.S. EPA National Priorities List (NPL), which considers contaminated properties for inclusion in the EPA's Superfund list;

- U.S. EPA CERCLIS[29] Superfund sites;
- National Pollution Discharge Elimination System (NPDES)[30] permitted facilities and pipes;
- Combined Sewer Overflow event locations;
- facilities that hold, generate, transport and/or dispose of hazardous waste as regulated by the U.S. EPA (RCRA[31] permits); and,
- facilities or sites where a hazardous substance release occurred (Toxic Release Inventory, EPCRA[32]).

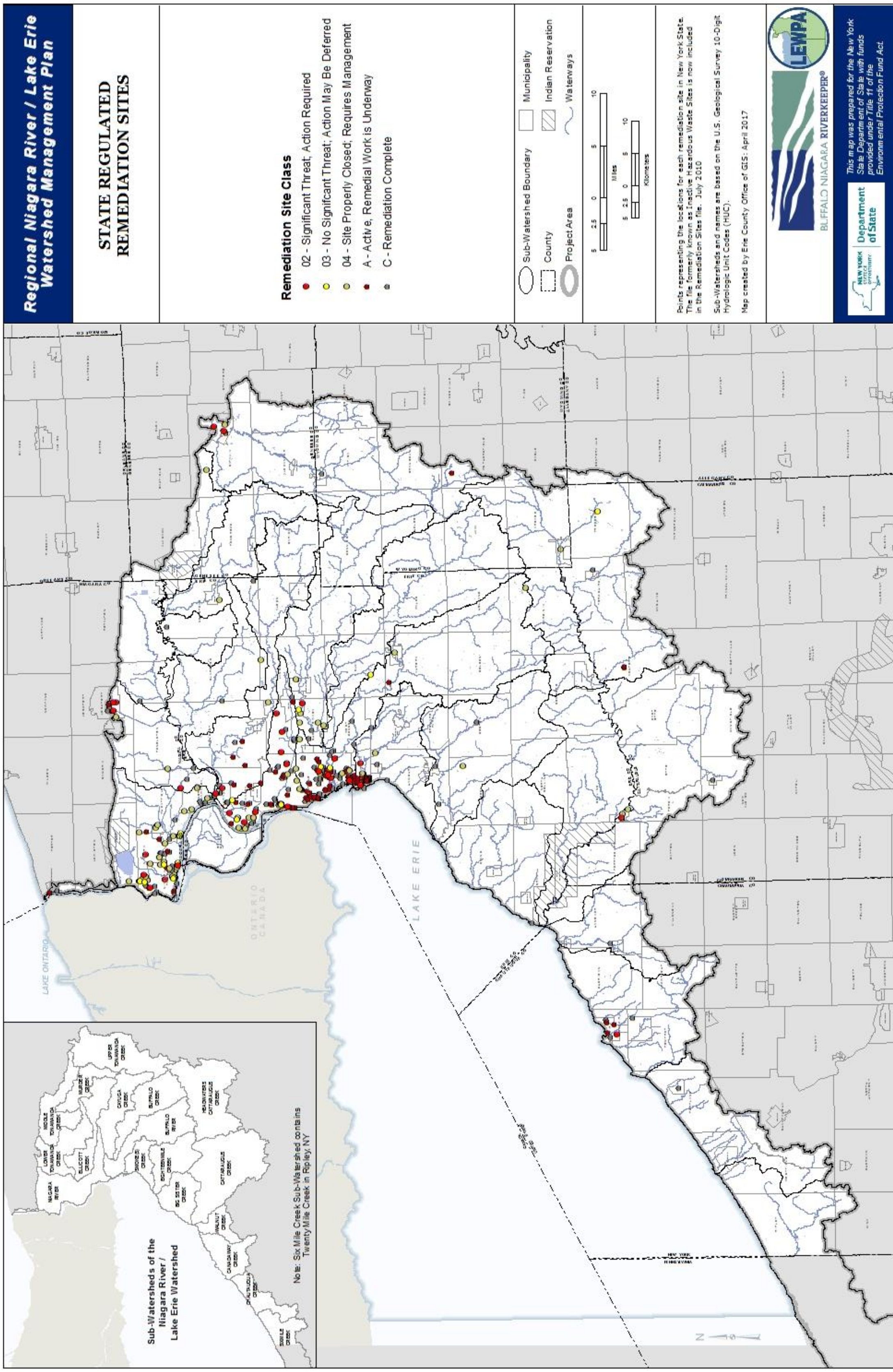
Figure 4.20: Cherry Farm, a former Superfund landfill now remediated, located on the Niagara River in Tonawanda (US EPA)

Presently, the watershed hosts ten sites on the National Priorities List, six of which are in the Niagara River sub-watershed. There are 76 Superfund Sites, including the infamous Love Canal, Hooker Chemical Plant properties and a half dozen landfills. Many of the documented hazardous waste sites in the watershed are part of the Buffalo River and Niagara River Areas of Concern and their Remedial Action Plans. Because remediation (clean-up) and rehabilitation of brownfield properties can take decades, many of them are still considered "active" sites today and can still pose a threat to surface and groundwater resources in the watershed.

In addition to brownfield properties there are a number of existing industrial, commercial, retail and institutional facilities in the watershed that utilize hazardous substances as part of their everyday operations. RCRA permitted facilities are those facilities required to track the generation, use and/or disposal of certain hazardous materials. There are 1,310 small quantity generators, 428 large quantity generators, and 28 transporters. RCRA facilities are also monitored and regulated at the state and federal level in order to ensure proper handling and to limit exposures to people and the environment. Unfortunately spills do occur at these facilities and sometimes in transport of their hazardous materials. The Toxic Release Inventory sites documents where a spill has occurred as part

[29] Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS).
[30] As part of the Clean Water Act
[31] Resource Conservation and Recovery Act
[32] Environmental Protection and Community Right-to-Know Act

Figure 4.21: State Regulated Remediation Sites



of the Environmental Protection and Community Right-to-Know Act. There are 313 spills or releases documented in the watershed on the map.

Known brownfields and Hazardous Waste Sites under NYS jurisdiction are represented in Figure 4.21, the State Regulated Remediation Sites Map. The Niagara River Sub-watershed has 152 remediation sites, the most of all the sub-watersheds. Buffalo River sub-watershed also has a numerous sites listed in the database (79). Figure 4.21 also clearly shows these sites concentrated in the urban areas of the watershed, along the Lake Erie and Niagara River shoreline, and along Tonawanda Creek, Scajaquada Creek, and Smokes Creek.

While the sheer numbers of hazardous sites within the watershed and along key waterways are alarming, former brownfield properties do offer opportunities when remediated and redeveloped. In many cases, environmental conditions limit options for redevelopment allowing sites to be reclaimed for features that would support watershed health, such as flood plains, wetlands, grasslands, riparian buffers, and green stormwater infrastructure, which are lacking in urban areas where brownfields concentrate.

Mining

Sand, gravel, and crushed rock mining has been a source of economic development in rural communities, especially in the southern portion of the Niagara River/Lake Erie Watershed. Limestone is also a large commodity mined mostly in the northern areas of the Watershed. The NYSDEC Division of Mineral Resources regulates mining operations, which are required to have a mining plan and reclamation plan with secured resources prior to permitting. Reclaimed mining sites can become farms, wetlands, habitat, public recreation areas, or residential developments, but it is important that these plans connect to existing community visions and master plans. Erie County has 43 active mines with the county with the highest percentage of acreage permitted by mining in the Watershed at 1,969 acres as of 2016.[33]

Water quality concerns with mining include land changes that can alter water flow in a region and can adversely impact adjacent properties. In addition, water quality impacts and sedimentation can be an issue if the mine is located in a floodplain or is inundated by heavy storm events. Transportation to and from the mine is a concern, both from atmospheric pollution that can deposit on land, as well as non-point source pollution issues with vehicle fluids, brake dust, etc. due to the increased amount of traffic in an area. Habitat areas are often disturbed for mining operations and can be lost permanently if the mine is reclaimed as developed land once closed. It is important to consider the cumulative impacts of mining operations within a sub-watershed.

[33] https://www.dec.ny.gov/lands/92956.html

Oil & Gas Production

Impacts of natural gas drilling can include heavy truck traffic on local roads, noise and odors emanating from drilling sites, and deterioration of air and water quality.[34] With proper management practices and maintenance, the land use impacts associated with this type of well are considered low. However, old wells run the risk of well casing failure, and without proper maintenance and testing, can become a public risk due to gas leakage into the atmosphere and surrounding water sources. Potential negative impacts to the surrounding environment can include chemical spills, road damage due to heavy truck traffic, water contamination, and drilling noise. Vigilant performance from the well operators is necessary to protect the watershed from these impacts.

Old gas wells are periodically reworked for performance enhancement. Reworking an existing active storage well consists of cleaning out the wellbore, installing a new casing inside the existing casing and then perforating the new casing and hydro fracking. These small hydraulic fracturing treatments are commonly used to remedy "skin damage," a low-permeability zone that sometimes forms at the rock-borehole interface. In such cases the fracturing may extend only a few feet from the borehole, though still using a considerable amount of fracking and drilling fluids.

This becomes a bigger environmental issue when dealing with high volume, hydraulically fractured (HVHF) gas wells. This is due to the drastic difference in scale of an HVHF site. A typical HVHF gas drilling permit application may encompass a 640 acre (one square mile) spacing unit. These wells are much deeper and the actual fracturing of the rock extends much further from the borehole. The scale of all potential environmental impacts increases accordingly. For example, reworking a vertical well uses approximately 14,000 gallons of fracking fluid and 10,000 gallons of drilling fluid. In comparison, one HVHF gas well uses 5 – 8 million gallons of water mixed with varying amounts of chemicals, estimated by researchers to range from 30 – 300 tons of chemicals.

HVHF has been banned in New York State, but reworking existing wells is still a concern. The gas development industry has been under pressure to reduce its environmental footprint by developing Best Management Practices to maintain the integrity of each well system, isolate the well from the surrounding subsurface environment, and effectively contain the produced gas and other fluids within the well’s innermost production conduit so the wastewater that is returned to the surface can be efficiently captured, contained, treated, and ultimately recycled. The American Petroleum Institute (API) has taken the lead in reviewing and evaluating the industry’s practices for drilling, completing, and operating oil and natural gas wells and has published an extensive number of documents describing recommended practices for well planning, well design, well construction, well completion, and well decommissioning. These practices can certainly be improved upon, but at a very minimum it should be required for all operators to employ drilling, completion, and environmental

[34] Gas Drilling in the Town of Colden, 2013 http://townofcolden.com/site/wp-content/uploads/2014/05/Gas-Drilling-Report.pdf

control technologies and practices that fully meet these evolving standards and that are considered up-to-date. Chapter 2 includes maps of where these wells are located in the Watershed.

Utility Infrastructure and Right-of-Ways

Utilities such as communications, electric, and natural gas often have infrastructure that follows roadways or requires a separate right-of-way to reach its destination. These right-of-ways are often wide strips of land mowed annually to prevent trees from growing into pipelines or wires. This mowing can isolate native habitat, disrupt the ecosystem, and create runoff.

A right-of-way can be managed to maintain diversity of plants and animals though by adding native grassland grasses and wildflowers, and by eliminating non-native invasive plant species. Management of the corridor can follow NYS DECs best management practices for grassland nesting birds and pollinators[35], and USFWS best management practices for pollinators[36]. Timing of the migration of birds, butterflies, and other pollinators should be considered when mowing to ensure that critical habitat, such as milkweed, is not mowed prior to mass migrations.

The 'ecosystems approach' to watershed management seeks to manage water quality through the sustainable exploitation of water resources and the maintenance of biodiversity within watersheds. It is founded upon the sharing of habitat with other ecosystem components and the minimization of human impact. By this definition, the best management practices described above allow for maintaining native habitats while meeting the needs of current and future human generations.

The Northern Access Pipeline is proposed to connect McKean County, Pennsylvania with an existing compressor station in Elma, New York. Additional work will construct an interconnection in Wales, New York, a new compressor station in Pendleton, New York, and a new natural gas dehydration facility in Wheatfield, New York. The NYSDEC issued a denial of the 401 certification, in particular due to the degradation of waterways, as this project is expected to cross 196 streams with a 75-foot right-of-way. Trenchless technology, which has the least impact on water quality, would only be used at five of the stream crossings. NYSDEC indicated that this pipeline would negatively impact fish and wildlife habitat as well as stir up sediment, a major water quality contaminant, thus impairing several waterbodies of their best uses and violating NYS water quality standards. The issue is now tied up in a legal battle between the Federal Energy Regulatory Commission and NYSDEC.

In addition to construction disturbances, the proposed project would have involved right-of-way maintenance for the pipeline. Riparian habitat loss at the waterway crossings would be maintained through regular mowing preventing large trees from establishing along the stream banks. This could cause long-term negative impacts on fish and wildlife habitat. Right-of-way maintenance through

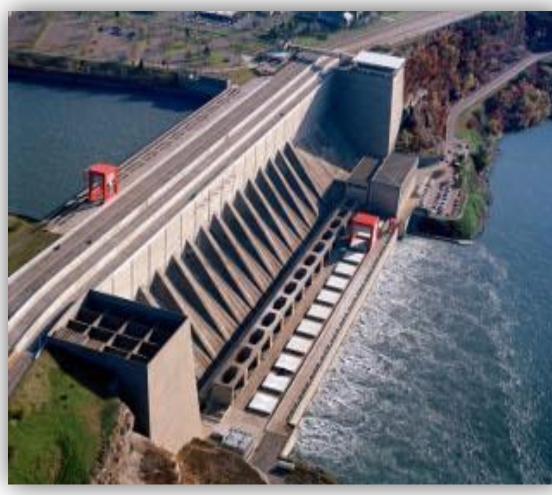
[35] http://www.dec.ny.gov/pubs/86582.html and http://www.dec.ny.gov/docs/administration_pdf/nyspollinatorplan.pdf

[36] https://www.fs.fed.us/wildflowers/pollinators/BMPs/documents/PollinatorFriendlyBMPsFederalLandsDRAFT05152015.pdf

wetlands could compact soils, change vegetation types, and decrease the wetland function as a water quality filter and natural sponge in periods of precipitation. It is important to consider these long-term impacts when developing utility projects and to mitigate the impacts wherever possible.

Dams

Figure 4.22: NYPA Hydroelectric Dam in Lewiston, NY



Dams can significantly alter the ecosystem of a waterway. Reservoirs created by dams can block fish migration, increase water temperatures, trap sediments, decrease water speed, reduce dissolved oxygen, increase nitrogen levels, and alter riparian areas. Because these changes to the ecosystem can lead to eutrophication and cause stress on fish populations and riparian habitats, older non-functioning dams in the watershed should be investigated for possible removal and restoration of waterway hydrology and habitat. In many cases reservoirs have protected lands and forests surrounding them. These areas should be conserved for habitat and water quality benefits along restored waterways. In cases where the dams are necessary, measures can be taken to mitigate negative impacts such as the installation of fish ladders.

There are several dam mitigation projects being planned or underway in the watershed. Smith Mills Reservoir Dam in the Town of Silver Creek in Chautauqua County is being removed starting in 2018 due to safety hazards. The best fish habitat is upstream of the dam and is expected to result in better fisheries on Silver Creek. Streambank and habitat restoration is also planned as part of this project.

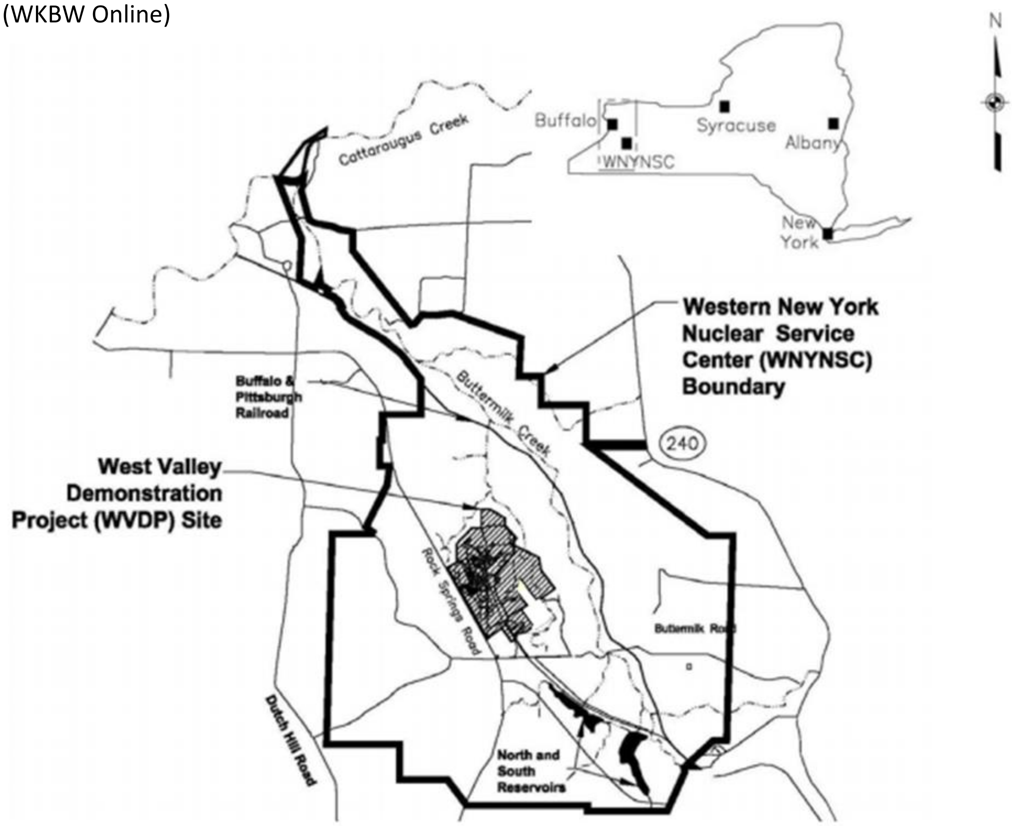
Scoby Dam on Cattaraugus Creek is being considered for lowering from 40 feet to approximately 13 feet with the addition of a fish ladder and sea lamprey controls. This is anticipated to connect the upper and lower fisheries. Prior to removal, the U.S. Army Corps of Engineers is studying the sediment that is currently trapped behind the dam to ensure that contaminants will not be released downstream upon lowering the dam. There is concern that upstream industrial activities may have released contaminated sediment. The West Valley Demonstration project is located upstream of this site along a tributary to Cattaraugus Creek

West Valley Demonstration Project

The West Valley Demonstration Project Site is a nuclear waste remediation site in West Valley, New York. The purpose of the project, which was created by an act of congress in 1980 and is jointly managed by state and federal agencies, is the cleanup and containment of radioactive waste left behind after the abandonment of a commercial nuclear fuel reprocessing plant. In accordance with the West Valley Demonstration Project Act, the U.S. Department of Energy (DOE) took the lead in solidifying the liquid high-level waste, and in decontaminating and decommissioning the facilities used in the solidification project. The New York State Energy Research and Development Authority (NYSERDA) is responsible for management of the shut-down commercial radioactive waste disposal site and surrounding Western New York Nuclear Service Center (WNYNSC) and, as the owner, is also the licensee for the site. While progress has been made on the site, the clean-up work still continues.

Figure 4.23: West Valley Demonstration Site Map

(WKBW Online)



The West Valley Demonstration Project Site watershed is drained by Quarry Creek, Franks Creek, and Erdman Brook. Most surface water runoff from the project premises funnels into a single stream channel at the confluence of Franks Creek and Erdman Brook located just inside the perimeter of the project premises. These waters flow into Buttermilk Creek, which runs through the retained premises east and north of the project premises. Buttermilk Creek enters Cattaraugus Creek at the north end of the WNYNSC in the Headwaters Cattaraugus Creek Sub-watershed.

The depth of groundwater in the sand and gravel unit on the north plateau ranges from the surface to 16 feet below the surface. The groundwater flows generally northeastward toward Franks Creek.

Near the northwestern margin of the sand and gravel until, flow is toward Quarry Creek and, at the southeastern margin, toward Erdman Brook. Groundwater seeps to the surface in places along stream banks and the edges of the north plateau. Underlying the north plateau and the south plateau is more than 500 feet of Pleistocene-age glacial tills.

The West Valley Citizen Task Force (CTF) was formed in 1997 to provide broader public participation in the Environmental Impact Statement and decontamination and decommissioning processes. The CTF issued a report in 1998 addressing what it felt should occur and has been meeting regularly since then. Members of the CTF are drawn from local government, community and environmental organizations, representatives of elected officials and the Seneca Nation of Indians. The CTF continues to meet regularly and public meetings are held quarterly.

Concern about contamination of the watershed has been expressed by the community, especially because of the unstable soil and the potential impacts of climate change on the site. Monitoring must continue to ensure that hazardous materials are not leaching into the Niagara River/ Lake Erie Watershed.[37]

NYPA Niagara Power Project Impacts & Relicensing

Findings from environmental studies completed as part of the relicensing of the Lewiston Hydroelectric Generation facility identified major impairments caused by the water diversions necessary for the operations of the plant. Water level draw-downs average 1.5 feet/day just above the intakes, up to 12 feet/day in the gorge area above the tailrace, up to 36 feet/day in the Lewiston Reservoir, and .6 feet/day at Lake Ontario.[38]

The water fluctuations may destabilize nearshore habitats for many plants and animals including spawning fish, nesting shorebirds, amphibians, and reptiles.[39] One NYPA study[40] identified 49 rare, threatened, or endangered species and three significant natural communities that were likely affected by these fluctuations, including pied-billed grebe, lake sturgeon, and the deep emergent marsh community at Buckhorn State Park. As a result, $9 millions /year over 50 years from 2007 was negotiated to restore public access and habitat to the communities impacted.

Thermal Increases

Increases in the temperature of waters can negatively affect water conditions in how they support aquatic life and the ecosystem. For

Thermal pollution affects many aquatic species.

[37] http://westvalleyctf.org/site-information/history and WVDP Phase 1 Decommissioning Plan for the West Valley Demonstration Project (2008)
[38] Niagara River Water Level and Flow Fluctuation Study (URS Corporation, 2005)
[39] Buffalo and Niagara Rivers Habitat Assessment and Conservation Framework (Buffalo Niagara Riverkeeper, 2008)
[40] Assessment of the Potential Effects of Water Level and Flow Fluctuations and Land Management Practices on Rare, Threatened, and Endangered Species and Significant Occurrences of Natural Communities at the Niagara Power Project. (Riveredge Associate, LLC., 2005)

example, cold water fish species are sensitive to raises in water temperature as higher temperatures reduce the amount of dissolved oxygen and cold water fish require larger amounts of oxygen. As mentioned previously, temperature increases can be caused by both natural conditions and man-made conditions. In the case of the Niagara River Watershed thermal increases are attributed to:

- Lack of forested riparian cover to shade rivers and stream corridors;
- Stormwater run-off traveling over heated surfaces (black top, concrete channels);
- Loss of forested wetlands;
- Industrial discharges; and,
- Climate change (increased air temperatures).

Thermal pollution is most evident in the loss of trout found in the watershed. In recent years the number of stream segments with trout documented in the watershed has been decreasing. Presently trout is found closest to the headwaters of Tonawanda Creek, Buffalo River, Buffalo Creek, and Cattaraugus Creek where springs help keep water temperatures colder than other areas of the watershed.

The primary means to affect thermal pollution in the watershed is by the restoration and protection of forested riparian areas and improved design of stormwater conveyance systems. Stream Visual Assessment Protocol (SVAP) data collection assesses the quality of riparian areas for the watershed as a whole. Where SVAPing has occurred, inadequate riparian cover is consistently documented as an issue affecting stream health. Continued SVAPing is recommended to assess more of the Niagara River/Lake Erie Watershed.

Erosion & Sedimentation

Many of the causes of erosion and sedimentation in the watershed have already been touched on as part of the discussion on stormwater infrastructure and agricultural operations. However, there are erosion and sedimentation problems occurring in the watershed from causes aside from these factors. Other common erosion and sedimentation causes stem from topographical and geological conditions, such as steep slopes/banks and highly erodible soils; stream channel changes include down cutting and meandering; and man-made conditions include loss of riparian buffers.

Erosion causes sediment pollution and degrades water quality.

A full comprehensive erosion assessment or geomorphic assessment does not currently exist for the Niagara River/ Lake Erie Watershed. Major erosion areas are mostly known in a piecemeal fashion, from projects and requests for assistance to the Soil and Water Conservation Districts, and at the municipal/county level from where erosion is threatening neighboring infrastructure (i.e. roads, bridge abutments) or private property.

Conducting Stream Visual Assessments are more involved than the GIS assessment and are unrealistic to utilize for all stream miles of the watershed, but these assessments also document shoreline erosion. In-depth SVAPing has occurred in five of the 18 sub-watersheds. Buffalo Niagara Riverkeeper traversed approximately 118 miles of streams in 2015 and 2016 to determine the riparian zone and bank stability, among other observations, in the Eighteenmile Creek, Buffalo River, Smoke(s) Creek, Lower Tonawanda Creek, and Upper Tonawanda Creek Sub-watersheds. Results can be found online.[41]

Figure 4.24: Forested Riparian Buffer in Agricultural District (USDA)

The most primary suspected cause of erosion and sedimentation in the watershed is the lack of adequate riparian buffers. In many stream corridors riparian buffers have been removed or severely reduced causing the benefits and protections of these vegetative strips to be ineffective in strengthening shorelines and protecting water quality. A well-functioning riparian buffer:

- improves water quality by acting as a filter for surface and ground waters to attenuate nutrient, sediment and chemical loading;
- stabilizes banks to reduce erosion and sedimentation downstream;
- provides storage during seasonal high-volume and flood events;
- slows the velocity of flood waters;
- improves water quantity and groundwater recharge by allowing for more surface water infiltration;
- maintains lower water temperatures that support aquatic habitats; and,
- supports wildlife habitat and movement corridors.

Studies on recommended buffer widths have been summarized as follows to show recommended widths for particular ecosystem benefits[42]:

Erosion/sediment control:	30 feet to 98 feet
Water quality:	
Nutrients	49 feet to 164 feet

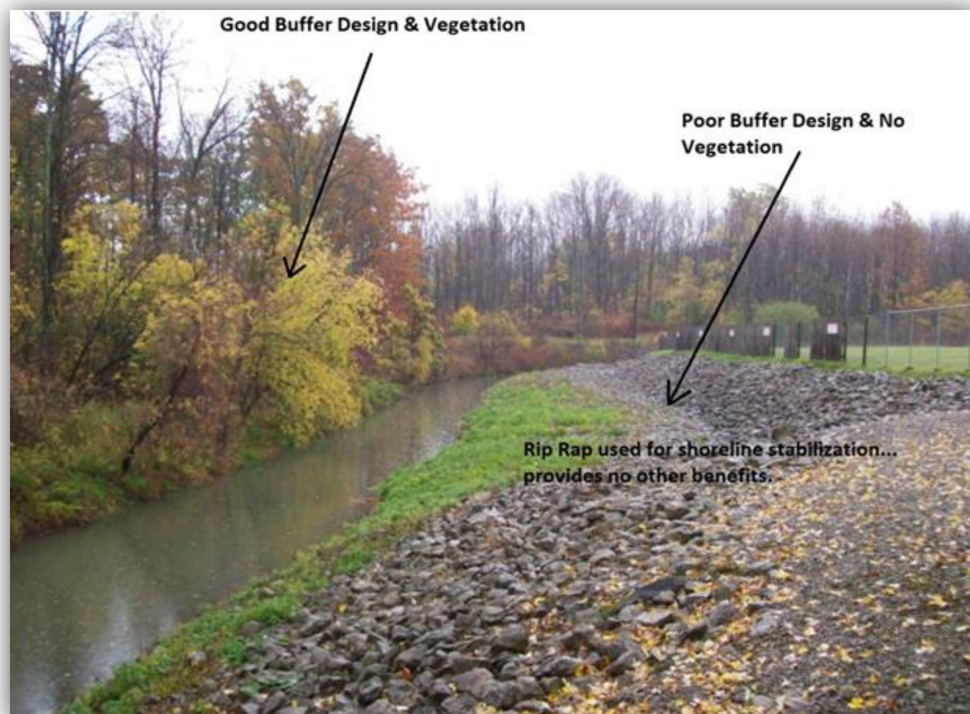
[41] https://bnwaterkeeper.org/projects/healthyniagara/

[42] Riparian Buffer Zones: Functions and Recommended Widths by Ellen Hawes and Markelle Smith, Yale School of Forestry, April 2005, http://www.eightmileriver.org/resources/digital_library/appendicies/09c3_Riparian%20Buffer%20Science_YALE.pdf

Pesticides	49 feet to 328 feet
Biocontaminants (fecal, etc.)	30 feet or more
Aquatic habitat:	
Wildlife	33 feet to 164 feet
Litter/debris	50 feet to 100 feet
Temperature	30 feet to 230 feet
Terrestrial habitat:	150 feet to 330 feet

The lack of riparian buffers has negative effects on the integrity of shorelines, limiting a shore's ability to withstand erosive forces. In the Watershed, riparian buffers have been lost due to land use practices, where residential, commercial, and agricultural property owners mow down vegetation all the way to the waters' edge. In other cases riparian loss is replaced with costly riprap to reduce further erosion, but while riprap may reduce erosion issues, the shoreline receives no additional benefits a vegetative buffer provides.

Figure 4.25: Riparian Areas along Cayuga Creek



A Statewide Riparian Opportunity Assessment was conducted to prioritize riparian sites for restoration on the hydrological unit code 12-digit scale. Nine ecological health indicators and seven ecological stress indicators were used to rate each catchment or sub-watershed (HUC12). These were combined into composite scores for health and stress, as well as a comprehensive score and the results were mapped.[43] This assessment generally shows that the headwaters areas tend to have a higher ecological health score and the urban areas and downstream areas tend to have a higher ecological stress score. When using this tool, a low comprehensive score is an area that should be prioritized for riparian buffer restoration activities.

As watershed planning continues, the state of riparian lands should be comprehensively assessed in the watershed, plus outreach and education programs, land use policies, and bioengineering solutions should be developed and implemented to improve and protect riparian lands.

Invasive Species

The invasive species found in the watershed and the problems they cause are documented in Chapter 5. Invasive species threaten the health of the watershed's ecosystems and in some cases, such as zebra mussels and hydrilla, contribute to water quality degradation, infrastructure issues, and/or algae blooms. Documentation of the extent of invasive species within the watershed depends on the specific species and how much research has been conducted. In recent years certain species have received more attention than others, such as Water Chestnut where several efforts exist to remove it and educate the public to limit transporting it.

Some invasive species may block out native plants and degrade the quality of a riparian buffer. In some cases, they may have much more shallow roots than native species and not provide the same bank stabilization benefits. In other cases, when large stands of invasive species are removed, stream banks are left vulnerable until native species can reestablish themselves. Invasive species can also block taller native species from establishing in areas where cold water fisheries need shaded streambanks.

Invasive Species contribute to thermal, nutrient, and bacterial pollution.

There are also the more difficult species to address, such as Japanese Knotweed, which can severely impact habitat and riparian areas, but its long-term removal involves the use of herbicides that can cause other water quality impacts.

Unfortunately the most common issue with trying to address invasive species in the watershed is the need to comprehensively document their extent and spread in a cost-effective manner. The iMAP Invasives website[44] utilizes online and smart phone spatial mapping applications to document invasive

[43] http://www.nynhp.org/treesfortribsny Conley, Amy K., Erin L. White, and Timothy G. Howard. 2018. New York State Riparian Opportunity Assessment. New York Natural Heritage Program, State University of New York College of Environmental Science and Forestry, Albany, NY.
[44] www.imapinvasives.org

species in the field as a good start in creating better base datasets, but additional data collection is needed. In addition, strategies and public education should focus on outlining the best ways to address invasive species that present the least impact on water quality and habitat (i.e. hand removal vs. herbicides).

Emerging Contaminants

As outlined by the *Emerging Contaminant Threats and the Great Lakes: Existing Science, estimating relative risk and determining policies* report completed by the Alliance for the Great Lakes (2011), the last two decades have seen a growing concern about human health risks from chemical contaminants in the environment. Exposure to some of these manmade and naturally occurring chemicals is unavoidable as they end up in wastewater, air and land. Many come from every day products such as personal care products, plastics, pharmaceuticals and flame retardants. For instance, Perfluoroalkyl substances (PFAS), which are used to repel water and oil, have been found in drinking water supplies and are used in numerous products, including dental floss. In addition, they have been used in fire-fighting foam at fire training centers and on the Niagara Falls Air Base for decades. The impacts of emerging contaminants on the health of organisms in the Great Lakes and human populations are largely unknown. The data that does exist suggest they are a health concern, but more data and further study are needed.

Figure 4.26: Pharmaceuticals

There are millions of pounds of medications that expire or go unused in the United States every year. Improper disposal of these medications has generated concerns about their impacts on aquatic and human health. A number of studies have observed fish developing sexual and behavioral abnormalities. The scientific consensus appears to be that pharmaceuticals threaten aquatic organisms, though the effects on human health aren't as clear. Scientists say there's not enough data or understanding about emerging contaminants in the Great Lakes, but what is known is cause for concern. Pharmaceutical chemicals have been found in 41 million Americans drinking water in 24 major metro areas.
The growing number of pharmaceuticals and other chemical byproducts in the Great Lakes pose a health risk to the more than 40 million who rely on the lakes for drinking water, as well as to fish and wildlife. A comprehensive Alliance for the Great Lakes study analyzed existing data on emerging contaminants in the Great Lakes, and what this could mean for our health. Some highlights from the study:

- Flame retardants, pesticides, the antibacterial and antifungal agent Triclosan, and the insect repellent DEET are all found in the Great Lakes.
- Bisphenol A (BPA), used in plastics from baby bottles to food packaging, is found in more than half the water samples analyzed in all studies to date.
- Most emerging contaminants found in the Great Lakes come from everyday products such as shampoos, sunscreens, plastics and pharmaceuticals.
- Emerging contaminants have been implicated in hormone disruption and cancers, but few studies have looked at long term impacts in drinking water.

Addressing the problem of emerging contaminants requires focus on four main areas: new research, new technologies aimed at removing more contaminants during wastewater treatment, marketplace behavioral changes, and policy reforms. A recent success has been the banning of microbeads from personal care products. These tiny plastic molecules were not able to be captured by most wastewater treatment plants and were found in fish and drinking water. Studies showed that micro plastics were contaminating, not only the Great Lakes, but also the tributaries that feed them. In a Great Lakes study that included Buffalo River and Tonawanda Creek, urban tributaries contributed more plastic fragments, foams, and films than rural tributaries. Meanwhile, plastic microfibers, such as from polyester clothing, were found across all tributaries in the study.[45] Further study is needed on the contributing factors, but the existence of plastic in water supplies has been shown. Because of the ability for plastic to adsorb other contaminants in the water and be mistaken for food by fish and wildlife, these contaminants are being moved up the food web with the potential to impact human health.

Few regulations exist regarding emerging contaminant control. The existing theory that a chemical cannot be removed from the marketplace without data showing a negative impact on people and the environment underscores the need for a more effective and realistic risk assessment program. Changing federal policies governing the production and use of new chemicals and existing contaminants may have the biggest impact. Few laws exist to control emerging contaminants, and current U.S. regulatory approaches don't keep pace with the deluge of new chemicals.

Climate Change

Changes to regional climate pose increased risks to the water resources, built environment and infrastructure, ecosystems, and recreation and tourism sectors that already face other pressures. The expected changes in climate are discussed in Chapter 2. Heavy rainfall (over short time periods) produces the most water quality impact, more than any other extreme weather event. With

[45] Plastic Debris in 29 Great Lakes Tributaries: Relations to Watershed Attributes and Hydrology by Austin K. Baldwin, Steven R. Corsi, and Sherri A. Mason from Environmental Science and Technology Journal.

increasing temperatures, and with rainfall making up a greater percentage of annual precipitation, this poses a serious threat for regional water quality.

In the next several years weather patterns are predicted to become more variable, with multiple weather events occurring simultaneously, for instance, droughts followed by heavy rains. This example would have multiple repercussions for water quality, by "negatively affecting turbidity, contaminant concentrations, and organic matter in raw water supplies."[46] Other anticipated climate change impacts include increased heat waves; exacerbated drought; more invasive species; shifts in native species range; changes in timing of ecological events including blooming and maturation of crops; reduced lake ice cover causing more evaporation and increased erosion of shorelines from wind events can lead to "increased turbidity and organic matter, hypoxia, eutrophication leading to algal and cyanobacteria growth, taste and odor problems, increased presence or risk of pathogens and changes to conductivity, pH and alkalinity."[47] In addition, extreme rainfall events can increase erosion, which can further increase sedimentation and turbidity of waterways.

The ability to estimate future flood risks and develop effective future flood mitigation strategies will become vital for municipalities. Current Base Flood Elevation levels from Flood Insurance Rate Maps used for many municipal building codes do not take climate change or future flood impacts into consideration. Ultimately, the relationship between climate change and water quality and quantity impacts is complex, demonstrating the need for long-term stream flow data to help guide future flood hazard mitigation and water resources planning.

Impacts on crops and livestock can mean additional fertilizers or pesticides may be needed to retain crop yields or additional infrastructure for cooling animals or storing manure may need to be constructed. Heavier late winter or spring rains or an increased number of snow melt and runoff events can mobilize contaminants and cause higher nutrient loading. If heavy rains occur frequently, reservoirs may have little time to recover from increased turbidity, and if those rains occur after a dry spell, organic materials can be flushed downstream all at once. Efforts to prepare for these immediate and longer-term impacts are needed, including planning for variable lake levels. Climate variability and change exacerbate many existing vulnerabilities and add to the complexity of resource management, capital investment, and community planning.[48]

The impact of climate change on Great Lakes water levels is a critical question for the region's economy and environment, and for one of the nation's key shipping corridors. Even small drops in lake water levels could create problems for shipping and navigation, recreational boating, hydro-electric production and other uses. Sustained periods of higher lake levels can mean increased erosion

[46] Great Lakes Integrated Science Assessments, 2012
[47] American Water Works Association, *Climate Change: how does weather affect surface water quality?*, 2013
[48] NYS's Open Space Conservation Plan, 2016

and flooding in coastal areas, which may have a significant economic impact as structures are damaged. Planning for climate change resiliency should take this variability into consideration.

Water level fluctuation in the Great Lakes basin and major tributaries also impact both biotic and abiotic components in near-shore, shoreline, and riparian zones. Wind and wave action can be modified by the depth of Lake Erie, causing shorelines to erode and fine sediment to be resuspended and deposited into deeper areas. Decreasing water levels or intense flooding both may result in the loss of macrophyte vegetation, lowering diversity and reducing habitat that would typically uptake nutrients or support fish spawning. The results can be an increase in algal growth or an increase in invasive species. Increasing water levels also can cause loss in invertebrate communities, increasing invasive species well.[49]

[49] Tamar Zohary & Ilia Ostrovsky (2011) Ecological impacts of excessive water level fluctuations in stratified freshwater lakes, Inland Waters, 1:1, 47-59, https://www.tandfonline.com/doi/pdf/10.5268/IW-1.1.406

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Chapter 5: Ecology & Biology

Biological diversity – or biodiversity – is the term given to the diversity, or variety of plants and animals and other living things in a particular area or region. It is the variety within and between all species of plants, animals and micro-organisms and the ecosystems within which they live and interact.

Ecological biodiversity is the diversity of ecosystems, natural communities, and habitats. In essence, ecological biodiversity is the variety of ways that species interact with each other and their environment, including humans. It is biodiversity on a larger scale. All natural areas are made up of a community of plants, animals, and other living things in a particular physical and chemical environment. In practice, conservation of biodiversity requires sustaining the diversity of species in each ecosystem as we plan human activities that affect the use of the land and natural resources.

Maintaining a wide diversity of species in each ecosystem is necessary to preserve the web of life that sustains all living things. Each species of vegetation and each creature have a place on the earth and play a vital role in the circle of life. Biodiversity boosts ecosystem productivity where each species, no matter how small have an important role to play. Plant, animal, and insect species interact and depend upon one another for what each offers, such as food, shelter, oxygen, and soil enrichment. Greater species diversity ensures natural sustainability and increased stability in the food web for all life forms. Therefore, healthy ecosystems and biodiversity influence and sustain natural ecosystems and the natural resources those ecosystems support, such as water. This chapter outlines the important biological components and ecology of the watershed. Protection of all organisms within an ecosystem, such as fish, birds, reptiles, mammals and plants should be considered in order to retain ecological biodiversity. By outlining the distribution of key indicators of ecological health in a given region, we can identify necessary improvements to mitigate impact from human activity.

Ecological Regions within the Watershed

The 1.5 million acres of the Niagara River/Lake Erie Watershed contains a variety of ecological conditions in regards to land cover, topography, hydrology, and geology. The headwaters contain distinct topographic relief and are dominated by large patches of forested cover, while the northern part of the watershed is flat and consists mostly of low-lying wetland habitat. More specific differences throughout the watershed are reflected through the classification of ecological regions (ecoregions). Defined by US EPA, ecoregions delineate areas containing similar ecological characteristics that provide a spatial framework recognizing the different potentials and capacities that are associated with the various environmental features within each region. Within the watershed, seven physiographic ecological regions exist (See Figure 5.1) and are listed here according to size from largest to smallest acreage:

- Cattaraugus Hills (461,639 acres or 30.4% of the watershed)
- Ontario Lowlands (387,091 acres or 25.5% of the watershed)
- Erie/Ontario Lake Plain (341,879 acres or 21.1% of the watershed)
- Glaciated Low Allegheny Plateau (175,818 acres or 11.6% of the watershed)
- Low Lime Drift Plain (141,597 acres or 9.3% of the watershed)
- Glaciated Allegheny Hills (10,060 acres or 0.7% of the watershed)
- Unglaciated High Allegheny Plateau (737 acres or < 0.1% of the watershed)

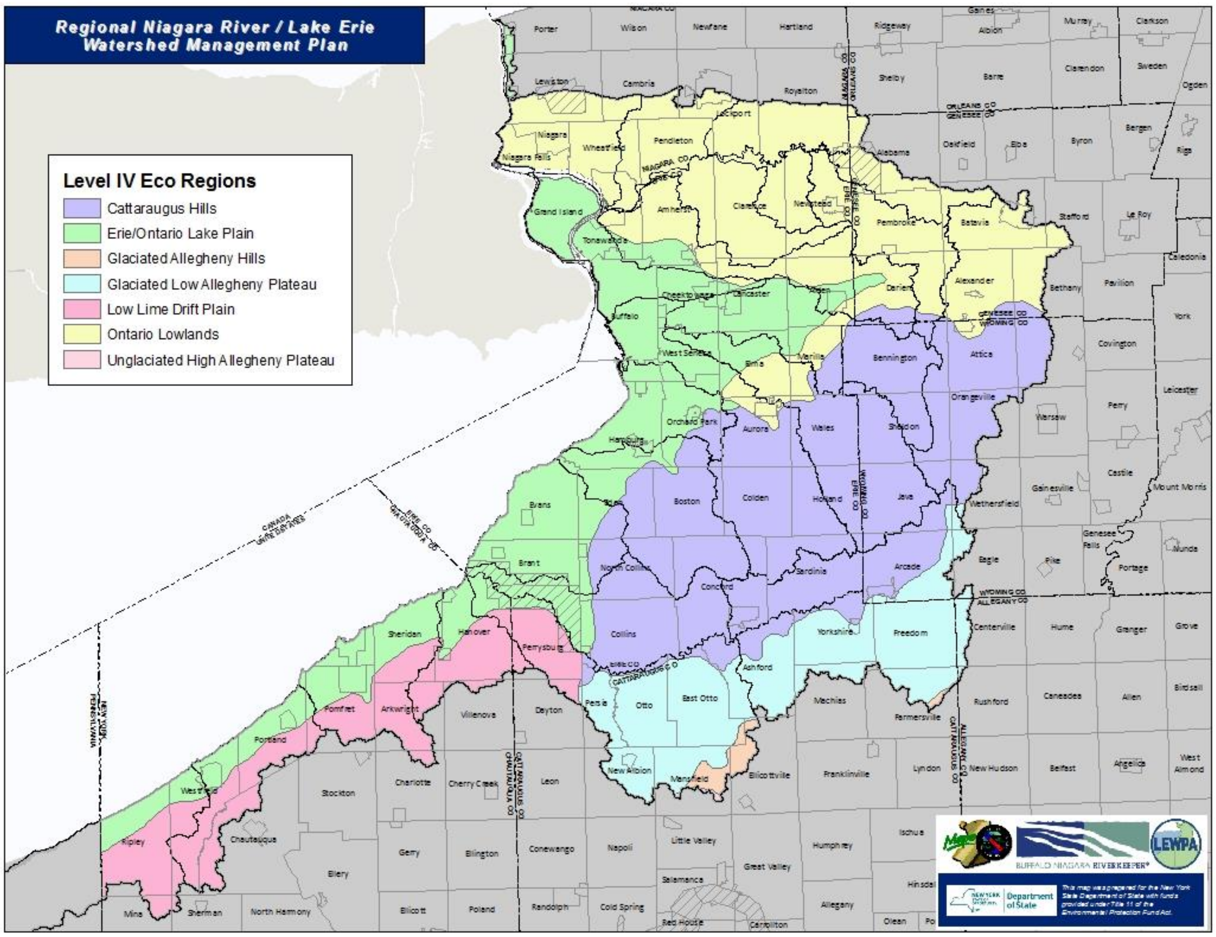


Figure 5.1: Ecoregions of the Niagara River/Lake Erie Watershed

Cattaraugus Hills

This ecoregion contains the upland headwater area of Eighteenmile Creek, Buffalo River, Buffalo Creek, Cayuga Creek, and Upper Tonawanda Creek sub-watersheds. The topography is characterized as dissected plateau, rolling hills, and plateau toe-slopes. Streams within this ecoregion are generally low gradient with substrates consisting of gravel or silt, and in some cases are spring-fed and therefore able to support populations of native trout. Land cover within the Cattaraugus Hills contains significant areas of both deciduous and evergreen forest, emergent herbaceous wetlands, and fens. Rural residential, urban and, farmed lands also exist throughout this ecoregion.

Ontario Lowlands

The delineation of the Ontario Lowlands ecoregion stems from the extent of glacial Lake Iroquois. This zone covers the northern portion of the watershed, including Lower Tonawanda Creek, Middle Tonawanda Creek, Ellicott Creek and Murder Creek sub-watersheds. This area was once dominated by forests, however much of it has been cleared due to the agricultural capability of the land. Much of the land is low-lying, containing large wetland complexes, glacial lake plains, grasslands, and kettle topography. Streams within this zone are characterized as low-gradient, and transition into a channel closer to the confluence with the Niagara River. The built landscape contains residential, urban centers, and farmed land for both livestock and crop cultivation.

Erie/Ontario Lake Plain

The middle portion of the watershed is characterized by the Erie/Ontario Lake Plan ecoregion. The physiography of this ecoregion consists of flat lake plain bounded inland by Pleistocene beach ridges. Streams empty into the Niagara River and Lake Erie, and host a variety of Great Lakes migratory fish species. Historically the area had natural vegetation types including beech-maple forest along with chestnut and oak, however the land is now dominated by residential and urban land uses.

Glaciated Low Allegheny Plateau

This ecoregion has shallow and stony soils, which drain well in moderately sloped areas, and are used for farmland. However, much of the ecoregion has a very dense layer of subsurface soil called fragipan, which is difficult for roots to penetrate through and drains very poorly. This leads to a patchwork of land use throughout the ecoregion, which consists of low rolling hills alternated by steep forested shale slopes. The forests are a mix of northern hardwood-conifers, Appalachian oaks, and hemlocks.

Low Lime Drift Plain

This ecoregion is just inland of the Erie/Ontario Lake Plain, so it is more protected from lake-effect weather conditions. A glacial moraine prevents Chautauqua Lake from draining into Lake Erie. The Low Lime Drift Plain has beech-maple forests with hemlocks. The soils do not drain properly, which makes the land better for dairy and livestock farming instead of crop cultivation.

Glaciated Allegheny Hills

This ecoregion is adjacent to the unglaciated High Allegheny plateau, but is more rounded with more lake features, due to its glaciated geologic history. The soils are stony, acidic, and nutrient depleted. As such, this ecoregion is highly forested and not well-suited for farming. Bedrock is Devonian sandstone and shale. There are many steep cliffs and waterfalls where the bedrock was not as susceptible to erosion, which causes a rugged look to the landscape. Forests are northern hardwoods and Appalachian oak.

Unglaciated High Allegheny Plateau

This ecoregion has lower quality soil for agriculture than its glaciated low plateau counterpart. The plateau is more dissected by streams, leading to a very steep topography interrupted by valleys and waterfalls. This area receives more precipitation than the unglaciated adjacent ecoregion as well. Historically, the area was forested by beech-hemlock, although currently there is more of a mix of hardwoods, maples, and basswoods scattered throughout the ecoregion. The waterways originate from Pleistocene glacial melt.

Watershed Biology

Fish

Various fish sampling efforts have taken place in select locations throughout the watershed; however most data exists for the Niagara River and the Niagara River/Lake Erie waterfront communities. Much of the data collection within the watershed has been conducted by NYSDEC, D. Carlson, and studies conducted in relation to the New York Power Authority's relicensing process.

Figure 5.2: Native Brook Trout

Typical fish species within the watershed include: smallmouth bass, walleye, white bass, yellow perch, white sucker, muskellunge, northern pike, carp, various shiners and minnows, brown bullhead, bluegill, and rainbow smelt.[1] Generally, migratory fishes travel upstream along the tributaries off of the Niagara River, however many are impeded by both man-made and naturally caused barriers. Figure 5.3 depicts the known fish barriers within the tributaries of the Niagara River Greenway Communities[2] from the Niagara River Greenway Habitat Strategy Phase 1. Barriers within the river itself are also present, and include water level fluctuations and changes in water velocities

[1] From Niagara River Greenway Plan and Final EIS.

[2] Niagara River Greenway Communities were designated as such as part of the New York Power Authority's relicensing process and include the City of Buffalo; Town of Tonawanda; Village of Kenmore; City of Tonawanda; City of North Tonawanda; Town of Wheatfield; Town of Grand Island; Town of Niagara, City of Niagara Falls, Town of Lewiston; Village of Lewiston, Town of Porter; and Village of Youngstown.

caused by man-made influences. In the upper portions of the watershed smaller populations of non-migratory fishes are present, including self-sustaining populations of native and naturalized trout. These trout streams are documented within the water quality classifications section found in Chapter 4 and in Figure 5.4.

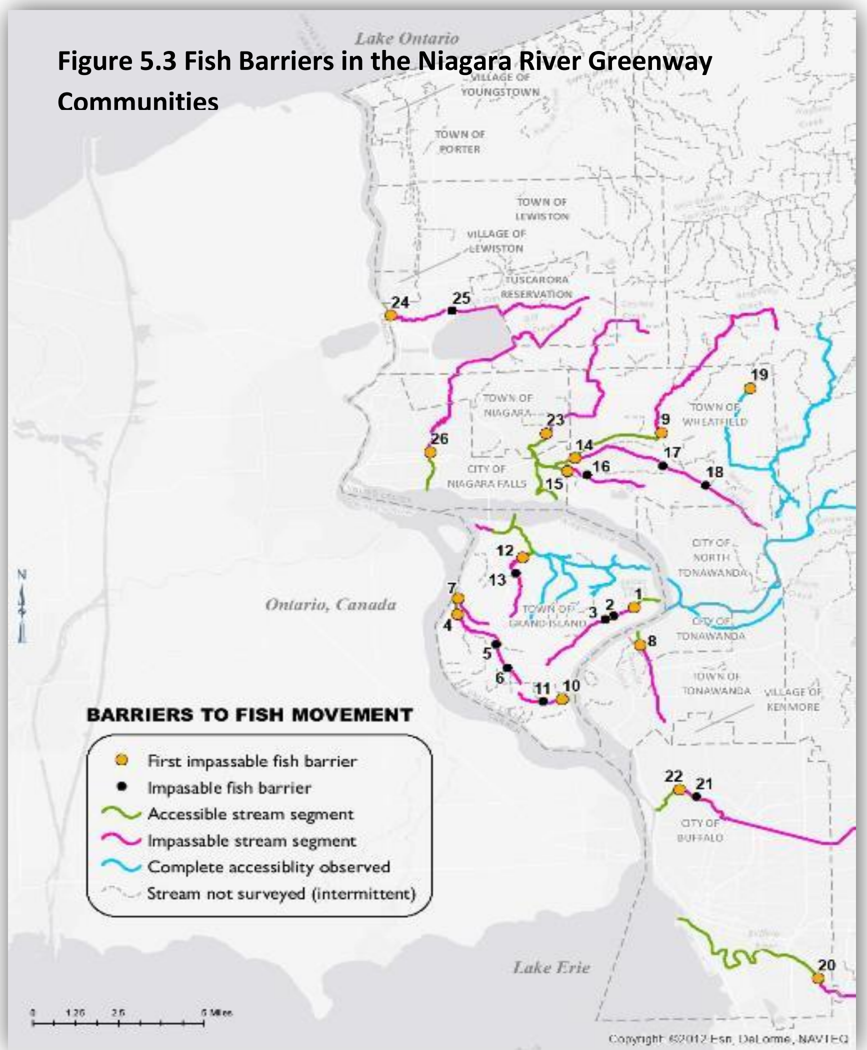


Figure 5.3 Fish Barriers in the Niagara River Greenway Communities

The master list of fish species is provided in Chart 5.1 and was compiled as part of the evaluation for Ramsar designation[3] of the Niagara River Corridor. The Niagara River Watershed Phase 1 list detailed 102 fish species that have been documented within the Niagara River Watershed. However, the following list has been updated to reflect other fishes found in the additional seven sub-watersheds. There are now 123 fish species listed. Within the Niagara River corridor, species community composition differs above and below the falls. The upper Niagara River has been recorded to support 89 species of fish, 36 of which have been introduced since 1960. The lower Niagara River has had 38 species documented, two of which were not observed until after the late 1800s.[4]

[3] https://www.ramsar.org/about-the-ramsar-convention

[4] Carlson, D.M. 2001. Species accounts for the rare fishes of New York. NYS Department of Environmental Conservation, Albany, NY.

Chart 5.1: Fish Species in the Niagara River/Lake Erie Watershed

FISH

Species	Status						Records		Spawning Records		Introduced
	IUCN Red List	CITES Appendix	US (Endangered Species Act)	New York State (Environmental Conservation Law)	Canada (Species at Risk Act)	Ontario (Endangered Species Act)	A	B	C	E	
Lake Sturgeon *(Acipenser fulvescens)*	Least concern	Appendix II	-	Threatened	-	Threatened	X	X			
Gizzard Shad *(Dorosoma cepedianum)*	Least concern	-	-	-	-	-	X	X		X	X[1]
Rainbow Smelt *(Osmerus mordax)*	Least concern	-	-	-	-	-	X	X	X		X[1]
Central Mudminnow *(Umbra limi)*	Least concern	-	-	-	-	-	X	X			
American Eel *(Anguilla rostrata)*	-	-	-	-	-	Endangered	X	X			
Lake Whitefish *(Coregonus clupeaformis)*	-	-	-	-	-	-	X				
Lake Herring *(Coregonus artedi)*	Least concern	-	-	-	-	-	X	X			
American Brook Lamprey *(Lampetra appendix)*	Least concern	-	-	SGCN*	-	-	X	X			
Longnose Gar *(Lepisosteus osseus)*	Least concern	-	-	-	-	-	X	X	X	X	
Bowfin *(Amia calva)*	Least concern	-	-	-	-	-	X	X	X	X	
Grass Pickerel *(Esox americanus vermiculatus)*	-	-	-	-	Special concern	Special concern	X	X			
Mooneye *(Hiodon tergisus)*	Least concern	-	-	Threatened	-	-	X				
Longnose Sucker *(Catostomus catostomus)*	-	-	-	SGCN	-	-	X				
White Sucker *(Catostomus commersonii)*	-	-	-	-	-	-	X	X	X	X	
Northern Hognose Sucker *(Hypentelium nigricans)*	Least concern	-	-	-	-	-		X		X	
Golden Redhorse *(Moxostoma erythrurum)*	Least concern	-	-	-	-	-	X	X			
Shorthead Redhorse *(Moxostoma macrolepidotum)*	Least concern	-	-	-	-	-	X	X			
Greater Redhorse *(Moxostoma valenciennesi)*	-	-	-	-	-	-	X	X			
Black Redhorse *(Moxostoma duquesnei)*	Least concern	-	-	Special concern	-	Threatened	X	X			
Silver Redhorse *(Moxostoma anisurum)*	Least concern	-	-	-	-	-	X				
Redhorse sp. *(Moxostoma sp.)*	-	-	-	-	-	-	X				
Quillback Carpsucker *(Carpiodes cyprinus)*	Least concern	-	-	-	-	-	X	X		X	
Lake Chubsucker *(Erimyzon sucetta)*	Least concern	-	-	Threatened	Endangered	Threatened	X	X			
Black Bullhead *(Ameiurus melas)*	Least concern	-	-	SGCN	-	-	X	X			
Yellow Bullhead *(Ameiurus natalis)*	Least concern	-	-	-	-	-	X	X			
Brown Bullhead *(Ameiurus nebulosus)*	Least concern	-	-	-	-	-	X	X	X	X	
Channel Catfish *(Ictalurus punctatus)*	Least concern	-	-	-	-	-	X	X			
Stonecat *(Noturus flavus)*	Least concern	-	-	-	-	-	X	X			
Tadpole Madtom *(Noturus gyrinus)*	Least concern	-	-	-	-	-	X	X			
Brindled Madtom *(Noturus miurus)*	Least concern	-	-	-	-	-	X	X			
Burbot *(Lota lota)*	Least concern	-	-	-	-	-	X	X			
White Perch *(Morone americana)*	Least concern	-	-	-	-	-	X	X	X	X	X[1]
White Bass *(Morone chrysops)*	-	-	-	-	-	-	X	X			
Brook Silverside *(Labidesthes sicculus)*	Least concern	-	-	-	-	-	X	X	X	X	
Brook Stickleback *(Culaea inconstans)*	Least concern	-	-	-	-	-	X	X			
Three-spine Stickleback *(Gasterosteus aculeatus)*	Least concern	-	-	-	-	-	X	X			X
Trout-perch *(Percopsis omiscomaycus)*	Least concern	-	-	-	-	-	X	X	X		
Greenside Darter *(Etheostoma blennioides)*	Least concern	-	-	-	-	-	X	X			
Iowa Darter *(Etheostoma exile)*	Least concern	-	-	SGCN	-	-	X	X			
Rainbow Darter *(Etheostoma caeruleum)*	Least concern	-	-	-	-	-	X	X	X		
Fantail Darter *(Etheostoma flabellare)*	Least concern	-	-	-	-	-	X	X			
Blackside Darter *(Percina maculata)*	Least concern	-	-	-	-	-	X				
Tesselated Darter *(Etheostoma olmstedi)*	Least concern	-	-	-	-	-	X				

Johnny Darter *(Etheostoma nigrum)*	-	-	-	-	-	-	X	X	X	X	
Freshwater Drum *(Aplodinotus grunniens)*	Least concern	-	-	-	-	-	X	X			
Deepwater Sculpin *(Myoxocephalus thompsoni)*	Least concern	-	-	Endangered	-	-	X				
Mottled Sculpin *(Cottus bairdi)*	-	-	-	-	-	-	X	X		X	
Slimy Sculpin *(Cottus cognatus)*	Least concern	-	-	-	-	-		X			
Logperch *(Percina caprodes)*	Least concern	-	-	-	-	-	X	X		X	
Hornyhead Chub *(Nocomis biguttatus)*	Least concern	-	-	-	-	-	X	X		X	
River Chub *(Nocomis micropogon)*	Least concern	-	-	-	-	-	X	X			
Lake Chub *(Couesius plumbeus)*	Least concern	-	-	SGCN	-	-	X				
Fallfish *(Semotilus corporalis)*	Least concern	-	-	-	-	-	X				
Creek Chub *(Semotilus atromaculatus)*	Least concern	-	-	-	-	-	X	X			
Chub spp. *(Semotilus spp.)*	-	-	-	-	-	-	X				
Golden Shiner *(Notemigonus crysoleucas)*	Least concern	-	-	-	-	-	X	X	X	X	
Striped Shiner *(Luxilus chrysocephalus)*	Least concern	-	-	-	-	-	X	X			
Common Shiner *(Luxilus cornutus)*	Least concern	-	-	-	-	-	X	X	X	X	
Emerald Shiner *(Notropis atherinoides)*	Least concern	-	-	-	-	-	X	X	X	X	
Spottail Shiner *(Notropis hudsonius)*	Least concern	-	-	-	-	-	X	X	X	X	
Rosyface Shiner *(Notropis rubellus)*	Least concern	-	-	-	-	-	X	X			
Spotfin Shiner *(Cyprinella spiloterus)*	-	-	-	-	-	-	X	X			
Sand Shiner *(Notropis stramineus)*	Least concern	-	-	-	-	-	X	X			
Mimic Shiner *(Notropis volucellus)*	Least concern	-	-	-	-	-	X	X			
Blackchin Shiner *(Notropis heterodon)*	Least concern	-	-	SGCN	-	-	X	X		X	
Blacknose Shiner *(Notropis heterolepis)*	Least concern	-	-	SGCN	-	-	X	X		X	
Bridle Shiner *(Notropis bifrenatus)*	Near Threatened	-	-	SGCN	Special concern	Special concern		X			
Redfin Shiner *(Lythrurus umbratilis)*	-	-	-	Special concern	-	-	X	X			
Fathead Minnow *(Pimephales promelas)*	Least concern	-	-	-	-	-	X	X		X	
Bluntnose Minnow *(Pimephales notatus)*	Least concern	-	-	-	-	-	X	X	X	X	
Longnose Dace *(Rhinichthys cataractae)*	Least concern	-	-	-	-	-	X	X			
Blacknose Dace *(Rhinichthys atratulus)*	Least concern	-	-	-	-	-	X	X			
Central Stoneroller *(Campostoma anomalum)*	Least concern	-	-	-	-	-	X	X			
Atlantic Salmon *(Salmo salar)*	Least concern	-	-	SGCN	-	-	X				X
Lake Trout *(Salvelinus namaycush)*	-	-	-	SGCN	-	-	X	X	X		
Northern Pike *(Esox lucius)*	Least concern	-	-	-	-	-	X	X		X	
Muskellunge *(Esox masquinongy)*	Least concern	-	-	SGCN	-	-	X	X		X	
Smallmouth Bass *(Micropterus dolomieui)*	-	-	-	-	-	-	X	X	X	X	
Largemouth Bass *(Micropterus salmoides)*	Least concern	-	-	-	-	-	X	X	X	X	
White Crappie *(Pomoxis annularis)*	Least concern	-	-	-	-	-	X	X			
Black Crappie *(Pomoxis nigromaculatus)*	Least concern	-	-	-	-	-	X	X		X	
Yellow Perch *(Perca flavescens)*	Least concern	-	-	-	-	-	X	X	X	X	
Sauger *(Sander canadensis)*	Least concern	-	-	SGCN*; Presumed Extirpated	-	-	X	X			
Walleye *(Sander vitreus)*	Least concern	-	-	-	-	-	X	X			
Rock Bass *(Ambloplites rupestris)*	Least concern	-	-	-	-	-	X	X	X	X	
Green Sunfish *(Lepomis cyanellus)*	Least concern	-	-	-	-	-	X	X		X	
Pumpkinseed *(Lepomis gibbosus)*	Least concern	-	-	-	-	-	X	X	X	X	
Bluegill *(Lepomis macrochirus)*	Least concern	-	-	-	-	-	X	X		X	
Longear Sunfish *(Lepomis megalotis)*	Least concern	-	-	Threatened	-	-	X				

Sea Lamprey (*Petromyzon marinus*)	Least concern	-	-	-	-	-	X	X			X
Alewife (*Alosa pseudoharengus*)	Least concern	-	-	-	-	-	X	X	X	X	X
Coho Salmon (*Oncorhynchus kisutch*)	-	-	-	-	-	-	X				X
Chinook Salmon (*Oncorhynchus tshawytscha*)	-	-	-	-	-	-	X	X			X
Rainbow Trout (*Oncorhynchus mykiss*)	-	-	-	-	-	-	X	X			X
Brown Trout (*Salmo trutta*)	Least concern	-	-	-	-	-	X				X
Goldfish (*Carassius auratus*)	Least concern	-	-	-	-	-	X	X		X	X
Common Carp (*Cyprinus carpio*)	Vulnerable	-	-	-	-	-	X	X	X	X	X
Round Goby (*Neogobius melanostomus*)	Least concern	-	-	-	-	-	X	X	X	X	X
Banded Killifish (*Fundulus diaphanus*)	Least concern	-	-	-	-	-	X	X	X	X	X[1]
Rudd (*Scardinius erythrophthalmus*)	Least concern	-	-	-	-	-	X	X		X	X
Bigmouth Buffalo (*Ictiobus cyprinellus*)	Least concern	-	-	-	Special concern	-		X			
Bigeye Chub (*Hybopsis amblops*)	Least concern	-	-	SGCN*	-	-		X			
Silver Chub (*Macrhybopsis storeriana*)	Least concern	-	-	Endangered	Endangered	Threatened		X			
Spoonhead Sculpin (*Cottus ricei*)	Least concern	-	-	Presumed Extirpated	-	-		X			
Longhead Darter (*Percina macrocephala*)	Data Deficient	-	-	Threatened	-	-		X			
Eastern Sand Darter (*Ammocrypta pellucida*)	Least concern	-	-	Threatened	Threatened	Endangered		X			
Northern Sunfish (*Lepomis peltastes*)	-	-	-	Threatened	Special concern	-		X			
Paddlefish (*Polyodon spathula*)	Vulnerable	-	-	Extirpated, currently being stocked	Extirpated	Extirpated		X			
Northern Brook Lamprey (*Ichthyomyzon fossor*)	Least concern	-	-	-	Special concern	Special concern	X	X			
Silver Lamprey (*Ichthyomyzon unicuspis*)	Least concern	-	-	-	-	-		X			
Northern Redbelly Dace (*Chrosomus eos*)	Least concern	-	-	-	-	-		X			
Bigmouth Shiner (*Notropis dorsalis*)	Least concern	-	-	SGCN	-	-		X			
Brook Trout (*Salvelinus fontinalis*)	-	-	-	SGCN	-	-	X	X			
Cisco (*Coregonus artedi*)	Least concern	-	-	SGCN	-	-		X			
Pirate Perch (*Aphredoderus sayanus*)	Least concern	-	-	SGCN	-	-		X			
Redside Dace (*Clinostomus elongatus*)	Least concern	-	-	-	Endangered	Endangered		X			
Grass Carp (*Ctenopharyngodon idella*)	Least concern	-	-	-	-	-		X			X
Allegheny Pearl Dace (*Margariscus margarita*)	Least concern	-	-	-	-	-		X			
Western Blacknose Dace (*Rhinichthys obtusus*)	Least concern	-	-	-	-	-		X			
Spotted Sucker (*Minytrema melanops*)	Least concern	-	-	-	Special Concern	Special Concern		X			
Pink Salmon (*Oncorhynchus gorbuscha*)	-	-	-	-	-	-		X			X
Tiger Muskellunge (*Esox lucius* x *Esox masquinongy*)	-	-	-	-	-	-		X			X
Chain Pickerel (*Esox niger*)	Least concern	-	-	-	-	-		X			X
Channel Darter (*Percina copelandi*)	Least concern	-	-	-	-	Threatened		X			

Sources of Status

IUCN Red List - "International Union for the Conservation of Nature, Red List of Threatened Species" (http://www.iucnredlist.org/)

CITES Appendix - "Convention on the International Trade in Endangered Species of Wild Flora and Fauna" (http://www.cites.org/)

US (Endangered Species Act) - "U.S. Fish and Wildlife Service, Endangered Species" (http://www.fws.gov/ENDANGERED/species/us-species.html)

New York State (Environmental Conservation Law) - List of Endangered, Threatened and Special Concern Fish & Wildlife Species of New York State (http://www.dec.ny.gov/animals/7494.html)

Canada (Species at Risk Act) - "Species at Risk Public Registry" (http://www.sararegistry.gc.ca/sar/index/default_e.cfm)

Ontario (Endangered Species Act) - "Species at Risk in Ontario (SARO) List" (http://www.mnr.gov.on.ca/en/Business/Species/2ColumnSubPage/MNR_SAR_CSSR_SARO_LST_EN.html)

New York State (Department of Environmental Conservation) - Species of Greatest Conservation Need (http://www.dec.ny.gov/docs/wildlife_pdf/sgnc2015list.pdf)

New York State (Department of Environmental Conservation) - Species of Potential Conservation Need (http://www.dec.ny.gov/docs/wildlife_pdf/spnc2015list.pdf)

Sources of Records

content/uploads/NIAGARA-RIVER-WATERSHED-FISH-COMMUNITY-FINAL-Aug-2013.pdf) (Canada records only)

B - NYS Department of Environmental Conservation website. "Fish Atlas Maps of New York". Retrieved on July 29, 2014. (http://www.dec.ny.gov/animals/84622.html) (U.S. records only)

C - Trometer, Betsy. 2011. Larval and young-of-the-year fishes found in the Upper and Lower Niagara River - Draft. USFWS – Lower Great Lakes Fish and Wildlife Conservation Office. (U.S. records only)

D - Kapuscinski, Kevin. 2014. Unpublished fish sampling data from the lower & upper Niagara. SUNY, College of Environmental Science and Forestry. (U.S. records only)

Additional Notes

Introduced species are a species living outside their native distributional range, which have arrived there by human activity, either deliberate or accidental.

Species marked with X[1] are found in both the lower and upper Niagara River, and are considered native to the lower Niagara River but introduced in the upper Niagara River.

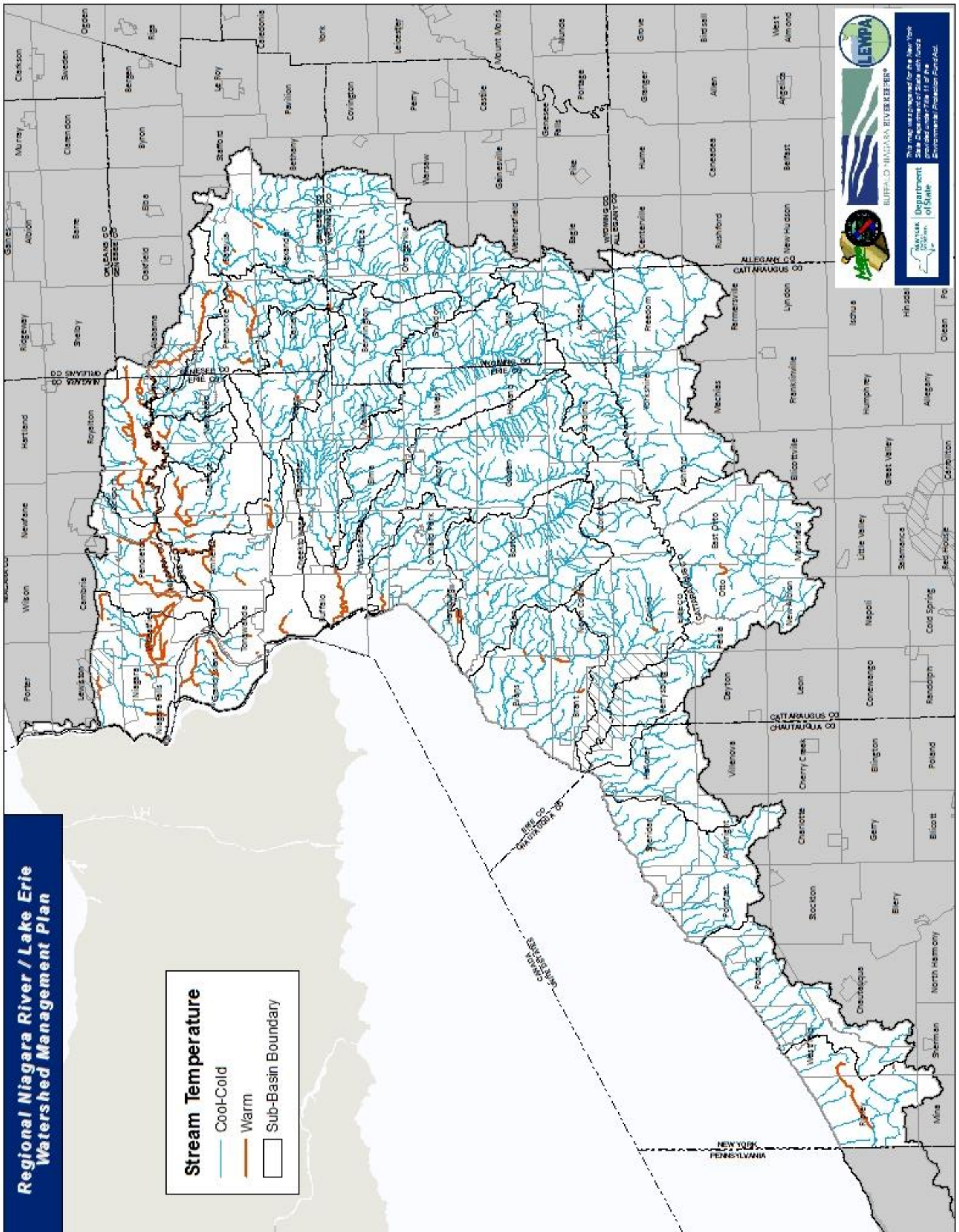


Figure 5.4: Stream Temperature in the Niagara River/Lake Erie Watershed
(Source: NYSDEC Classifications, USGS National Hydrography Dataset)

Loss of fish habitat within the watershed has been significant, resulting from human activities including development, dredging, water diversions, and bulk heading. This loss is most dramatic in the upper Niagara River, where valuable habitat including submerged aquatic vegetation and coastal wetlands have been destroyed and degraded. The Niagara River Remedial Action Plan lists the loss of both fish and wildlife habitat as a Beneficial Use Impairment for both the Buffalo and Niagara Rivers that need to be addressed before they can be delisted as Areas of Concern (AOC). However, improving trends have been observed within the past 20 years, as more sensitive fish species are showing recovery within the Niagara River.[4]

Water temperature is another factor affecting the viability of certain fish species in the watershed. The U.S. Geological Survey tracks water temperature data from its stream gauge locations and identifies which streams fall into warm and cold categories. Figure 5.4 outlines the water temperature classifications for the sub-watersheds from the research conducted as part of the Niagara River Greenway Habitat Conservation Strategy.[5]

Birds

A total of 338 bird species were documented in the Niagara River Watershed as part of the Niagara River Corridor Ramsar Site[6] nomination package, 2016 and was used in the Niagara River Habitat Conservation Strategy. A master list of bird species is provided in Chart 5.2.[7] The Niagara River corridor is currently designated as an Important Bird Area, signifying it is internationally recognized for its ability to support large populations of migratory gulls and waterfowl. A number of species flock to this area and rely on the resources it provides for both wintering and breeding activities. The sensitive bird areas that exist along the Niagara River corridor are detailed in the Table 5.1. Information on bird species was not updated for the Phase 2 watershed expansion to the Lake Erie portion of the Niagara River/Lake Erie Watershed as it was beyond the scope of this project.

[5] NYSDEC Classifications, USGS National Hydrography Dataset

[6] https://www.ramsar.org/about-the-ramsar-convention

[7] In this report we use the English capitalization standard for all species common names except birds. Cornell and Audubon have set a standard that bird common names should be written in title case.

Chart 5.2 Birds of the Niagara River/Lake Erie Watershed

BIRDS

Species	Status						Records			Nesting Records			Waterbirds	Overwintering	Migratory	Introduced
	IUCN Red List	CITES Appendix	US (Endangered Species Act)	New York State (Environmental Conservation Law)	Canada (Species at Risk Act)	Ontario (Endangered Species Act)	A	B	C	D	E	F				
Greater White-fronted Goose *(Anser albifrons)*	Least Concern	-	-	-	-	-			X				X		X	
Snow Goose *(Chen caerulescens)*	Least Concern	-	-	-	-	-	X		X				X		X	
Ross's Goose *(Chen rossii)*	Least Concern	-	-	-	-	-	X		X				X			
Brant *(Branta bernicla)*	Least Concern	-	-	-	-	-	X		X				X		X	
Cackling Goose *(Branta hutchinsii)*	Least Concern	-	-	-	-	-	X		X				X			
Canada Goose *(Branta canadensis)*	Least Concern	-	-	-	-	-	X		X		X	X	X	X	X	
Mute Swan *(Cygnus olor)*	Least Concern	-	-	-	-	-	X		X		X		X	X		X
Trumpeter Swan *(Cygnus buccinator)*	Least Concern	-	-	-	-	-	X		X				X			
Tundra Swan *(Cygnus columbianus)*	Least Concern	-	-	-	-	-	X		X				X	X	X	
Wood Duck *(Aix sponsa)*	Least Concern	-	-	-	-	-	X	X	X		X	X	X		X	
Gadwall *(Anas strepera)*	Least Concern	-	-	-	-	-	X	X	X		X	X	X	X	X	
Eurasian Wigeon *(Anas penelope)*	Least Concern	-	-	-	-	-			X				X			
American Wigeon *(Anas americana)*	Least Concern	-	-	-	-	-	X	X	X		X	X	X	X	X	
American Black Duck *(Anas rubripes)*	Least Concern	-	-	SGCN*	-	-	X	X	X		X	X	X	X	X	
Mallard *(Anas platyrhynchos)*	Least Concern	-	-	-	-	-	X	X	X		X	X	X	X	X	
Blue-winged Teal *(Anas discors)*	Least Concern	-	-	SGCN	-	-	X	X	X		X	X	X		X	
Cinnamon Teal *(Anas cyanoptera)*	Least Concern	-	-	-	-	-			X				X			
Northern Shoveler *(Anas clypeata)*	Least Concern	-	-	-	-	-	X	X	X		X		X		X	
Northern Pintail *(Anas acuta)*	Least Concern	-	-	SGCN	-	-	X	X	X				X	X	X	
Green-winged Teal *(Anas crecca)*	Least Concern	-	-	-	-	-	X	X	X		X		X		X	
Canvasback *(Aythya valisineria)*	Least Concern	-	-	-	-	-	X	X	X				X	X	X	
Redhead *(Aythya americana)*	Least Concern	-	-	-	-	-	X	X	X				X	X	X	
Ring-necked Duck *(Aythya collaris)*	Least Concern	-	-	-	-	-	X	X	X				X	X	X	
Tufted Duck *(Aythya fuligula)*	Least Concern	-	-	-	-	-	X		X				X			
Greater Scaup *(Aythya marila)*	Least Concern	-	-	SGCN	-	-	X	X	X				X	X	X	
Lesser Scaup *(Aythya affinis)*	Least Concern	-	-	SGCN	-	-	X	X	X				X	X	X	
King Eider *(Somateria spectabilis)*	Least Concern	-	-	-	-	-	X	X	X				X	X	X	
Common Eider *(Somateria mollissima)*	Near Threatened	-	-	SGCN	-	-	X	X	X				X			
Harlequin Duck *(Histrionicus histrionicus)*	Least Concern	-	-	SGCN	Special Concern	-	X	X	X				X	X	X	
Surf Scoter *(Melanitta perspicillata)*	Least Concern	-	-	SGCN	-	-	X	X	X				X	X	X	
White-winged Scoter *(Melanitta deglandi)*	Least Concern	-	-	SGCN	-	-	X	X	X				X	X	X	
Black Scoter *(Melanitta americana)*	Near Threatened	-	-	SGCN	-	-	X	X	X				X		X	
Long-tailed Duck *(Clangula hyemalis)*	Vulnerable	-	-	SGCN	-	-	X	X	X				X	X	X	
Bufflehead *(Bucephala albeola)*	Least Concern	-	-	-	-	-	X	X	X				X	X	X	
Common Goldeneye *(Bucephala clangula)*	Least Concern	-	-	SGCN	-	-	X	X	X				X	X	X	
Barrow's Goldeneye *(Bucephala islandica)*	Least Concern	-	-	-	Special Concern	-		X	X				X			
Hooded Merganser *(Lophodytes cucullatus)*	Least Concern	-	-	-	-	-	X	X	X		X		X	X	X	
Common Merganser *(Mergus merganser)*	Least Concern	-	-	-	-	-	X	X	X		X		X	X	X	
Red-breasted Merganser *(Mergus serrator)*	Least Concern	-	-	-	-	-	X	X	X				X	X	X	
Ruddy Duck *(Oxyura jamaicensis)*	Least Concern	-	-	SGCN	-	-	X	X	X				X		X	
Northern Bobwhite *(Colinus virginianus)*	Near Threatened	-	-	SGCN*	Endangered	Endangered		X	X							
Ring-necked Pheasant *(Phasianus colchicus)*	Least Concern	-	-	-	-	-	X		X		X	X		X		X

Ruffed Grouse *(Bonasa umbellus)*	Least Concern	-	-	SGCN	-	-			X					X		
Wild Turkey *(Meleagris gallopavo)*	Least Concern	-	-	-	-	-	X		X		X			X		
Red-throated Loon *(Gavia stellata)*	Least Concern	-	-	-	-	-	X		X				X		X	
Pacific Loon *(Gavia pacifica)*	Least Concern	-	-	-	-	-			X				X			
Common Loon *(Gavia immer)*	Least Concern	-	-	Special Concern	-	-	X	X	X				X	X	X	
Pied-billed Grebe *(Podilymbus podiceps)*	Least Concern	-	-	Threatened	-	-	X	X	X		X	X	X	X	X	
Horned Grebe *(Podiceps auritus)*	Vulnerable	-	-	SGCN	Special Concern	Special Concern	X		X				X	X	X	
Red-necked Grebe *(Podiceps grisegena)*	Least Concern	-	-	-	-	-	X		X				X		X	
Eared Grebe *(Podiceps nigricollis)*	Least Concern	-	-	-	-	-	X		X				X			
Western Grebe *(Aechmophorus occidentalis)*	Least Concern	-	-	-	-	-			X				X			
Black-capped Petrel *(Pterodroma hasitata)*	Endangered	-	-	-	-	-			X				X			
Wilson's Storm-Petrel *(Oceanites oceanicus)*	Least Concern	-	-	-	-	-			X				X			
Leach's Storm-Petrel *(Oceanodroma leucorhoa)*	Least Concern	-	-	-	-	-			X				X			
Brown Booby *(Sula leucogaster)*	Least Concern	-	-	-	-	-	X		X				X			
Northern Gannet *(Morus bassanus)*	Least Concern	-	-	-	-	-	X		X				X			
Double-crested Cormorant *(Phalacrocorax aurit*	Least Concern	-	-	-	-	-	X		X	X	X		X	X	X	
Great Cormorant *(Phalacrocorax carbo)*	Least Concern	-	-	-	-	-			X				X			
American White Pelican *(Pelecanus erythrorhync*	Least Concern	-	-	-	-	Threatened	X		X				X			
Brown Pelican *(Pelecanus occidentalis)*	Least Concern	-	-	-	-	-	X		X				X			
American Bittern *(Botaurus lentiginosus)*	Least Concern	-	-	Special Concern	-	-	X		X		X	X	X		X	
Least Bittern *(Ixobrychus exilis)*	Least Concern	-	-	Threatened	Threatened	Threatened		X	X		X	X	X		X	
Great Blue Heron *(Ardea herodias)*	Least Concern	-	-	-	-	-	X		X	X	X	X	X	X	X	
Great Egret *(Ardea alba)*	Least Concern	-	-	SGCN	-	-	X		X	X	X		X		X	
Snowy Egret *(Egretta thula)*	Least Concern	-	-	SGCN	-	-	X		X		X		X			
Little Blue Heron *(Egretta caerulea)*	Least Concern	-	-	SGCN	-	-			X				X			
Tricolored Heron *(Egretta tricolor)*	Least Concern	-	-	SGCN	-	-			X				X			
Cattle Egret *(Bubulcus ibis)*	Least Concern	-	-	SGCN*	-	-			X				X			
Green Heron *(Butorides virescens)*	Least Concern	-	-	-	-	-	X		X		X	X	X		X	
Black-crowned Night-Heron *(Nycticorax nycticor*	Least Concern	-	-	SGCN	-	-	X		X	X	X		X		X	
Yellow-crowned Night-Heron *(Nyctanassa violac*	Least Concern	-	-	SGCN	-	-			X				X			
Glossy Ibis *(Plegadis falcinellus)*	Least Concern	-	-	SGCN	-	-			X				X			
White-faced Ibis *(Plegadis chihi)*	Least Concern	-	-	-	-	-			X				X			
Black Vulture *(Coragyps atratus)*	Least Concern	-	-	-	-	-	X		X							
Turkey Vulture *(Cathartes aura)*	Least Concern	-	-	-	-	-	X		X		X				X	
Osprey *(Pandion haliaetus)*	Least Concern	Appendix II	-	Special Concern	-	-	X	X	X		X		X		X	
Golden Eagle *(Aquila chrysaetos)*	Least Concern	Appendix II	-	Endangered	-	Endangered			X				-			
Northern Harrier *(Circus cyaneus)*	Least Concern	Appendix II	-	Threatened	-	-	X	X	X		X	X	X	X	X	
Sharp-shinned Hawk *(Accipiter striatus)*	Least Concern	Appendix II	-	Special Concern	-	-	X		X		X	X		X	X	
Cooper's Hawk *(Accipiter cooperii)*	Least Concern	Appendix II	-	Special Concern	-	-	X		X		X			X	X	
Northern Goshawk *(Accipiter gentilis)*	Least Concern	Appendix II	-	Special Concern	-	-	X		X							
Bald Eagle *(Haliaeetus leucocephalus)*	Least Concern	Appendix II	-	Threatened	-	Special Concern	X	X	X		X		X	X		
Red-shouldered Hawk *(Buteo lineatus)*	Least Concern	Appendix II	-	Special Concern	Special Concern	-		X	X						X	
Broad-winged Hawk *(Buteo platypterus)*	Least Concern	Appendix II	-	-	-	-			X		X				X	
Red-tailed Hawk *(Buteo jamaicensis)*	Least Concern	Appendix II	-	-	-	-	X		X		X	X		X		
Rough-legged Hawk *(Buteo lagopus)*	Least Concern	Appendix II	-	-	-	-	X		X					X	X	

Yellow Rail *(Coturnicops noveboracensis)*	Least Concern	-	-	-	Special Concern	Special Concern		X					X			
King Rail *(Rallus elegans)*	Near Threatened	-	-	Threatened	Endangered	Endangered		X					X			
Virginia Rail *(Rallus limicola)*	Least Concern	-	-	-	-	-	X		X		X	X	X		X	
Sora *(Porzana carolina)*	Least Concern	-	-	-	-	-	X		X		X	X	X		X	
Common Gallinule *(Gallinula galeata)*	Least Concern	-	-	-	-	-	X		X		X	X	X		X	
American Coot *(Fulica americana)*	Least Concern	-	-	-	-	-	X		X		X	X	X	X	X	
Sandhill Crane *(Grus canadensis)*	Least Concern	Appendix II	-	-	-	-	X		X				X		X	
American Avocet *(Recurvirostra americana)*	Least Concern	-	-	-	-	-	X		X				X		X	
Black-bellied Plover *(Pluvialis squatarola)*	Least Concern	-	-	SGCN	-	-	X		X				X		X	
American Golden-Plover *(Pluvialis dominica)*	Least Concern	-	-	SPCN	-	-			X				X		X	
Semipalmated Plover *(Charadrius semipalmatus*	Least Concern	-	-	-	-	-	X		X				X		X	
Piping Plover *(Charadrius melodus)*	Near Threatened	-	Endangered	Endangered	Endangered	Endangered		X	X				X			
Killdeer *(Charadrius vociferus)*	Least Concern	-	-	-	-	-	X		X		X	X	X		X	
Spotted Sandpiper *(Actitis macularius)*	Least Concern	-	-	-	-	-	X		X		X	X	X		X	
Solitary Sandpiper *(Tringa solitaria)*	Least Concern	-	-	-	-	-	X		X				X		X	
Greater Yellowlegs *(Tringa melanoleuca)*	Least Concern	-	-	SGCN	-	-	X		X				X		X	
Willet *(Tringa semipalmata)*	Least Concern	-	-	SGCN	-	-	X		X				X		X	
Lesser Yellowlegs *(Tringa flavipes)*	Least Concern	-	-	-	-	-	X		X				X		X	
Upland Sandpiper *(Bartramia longicauda)*	Least Concern	-	-	Threatened	-	-		X	X			X	X		X	
Whimbrel *(Numenius phaeopus)*	Least Concern	-	-	SGCN*	-	-			X				X		X	
Hudsonian Godwit *(Limosa haemastica)*	Least Concern	-	-	SPCN	-	-			X				X		X	
Marbled Godwit *(Limosa fedoa)*	Least Concern	-	-	SPCN	-	-			X				X		X	
Ruddy Turnstone *(Arenaria interpres)*	Least Concern	-	-	SGCN	-	-	X		X				X		X	
Red Knot *(Calidris canutus)*	Near Threatened	-	-	SGCN*	Endangered	Endangered			X				X		X	
Ruff *(Calidris pugnax)*	Least Concern	-	-	-	-	-			X				X			
Stilt Sandpiper *(Calidris himantopus)*	Least Concern	-	-	-	-	-			X				X		X	
Curlew Sandpiper *(Calidris ferruginea)*	Least Concern	-	-	-	-	-			X				X			
Sanderling *(Calidris alba)*	Least Concern	-	-	SPCN	-	-	X		X				X		X	
Dunlin *(Calidris alpina)*	Least Concern	-	-	-	-	-	X		X				X		X	
Purple Sandpiper *(Calidris maritima)*	Least Concern	-	-	SGCN	-	-	X		X				X		X	
Baird's Sandpiper *(Calidris bairdii)*	Least Concern	-	-	-	-	-			X				X		X	
Least Sandpiper *(Calidris minutilla)*	Least Concern	-	-	-	-	-	X		X				X		X	
White-rumped Sandpiper *(Calidris fuscicollis)*	Least Concern	-	-	-	-	-			X				X		X	
Buff-breasted Sandpiper *(Calidris subruficollis)*	Near Threatened	-	-	SGCN*	-	-			X				X		X	
Pectoral Sandpiper *(Calidris melanotos)*	Least Concern	-	-	-	-	-	X		X				X		X	
Semipalmated Sandpiper *(Calidris pusilla)*	Near Threatened	-	-	SGCN*	-	-	X		X				X		X	
Western Sandpiper *(Calidris mauri)*	Least Concern	-	-	-	-	-	X		X				X		X	
Short-billed Dowitcher *(Limnodromus griseus)*	Least Concern	-	-	SGCN*	-	-	X		X				X		X	
Long-billed Dowitcher *(Limnodromus scolopace*	Least Concern	-	-	-	-	-			X				X			
Wilson's Snipe *(Gallinago delicata)*	Least Concern	-	-	-	-	-	X		X		X	X	X		X	
American Woodcock *(Scolopax minor)*	Least Concern	-	-	SGCN	-	-	X		X		X	X	X		X	
Wilson's Phalarope *(Phalaropus tricolor)*	Least Concern	-	-	-	-	-			X				X		X	
Red-necked Phalarope *(Phalaropus lobatus)*	Least Concern	-	-	SPCN	-	-			X				X		X	
Red Phalarope *(Phalaropus fulicarius)*	Least Concern	-	-	-	-	-	X		X				X		X	
Pomarine Jaeger *(Stercorarius pomarinus)*	Least Concern	-	-	-	-	-	X		X				X			

Parasitic Jaeger *(Stercorarius parasiticus)*	Least Concern	-	-	-	-	-	X		X				X		X	
Long-tailed Jaeger *(Stercorarius longicaudus)*	Least Concern	-	-	-	-	-			X				X			
Thick-billed Murre *(Uria lomvia)*	Least Concern	-	-	-	-	-	X						X			
Razorbill *(Alca torda)*	Near Threatened	-	-	SGCN	-	-	X		X				X			
Black-legged Kittiwake *(Rissa tridactyla)*	Least Concern	-	-	-	-	-	X	X	X				X		X	
Ivory Gull *(Pagophila eburnea)*	Near Threatened	-	-	-	Endangered	-		X	X				X			
Sabine's Gull *(Xema sabini)*	Least Concern	-	-	-	-	-	X	X	X				X		X	
Bonaparte's Gull *(Chroicocephalus philadelphia*	Least Concern	-	-	SGCN	-	-	X	X	X				X	X	X	
Black-headed Gull *(Chroicocephalus ridibundus*	Least Concern	-	-	-	-	-	X	X	X				X		X	
Little Gull *(Hydrocoloeus minutus)*	Least Concern	-	-	SGCN*	-	-	X	X	X				X	X	X	
Ross's Gull *(Rhodostethia rosea)*	Least Concern	-	-	-	Threatened	-	X	X	X				X			
Laughing Gull *(Leucophaeus atricilla)*	Least Concern	-	-	SGCN	-	-		X	X				X			
Franklin's Gull *(Leucophaeus pipixcan)*	Least Concern	-	-	-	-	-	X	X	X				X		X	
Mew Gull *(Larus canus)*	Least Concern	-	-	-	-	-	X	X	X				X			
Ring-billed Gull *(Larus delawarensis)*	Least Concern	-	-	-	-	-	X	X	X	X	X	X	X	X		
California Gull *(Larus californicus)*	Least Concern	-	-	-	-	-	X	X	X				X			
Herring Gull *(Larus argentatus)*	Least Concern	-	-	-	-	-	X	X	X	X	X	X	X	X		
Thayer's Gull *(Larus thayeri)*	Least Concern	-	-	SPCN	-	-	X	X	X				X	X	X	
Iceland Gull *(Larus glaucoides)*	Least Concern	-	-	-	-	-	X	X	X				X	X	X	
Lesser Black-backed Gull *(Larus fuscus)*	Least Concern	-	-	-	-	-	X	X	X				X	X	X	
Slaty-backed Gull *(Larus schistisagus)*	Least Concern	-	-	-	-	-	X	X	X				X			
Glaucous Gull *(Larus hyperboreus)*	Least Concern	-	-	-	-	-	X	X	X				X	X	X	
Great Black-backed Gull *(Larus marinus)*	Least Concern	-	-	-	-	-	X	X	X				X	X	X	
Caspian Tern *(Hydroprogne caspia)*	Least Concern	-	-	SGCN	-	-	X	X	X				X		X	
Black Tern *(Chlidonias niger)*	Least Concern	-	-	Endangered	-	Special Concern	X	X	X			X	X		X	
Common Tern *(Sterna hirundo)*	Least Concern	-	-	Threatened	-	-	X	X	X	X	X	X	X		X	
Forster's Tern *(Sterna forsteri)*	Least Concern	-	-	SGCN	-	-	X		X				X		X	
Elegant Tern *(Thalasseus elegans)*	Near Threatened	-	-	-	-	-	X		X				X			
Rock Pigeon *(Columba livia)*	Least Concern	-	-	-	-	-	X				X	X		X		X
Mourning Dove *(Zenaida macroura)*	Least Concern	-	-	-	-	-	X		X		X	X		X		
Yellow-billed Cuckoo *(Coccyzus americanus)*	Least Concern	-	-	-	-	-	X		X		X	X			X	
Black-billed Cuckoo *(Coccyzus erythropthalmus*	Least Concern	-	-	SGCN	-	-	X		X		X	X			X	
Barn Owl *(Tyto alba)*	Least Concern	Appendix II	-	SGCN*	Endangered	Endangered		X	X			X				
Eastern Screech-Owl *(Megascops asio)*	Least Concern	Appendix II	-	-	-	-	X		X		X	X		X		
Great Horned Owl *(Bubo virginianus)*	Least Concern	Appendix II	-	-	-	-	X		X		X	X		X		
Snowy Owl *(Bubo scandiacus)*	Least Concern	Appendix II	-	-	-	-	X		X					X	X	
Long-eared Owl *(Asio otus)*	Least Concern	Appendix II	-	SGCN	-	-	X		X					X	X	
Short-eared Owl *(Asio flammeus)*	Least Concern	Appendix II	-	Endangered	Special Concern	Special Concern	X	X	X					X	X	
Boreal Owl *(Aegolius funereus)*	Least Concern	Appendix II	-	-	-	-			X							
Northern Saw-whet Owl *(Aegolius acadicus)*	Least Concern	Appendix II	-	-	-	-	X		X						X	
Common Nighthawk *(Chordeiles minor)*	Least Concern	-	-	Special Concern	Threatened	Special Concern	X		X		X	X			X	
Eastern Whip-poor-will *(Antrostomus vociferus)*	Least Concern	-	-	Special Concern	Threatened	Threatened			X						X	
Chimney Swift *(Chaetura pelagica)*	Near Threatened	-	-	-	Threatened	Threatened	X		X		X	X			X	
Ruby-throated Hummingbird *(Archilochus colubi*	Least Concern	-	-	-	-	-	X		X		X	X			X	
Rufous Hummingbird *(Selasphorus rufus)*	Least Concern	-	-	-	-	-										

Belted Kingfisher *(Megaceryle alcyon)*	Least Concern	-	-	-	-	-	X		X		X	X	X		X	
Red-headed Woodpecker *(Melanerpes erythroce*	Near Threatened	-	-	Special Concern	Threatened	Special Concern	X	X	X		X	X			X	
Red-bellied Woodpecker *(Melanerpes carolinus*	Least Concern	-	-	-	-	-	X		X		X	X		X		
Yellow-bellied Sapsucker *(Sphyrapicus varius)*	Least Concern	-	-	-	-	-	X		X		X				X	
Downy Woodpecker *(Picoides pubescens)*	Least Concern	-	-	-	-	-	X				X	X		X		
Hairy Woodpecker *(Picoides villosus)*	Least Concern	-	-	-	-	-	X				X	X		X		
American Three-toed Woodpecker *(Picoides dor*	Least Concern	-	-	-	-	-	X		X							
Northern Flicker *(Colaptes auratus)*	Least Concern	-	-	-	-	-	X		X		X	X		X	X	
Pileated Woodpecker *(Dryocopus pileatus)*	Least Concern	-	-	-	-	-	X		X		X	X		X		
American Kestrel *(Falco sparverius)*	Least Concern	Appendix II	-	SGCN	-	-	X		X		X	X		X		
Merlin *(Falco columbarius)*	Least Concern	Appendix II	-	-	-	-	X		X		X				X	
Gyrfalcon *(Falco rusticolus)*	Least Concern	Appendix I	-	-	-	-			X							
Peregrine Falcon *(Falco peregrinus)*	Least Concern	Appendix I	-	Endangered	Special Concern	Special Concern	X	X	X		X				X	
Olive-sided Flycatcher *(Contopus cooperi)*	Near Threatened	-	-	-	Threatened	Special Concern			X						X	
Eastern Wood-Pewee *(Contopus virens)*	Least Concern	-	-	-	-	Special Concern	X		X		X	X			X	
Yellow-bellied Flycatcher *(Empidonax flaviventr*	Least Concern	-	-	-	-	-	X		X						X	
Acadian Flycatcher *(Empidonax virescens)*	Least Concern	-	-	-	Endangered	Endangered			X						X	
Alder Flycatcher *(Empidonax alnorum)*	Least Concern	-	-	-	-	-	X		X		X	X			X	
Willow Flycatcher *(Empidonax traillii)*	Least Concern	-	-	-	-	-	X		X		X	X			X	
Least Flycatcher *(Empidonax minimus)*	Least Concern	-	-	-	-	-	X		X		X	X			X	
Eastern Phoebe *(Sayornis phoebe)*	Least Concern	-	-	-	-	-	X		X		X	X			X	
Great Crested Flycatcher *(Myiarchus crinitus)*	Least Concern	-	-	-	-	-	X		X		X	X			X	
Eastern Kingbird *(Tyrannus tyrannus)*	Least Concern	-	-	-	-	-	X		X		X	X			X	
Loggerhead Shrike *(Lanius ludovicianus)*	Least Concern	-	-	Endangered	Endangered	Endangered	X	X	X							
Northern Shrike *(Lanius excubitor)*	Least Concern	-	-	-	-	-	X		X					X	X	
White-eyed Vireo *(Vireo griseus)*	Least Concern	-	-	-	-	-			X						X	
Yellow-throated Vireo *(Vireo flavifrons)*	Least Concern	-	-	-	-	-	X		X		X				X	
Blue-headed Vireo *(Vireo solitarius)*	Least Concern	-	-	-	-	-	X		X						X	
Warbling Vireo *(Vireo gilvus)*	Least Concern	-	-	-	-	-	X		X		X	X			X	
Philadelphia Vireo *(Vireo philadelphicus)*	Least Concern	-	-	-	-	-	X		X						X	
Red-eyed Vireo *(Vireo olivaceus)*	Least Concern	-	-	-	-	-	X		X		X	X			X	
Blue Jay *(Cyanocitta cristata)*	Least Concern	-	-	-	-	-	X		X		X	X		X		
Black-billed Magpie *(Pica hudsonia)*	Least Concern	-	-	-	-	-			X							
American Crow *(Corvus brachyrhynchos)*	Least Concern	-	-	-	-	-	X		X		X	X		X		
Fish Crow *(Corvus ossifragus)*	Least Concern	-	-	-	-	-	X		X							
Common Raven *(Corvus corax)*	Least Concern	-	-	-	-	-			X							
Horned Lark *(Eremophila alpestris)*	Least Concern	-	-	Special Concern	-	-	X		X		X	X		X	X	
Northern Rough-winged Swallow *(Stelgidopteryx*	Least Concern	-	-	-	-	-	X		X		X	X			X	
Purple Martin *(Progne subis)*	Least Concern	-	-	-	-	-	X		X		X	X			X	
Tree Swallow *(Tachycineta bicolor)*	Least Concern	-	-	-	-	-	X		X		X	X			X	
Bank Swallow *(Riparia riparia)*	Least Concern	-	-	-	-	Threatened	X		X		X	X			X	
Barn Swallow *(Hirundo rustica)*	Least Concern	-	-	-	-	Threatened	X		X		X	X			X	
Cliff Swallow *(Petrochelidon pyrrhonota)*	Least Concern	-	-	-	-	-	X		X		X				X	
Cave Swallow *(Petrochelidon fulva)*	Least Concern	-	-	-	-	-			X							
Boreal Chickadee *(Poecile hudsonicus)*	Least Concern	-	-	-	-	-			X							

Black-capped Chickadee *(Poecile atricapillus)*	Least Concern	-	-	-	-	-	X				X	X		X		
Tufted Titmouse *(Baeolophus bicolor)*	Least Concern	-	-	-	-	-	X		X		X	X		X		
Red-breasted Nuthatch *(Sitta canadensis)*	Least Concern	-	-	-	-	-	X		X		X			X		
White-breasted Nuthatch *(Sitta carolinensis)*	Least Concern	-	-	-	-	-	X				X	X		X		
Brown Creeper *(Certhia americana)*	Least Concern	-	-	-	-	-	X		X		X	X		X		
House Wren *(Troglodytes aedon)*	Least Concern	-	-	-	-	-	X		X		X	X			X	
Winter Wren (*Troglodytes hiemalis)*	Least Concern	-	-	-	-	-	X		X		X				X	
Sedge Wren *(Cistothorus platensis)*	Least Concern	-	-	Threatened	-	-		X	X						X	
Marsh Wren *(Cistothorus palustris)*	Least Concern	-	-	-	-	-	X		X		X	X	X		X	
Carolina Wren *(Thryothorus ludovicianus)*	Least Concern	-	-	-	-	-	X		X		X	X		X		
Blue-gray Gnatcatcher *(Polioptila caerulea)*	Least Concern	-	-	-	-	-	X		X		X	X			X	
Golden-crowned Kinglet *(Regulus satrapa)*	Least Concern	-	-	-	-	-	X		X					X	X	
Ruby-crowned Kinglet *(Regulus calendula)*	Least Concern	-	-	-	-	-	X		X						X	
Eastern Bluebird *(Sialia sialis)*	Least Concern	-	-	-	-	-	X		X		X	X		X	X	
Townsend's Solitaire *(Myadestes townsendi)*	Least Concern	-	-	-	-	-	X		X							
Veery *(Catharus fuscescens)*	Least Concern	-	-	-	-	-	X		X		X	X			X	
Gray-cheeked Thrush *(Catharus minimus)*	Least Concern	-	-	-	-	-	X		X						X	
Swainson's Thrush *(Catharus ustulatus)*	Least Concern	-	-	-	-	-	X		X						X	
Hermit Thrush *(Catharus guttatus)*	Least Concern	-	-	-	-	-	X		X						X	
Wood Thrush *(Hylocichla mustelina)*	Near Threatened	-	-	SGCN	-	Special Concern	X		X		X	X			X	
American Robin *(Turdus migratorius)*	Least Concern	-	-	-	-	-	X		X		X	X		X	X	
Varied Thrush *(Ixoreus naevius)*	Least Concern	-	-	-	-	-	X		X							
Gray Catbird *(Dumetella carolinensis)*	Least Concern	-	-	-	-	-	X		X		X	X			X	
Brown Thrasher *(Toxostoma rufum)*	Least Concern	-	-	SGCN*	-	-	X		X		X	X			X	
Northern Mockingbird *(Mimus polyglottos)*	Least Concern	-	-	-	-	-	X		X		X	X		X		
European Starling *(Sturnus vulgaris)*	Least Concern	-	-	-	-	-	X		X		X	X		X		X
American Pipit *(Anthus rubescens)*	Least Concern	-	-	-	-	-	X		X						X	
Bohemian Waxwing *(Bombycilla garrulus)*	Least Concern	-	-	-	-	-			X							
Cedar Waxwing *(Bombycilla cedrorum)*	Least Concern	-	-	-	-	-	X		X		X	X		X	X	
Lapland Longspur *(Calcarius lapponicus)*	Least Concern	-	-	-	-	-	X		X					X	X	
Snow Bunting *(Plectrophenax nivalis)*	Least Concern	-	-	-	-	-	X		X					X	X	
Ovenbird *(Seiurus aurocapilla)*	Least Concern	-	-	-	-	-	X		X		X	X			X	
Worm-eating Warbler *(Helmitheros vermivorum)*	Least Concern	-	-	SGCN	-	-			X						X	
Louisiana Waterthrush *(Parkesia motacilla)*	Least Concern	-	-	SGCN	Special Concern	Special Concern	X		X				X		X	
Northern Waterthrush *(Parkesia noveboracensis)*	Least Concern	-	-	SGCN	-	-	X		X		X		X		X	
Blue-winged Warbler *(Vermivora cyanoptera)*	Least Concern	-	-	SGCN	-	-	X		X		X	X			X	
Golden-winged Warbler *(Vermivora chrysoptera)*	Near Threatened	-	-	Special Concern	Threatened	Special Concern			X						X	
Black-and-white Warbler *(Mniotilta varia)*	Least Concern	-	-	-	-	-	X		X						X	
Prothonotary Warbler *(Protonotaria citrea)*	Least Concern	-	-	SGCN*	Endangered	Endangered	X	X	X				X		X	
Swainson's Warbler *(Limnothlypis swainsonii)*	Least Concern	-	-	-	-	-			X							
Tennessee Warbler *(Oreothlypis peregrina)*	Least Concern	-	-	SPCN	-	-	X		X						X	
Orange-crowned Warbler *(Oreothlypis celata)*	Least Concern	-	-	-	-	-	X		X						X	
Nashville Warbler *(Oreothlypis ruficapilla)*	Least Concern	-	-	-	-	-	X		X			X			X	
Connecticut Warbler *(Oporornis agilis)*	Least Concern	-	-	-	-	-			X						X	
Mourning Warbler *(Geothlypis philadelphia)*	Least Concern	-	-	-	-	-	X		X			X				

Kentucky Warbler *(Geothlypis formosa)*	Least Concern	-	-	SGCN*	-	-			X							
Common Yellowthroat *(Geothlypis trichas)*	Least Concern	-	-	-	-	-	X		X		X	X	X		X	
Hooded Warbler *(Setophaga citrina)*	Least Concern	-	-	-	Threatened	Special Concern	X		X						X	
American Redstart *(Setophaga ruticilla)*	Least Concern	-	-	-	-	-	X		X		X	X			X	
Cape May Warbler *(Setophaga tigrina)*	Least Concern	-	-	-	-	-	X		X						X	
Cerulean Warbler *(Setophaga cerulea)*	Vulnerable	-	-	Special Concern	Special Concern	Threatened	X	X	X						X	
Northern Parula *(Setophaga americana)*	Least Concern	-	-	-	-	-	X		X		X				X	
Magnolia Warbler *(Setophaga magnolia)*	Least Concern	-	-	-	-	-	X		X						X	
Bay-breasted Warbler *(Setophaga castanea)*	Least Concern	-	-	SGCN*	-	-	X		X						X	
Blackburnian Warbler *(Setophaga fusca)*	Least Concern	-	-	-	-	-	X		X						X	
Yellow Warbler *(Setophaga petechia)*	Least Concern	-	-	-	-	-	X		X		X	X			X	
Chestnut-sided Warbler *(Setophaga pensylvanica*	Least Concern	-	-	-	-	-	X		X		X	X			X	
Blackpoll Warbler *(Setophaga striata)*	Least Concern	-	-	-	-	-	X		X						X	
Black-throated Blue Warbler *(Setophaga caerule*	Least Concern	-	-	SGCN	-	-	X		X						X	
Palm Warbler *(Setophaga palmarum)*	Least Concern	-	-	-	-	-	X		X						X	
Pine Warbler *(Setophaga pinus)*	Least Concern	-	-	-	-	-	X		X						X	
Yellow-rumped Warbler *(Setophaga coronata)*	Least Concern	-	-	-	-	-	X		X		X				X	
Yellow-throated Warbler *(Setophaga dominica)*	Least Concern	-	-	-	-	-			X							
Prairie Warbler *(Setophaga discolor)*	Least Concern	-	-	SGCN	-	-	X		X						X	
Black-throated Gray Warbler *(Setophaga nigresc*	Least Concern	-	-	-	-	-			X							
Black-throated Green Warbler *(Setophaga virens*	Least Concern	-	-	-	-	-	X		X						X	
Canada Warbler *(Cardellina canadensis)*	Least Concern	-	-	SGCN*	Threatened	Special Concern	X		X						X	
Wilson's Warbler *(Cardellina pusilla)*	Least Concern	-	-	-	-	-	X		X						X	
Yellow-breasted Chat *(Icteria virens)*	Least Concern	-	-	Special Concern	Special Concern	Endangered		X	X						X	
Eastern Towhee *(Pipilo erythrophthalmus)*	Least Concern	-	-	-	-	-	X		X		X	X			X	
American Tree Sparrow *(Spizella arborea)*	Least Concern	-	-	-	-	-	X		X					X	X	
Chipping Sparrow *(Spizella passerina)*	Least Concern	-	-	-	-	-	X		X		X	X			X	
Clay-colored Sparrow *(Spizella pallida)*	Least Concern	-	-	-	-	-			X						X	
Field Sparrow *(Spizella pusilla)*	Least Concern	-	-	-	-	-	X		X		X	X			X	
Vesper Sparrow *(Pooecetes gramineus)*	Least Concern	-	-	Special Concern	-	-	X		X						X	
Lark Sparrow *(Chondestes grammacus)*	Least Concern	-	-	-	-	-			X							
Savannah Sparrow *(Passerculus sandwichensis)*	Least Concern	-	-	-	-	-	X		X		X	X			X	
Grasshopper Sparrow *(Ammodramus savannaru*	Least Concern	-	-	Special Concern	-	Special Concern	X	X	X			X			X	
Henslow's Sparrow *(Ammodramus henslowii)*	Near Threatened	-	-	Threatened	Endangered	Endangered		X	X						X	
Fox Sparrow *(Passerella iliaca)*	Least Concern	-	-	-	-	-	X		X						X	
Song Sparrow *(Melospiza melodia)*	Least Concern	-	-	-	-	-	X		X		X	X		X	X	
Lincoln's Sparrow *(Melospiza lincolnii)*	Least Concern	-	-	-	-	-			X						X	
Swamp Sparrow *(Melospiza georgiana)*	Least Concern	-	-	-	-	-	X		X		X	X	X		X	
White-throated Sparrow *(Zonotrichia albicollis)*	Least Concern	-	-	-	-	-	X		X					X	X	
Harris's Sparrow *(Zonotrichia querula)*	Least Concern	-	-	-	-	-			X							
White-crowned Sparrow *(Zonotrichia leucophrys*	Least Concern	-	-	-	-	-	X		X						X	
Dark-eyed Junco *(Junco hyemalis)*	Least Concern	-	-	-	-	-	X		X		X			X	X	
Summer Tanager *(Piranga rubra)*	Least Concern	-	-	-	-	-			X							
Scarlet Tanager *(Piranga olivacea)*	Least Concern	-	-	SGCN	-	-	X		X		X	X			X	
Northern Cardinal *(Cardinalis cardinalis)*	Least Concern	-	-	-	-	-	X		X		X	X		X		

Rose-breasted Grosbeak *(Pheucticus ludovician*	Least Concern	-	-	-	-	-	X		X		X	X			X	
Blue Grosbeak *(Passerina caerulea)*	Least Concern	-	-	-	-	-			X							
Indigo Bunting *(Passerina cyanea)*	Least Concern	-	-	-	-	-	X		X		X	X			X	
Painted Bunting *(Passerina ciris)*	Near Threatened	-	-	-	-	-			X							
Dickcissel *(Spiza americana)*	Least Concern	-	-	-	-	-			X						X	
Bobolink *(Dolichonyx oryzivorus)*	Least Concern	-	-	SGCN*	-	Threatened	X		X		X	X			X	
Red-winged Blackbird *(Agelaius phoeniceus)*	Least Concern	-	-	-	-	-	X		X		X	X		X	X	
Eastern Meadowlark *(Sturnella magna)*	Least Concern	-	-	SGCN*	-	Threatened	X		X		X	X			X	
Yellow-headed Blackbird *(Xanthocephalus xanth*	Least Concern	-	-	-	-	-			X							
Rusty Blackbird *(Euphagus carolinus)*	Vulnerable	-	-	SGCN*	Special Concern	-	X		X						X	
Brewer's Blackbird *(Euphagus cyanocephalus)*	Least Concern	-	-	-	-	-			X							
Common Grackle *(Quiscalus quiscula)*	Least Concern	-	-	-	-	-	X		X		X	X			X	
Brown-headed Cowbird *(Molothrus ater)*	Least Concern	-	-	-	-	-	X		X		X	X		X	X	
Orchard Oriole *(Icterus spurius)*	Least Concern	-	-	-	-	-	X		X		X				X	
Baltimore Oriole *(Icterus galbula)*	Least Concern	-	-	-	-	-	X		X		X	X			X	
Pine Grosbeak *(Pinicola enucleator)*	Least Concern	-	-	-	-	-			X						X	
House Finch *(Haemorhous mexicanus)*	Least Concern	-	-	-	-	-	X		X		X	X		X		X
Purple Finch *(Haemorhous purpureus)*	Least Concern	-	-	-	-	-	X		X		X	X		X	X	
Red Crossbill *(Loxia curvirostra)*	Least Concern	-	-	-	-	-	X		X							
White-winged Crossbill *(Loxia leucoptera)*	Least Concern	-	-	-	-	-	X		X						X	
Common Redpoll *(Acanthis flammea)*	Least Concern	-	-	-	-	-	X		X					X	X	
Hoary Redpoll *(Acanthis hornemanni)*	-	-	-	-	-	-	X		X							
Pine Siskin *(Spinus pinus)*	Least Concern	-	-	-	-	-	X		X					X	X	
American Goldfinch *(Spinus tristis)*	Least Concern	-	-	-	-	-	X		X		X	X		X		
Evening Grosbeak *(Coccothraustes vespertinus)*	Least Concern	-	-	-	-	-	X		X					X	X	
House Sparrow *(Passer domesticus)*	Least Concern	-	-	-	-	-	X				X	X		X		X

Sources of Status

IUCN Red List - "International Union for the Conservation of Nature, Red List of Threatened Species" (http://www.iucnredlist.org/)

CITES Appendix - "Convention on the International Trade in Endangered Species of Wild Flora and Fauna" (http://www.cites.org/)

US (Endangered Species Act) - "U.S. Fish and Wildlife Service, Endangered Species" (http://www.fws.gov/ENDANGERED/species/us-species.html)

New York State (Environmental Conservation Law) - List of Endangered, Threatened and Special Concern Fish & Wildlife Species of New York State (http://www.d

Canada (Species at Risk Act) - "Species at Risk Public Registry" (http://www.sararegistry.gc.ca/sar/index/default_e.cfm)

Ontario (Endangered Species Act) - "Species at Risk in Ontario (SARO) List" (http://www.mnr.gov.on.ca/en/Business/Species/2ColumnSubPage/MNR_SAR_CSSI

Sources of Records

A - eBird data for the Niagara River Corridor IBA. Retrieved on February 1, 2014. (www.ebird.org) (U.S. and Canada Records)

B - Niagara River Corridor IBA Working Group. 2002. Niagara River Corridor Important bird Area Conservation Plan. Bird Studies Canada, Birdlife

C - DiTommaso, Dean, and David Suggs. B.O.S. Noteworthy Records Database, 1964-2013. "The Prothonotary." vols. 30-79. Buffalo Ornithological Society.

D - Moore, Dave, Francie Cuthbert, Chip Weseloh, and Linda Wires. Colonial Waterbirds Nesting on the Niagara River, 1976-2011. (PowerPoint Presentation at

E - NYS Department of Environmental Conservation website. "NYS Breeding Bird Atlas (2000-2005) ." Confirmed, probable and possible records. Retrieved

Additional Notes

Waterbirds are defined by Audubon as birds predominantly associated with water, either ecologically or taxonomically.

Overwintering birds are those listed as common, fairly common, or uncommon in records from: Seasonal Checklist of the Birds, Niagara Frontier Region. 2002.

Migratory birds are those that show significant changes in abundance by season, excluding those only listed as very rare or exceptional, in records from:

Introduced species are a species living outside their native distributional range, which have arrived there by human activity, either deliberate or accidental.

6/6/2017: Jo J

I did not attempt to update additional birds onto this list. Instead I searched DEC status, to update whether or not some plants have switched to threatened/endangered/SGCN in the last 4 years.

I did the same for SARA (queried only endangered, threatened, etc. birds inhabiting Ontario)

While most of the water bird species are located along the river, the species that rely on other habitats such as early successional forests, grass and shrub lands, and deciduous and mixed forests exist in the outer regions of the watershed where these land cover types are more abundant. Sources of species data around the watershed come from wildlife surveys related to the Niagara River and Buffalo River AOCs, NYS Natural Heritage Program occurrences, and lists that are developed by wildlife preserves including Beaver Meadow Audubon Center. This master list also includes data collected in the Niagara River corridor from Canadian resources.

Table 5.1 Sensitive Bird Areas along Niagara River Corridor

Location	Type of Bird Species
Buffalo Harbor: Donnelly's Wall, South Breakwall and Short Breakwall	Approximately 1,300 pairs of Common Tern
Former Bethlehem Steel Site	Gulls: Ring-billed, Herring, Great Black Backed
Motor Island	Great Egret, Black-crowned Night Heron, Great-blue Heron, Double-crested Cormorant
Strawberry Island	Cormorant and Great-blue Heron
Tonawanda and North Tonawanda Intake	12-75 pairs of Common Tern
Buckhorn Weir	Historical Tern colony, abandoned c. 1988. Ring-billed and Herring gulls, Double-crested Cormorants
Near Crib/Far Crib (NYPA-owned parcels)	2-80 pair of Common Tern
Tower Island	Historical Tern colonies, abandoned c. 1998.
Goat Island	Ring-billed gulls, Herring Gulls, Double-crested Cormorants, Peregrine Falcon nest.

Source: NYSDEC, 2006 (HAB43)

The Great Lakes Marsh Monitoring Program (MMP) examines the presence of indicator bird and amphibian species associated with the AOCs in order to gauge the restoration status of wetland and marsh habitats. Indicator species are those which are sensitive to degraded ecosystems, so their presence suggests that a marsh or wetland is functionally adequate to host these sensitive species. The MMP results from 1995 to 2002 suggest that marsh nesting birds within these areas are at a moderate level of diversity. For the Niagara River AOC, nine out of twelve indicator species were found during surveys completed in 2009-2010. These species include the American Coot, Black Rail, Common Moorhen, Least Bittern, Marsh Wren, Pied-billed Grebe, Sora Rail, and Swamp sparrow. Only one site was

Figure 5.5: Great Blue Herron nesting on Strawberry Island

monitored for bird species within the Buffalo River AOC, however no indicator species were recorded. Recommendations from the MMP stress the need to further improve marsh conditions within both the Niagara and Buffalo River AOCs in order to support more robust marsh bird communities.[8]

Several studies on grassland birds within the watershed have been published by Norment et al. (2002, 2006).[9] [10] Grassland bird species have been decreasing throughout the region. Within the Lake Erie Basin, 16 out of 22 Species of Greatest Conservation Need, which rely on grassland and shrubland habitat are said to be experiencing a decreasing trend according to the New York State Comprehensive Wildlife Conservation Strategy. Norment et al. conducted two studies regarding grassland birds and their habitats in order to evaluate the status of populations and breeding success and provide management recommendations. Both studies took place at Iroquois National Wildlife Refuge and Tonawanda and Oak Orchard Wildlife Management Areas, portions of which are in the Niagara River/ Lake Erie Watershed. In most of the fields assessed, four or fewer species were observed, and Savannah Sparrow and Bobolink were the two most commonly seen. Results show that nest success was generally high in the Northeast (study area) compared to other comparable regions in the Midwest, however this could be improved through management practices such as increasing field area, controlling the presence of shrubs, encouraging the growth of cool-season grasses, and haying or mowing either early or late in the season when birds are not nesting. If managed correctly, areas of the watershed have a great potential to offer high-quality breeding habitat for obligate grassland bird species.

Macroinvertebrates

According to the U.S. Environmental Protection Agency, macroinvertebrates are organisms that are large (macro) enough to be seen with the naked eye and lack a backbone (invertebrate). They inhabit all types of running water and include such varieties as crayfish, clams, snails, and worms. Table 5.2 outlines the variety of macroinvertebrate groups found in New York State. Many of these taxa include up to several hundred species families within their biological classification as well.

Table 5.2 Freshwater Macroinvertebrates of New York

Flatworms (Platyhelminthes)
Mussels and Clams (Pelecypoda)
Snails (Mollusca: Gastropoda)
Worms (Oligochaeta)
Leeches (Hirundinea)
Scuds or Side Swimmers (Amphipoda)
Crayfish (Decapoda)
Sow Bugs (Isopoda)
Mayflies (Ephermeroptera)
Dragonfiles and Damselflies (Odonata)
Stoneflies (Plecoptera)
True Bugs (Hemiptera)
Dobsonflies, Hellgrammites, Fishfiles, Alderflies (Megaloptera)
Beetles (Coleoptera)
Caddisflies (Trichoptera)
True flies, mosquitoes, gnats, midges (Diptera)

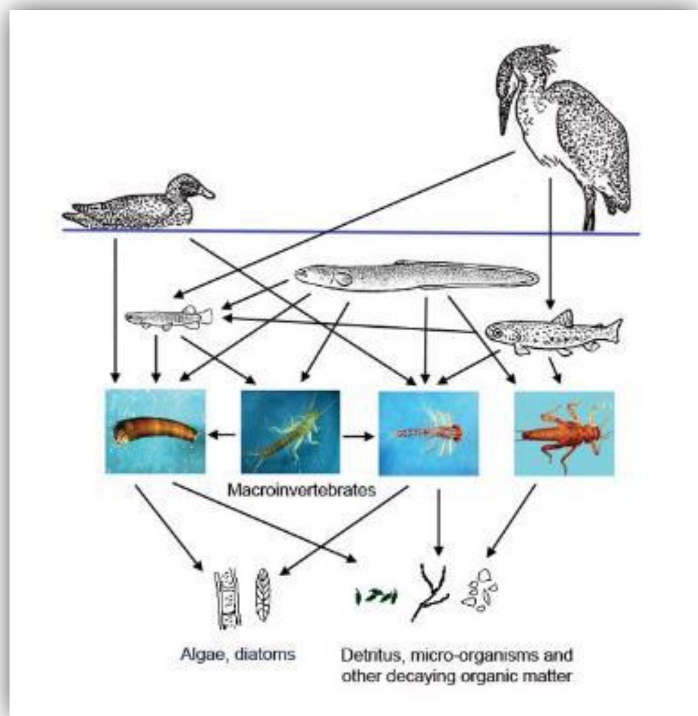
Source: NYSDEC

[8] Legacy Conserving New York State Biodiversity (American Museum of Natural History NYS Biodiversity Research Institute, 2012) & Bi National Assessments of Marsh Habitat Quality for the Niagara River and Buffalo River Areas of Concern (Archer, Rankin 2011)

[9] Norment, C. J. 2002. Grassland bird conservation in the Northeast. Auk 119: 271-279.

[10] Norment, C.J. and Saskia Windig. 2006. Influence of distance to habitat edge on depredation rates of simulates grassland bid nests. Final Report, Challenge Cost Share Agreement between the Research Foundation of SUNY Brockport and USFWS.

Figure 5.6 General Water-based Food Web Structure



Macroinvertebrates are important indicators of ecosystem health and often utilized to track water quality conditions over time, such as with NYSDEC's Stream Biomonitoring Program. Different species of macroinvertebrates are affected by certain levels of pollution. Absence of the most sensitive species indicates lower water quality conditions in a given waterway. Macroinvertebrate data specific to the Niagara River/Lake Erie Watershed is collected and documented by the NYSDEC's Stream Biomonitoring Unit and includes period Biotic Assessment Profiles (BAP), which are documented in Chapter 4: Water Quality.

The presence and diversity of macroinvertebrates reflects the health of waterways ecosystems, and thus they are commonly recognized as good water quality indicators. Aside from their extremely important role in the food web (Figure 5.6), many of these species are very susceptible to pollution and water quality, such as abrupt changes in temperature or oxygen levels. Current trends highlighted in the Niagara River Habitat Conservation Strategy have indicated that there has been a slight increase in macroinvertebrate levels in the Niagara River Watershed between the 2005 and 2010 BAP scoring. The BAP model accounts for four commonly accepted metrics that describe macroinvertebrate community composition (species richness, EPT richness, biotic index, and percent model affinity), where a higher BAP score indicates a healthier system.

Figure 5.7: Macroinvertebrate sampling

Chart 5.3: Mollusks of the Niagara River/Lake Erie Watershed

Mollusks

Species	Status						Records		Introduced
	IUCN Red List	CITES Appendix	US (Endangered Species Act)	New York State (Environmental Conservation Law)	Canada (Species at Risk Act)	Ontario (Endangered Species Act)	A	B	
Eastern Pondmussel *(Ligumia nasuta)*	Near Threatened	-	-	SGCN	Endangered	Endangered	X		
Fragile Papershell *(Leptodea fragilis)*	-	-	-	-	-	-	X		
Hickorynut *(Obovaria olivaria)*	Least concern	-	-	SPCN	-	Endangered	X		
Kidneyshell *(Ptychobranchus fasciolaris)*	Least concern	-	-	SGCN	Endangered	Endangered	X		
Pink heelsplitter *(Potamilus alatus)*	Least concern	-	-	SGCN	-	-	X		
Rainbow *(Villosa iris)*	-	-	-	SGCN*	Endangered	Threatened	X		
Round Pigtoe *(Pleurobema sintoxia)*	Least concern	-	-	SGCN	Endangered	Endangered	X		
Slippershell Mussel *(Alasmidonta viridis)*	Least concern	-	-	SGCN*	-	-	X		
Threeridge *(Amblema plicata)*	Least concern	-	-	SGCN	-	-	X		
Wabash Pigtoe *(Fusconaia flava)*	Least concern	-	-	SGCN*	-	-	X		
Quagga Mussel *(Dreissena rostriformis bugensis)*	Least concern	-	-	-	-	-		X	X
Zebra Mussel *(Dreissena polymorpha)*	Least concern	-	-	-	-	-		X	X

Sources of Status

IUCN Red List - "International Union for the Conservation of Nature, Red List of Threatened Species" (http://www.iucnredlist.org/)

CITES Appendix - "Convention on the International Trade in Endangered Species of Wild Flora and Fauna" (http://www.cites.org/)

US (Endangered Species Act) - "U.S. Fish and Wildlife Service, Endangered Species" (http://www.fws.gov/ENDANGERED/species/us-species.html)

New York State (Environmental Conservation Law) - List of Endangered, Threatened and Special Concern Fish & Wildlife Species of New York State (http://www.dec.ny.gov/animals/7494.html)

Canada (Species at Risk Act) - "Species at Risk Public Registry" (http://www.sararegistry.gc.ca/sar/index/default_e.cfm)

Ontario (Endangered Species Act) - "Species at Risk in Ontario (SARO) List" (http://www.mnr.gov.on.ca/en/Business/Species/2ColumnSubPage/MNR_SAR_CSSR_SARO_LST_EN.html)

Sources of Records

A - From a list compiled by Margaret Wooster at Buffalo Niagara Riverkeeper from NYS Natural Heritage Program data and NYS Species of Greatest Conservation Need data. (U.S. Records)

B - U.S. Geological Survey website. "NAS - Nonindigenous Aquatic Species". Retrieved on August 12, 2014. (http://nas.er.usgs.gov/taxgroup/mollusks/zebramussel/) (U.S. records only)

Additional Notes

Introduced species are a species living outside their native distributional range, which have arrived there by human activity, either deliberate or accidental.

* beside some SGCN species is a designation for those in highest priority, DEC knows they are declining and require stabilization in the next ten years

[11]

[11] Mollusk table created as part of Niagara River Corridor Ramsar Site nomination package, 2016.

There is great concern regarding native mussel populations. Some invasive species of mussels, particularly Dreissenids, exceed native populations, and directly harm natives by using native mussel shells as a substrate for their own growth. Additionally, there has been decline in the populations of some host fishes necessary for native freshwater mussel dispersal. Unionidae, a native mussel family that historically dominated the Great Lakes, has a parasitic larval life stage, in which it attaches to free-moving fish in order to disperse throughout the watershed. Certain mussels have extremely high host-specificity and can only attach to a certain species of fish.[12] With increased fragmentation of streams, the loss of free movement among connecting channels for a fish also means the loss of movement for native mussels. Increased siltation and other pollution sources such as agriculture runoff, wastewater, and urban stormwater runoff are also suspected as a threat to mussel populations in the region.[13]

Herptiles

Herptiles, or herps for short, refer to both amphibian species such as frogs, toads, and salamanders, and reptile species such as snakes, lizards, turtles, and tortoises. Much of the data regarding amphibians within the region come from the Marsh Monitoring Program (MMP), the NYSDEC, and Niagara Parks Commission Authority. A chart documenting amphibians and reptiles in the Niagara River region is provided on the following page and includes 31 documented species.

Figure 5.8: Northern Spring Peeper

It's important to note that the presence or absence of indicator species can be used to determine the health of marsh habitats in the watershed, and to make inferences about the restoration status of specific areas. In the Niagara River AOC, MMP sampling between 2009 and 2010 found six total amphibian species, including three out of four indicator species (bullfrog, northern leopard frog, and spring peeper). Similarly, within the Buffalo River AOC three indicator species were recorded (bullfrog, western chorus frog, and northern leopard frog), and five total species were found. Results from amphibian Index of Biotic Integrity calculations showed that Niagara River AOC sites were classified as "good" to "fair", whereas Buffalo River sites were "fair" and "poor". Within the

[12] Paterson, W.L., Griffith, T.A., Krebs, R.A., Burlakova, L.E., & D.T. Zanatta. 2015. An evaluation of the genetic structure of mapleleaf mussels (*Quadrula quadrula*) in the Lake Erie watershed. Journal of Great Lakes Research. 41:1123-1130.

[13] https://www.dec.ny.gov/docs/wildlife_pdf/sgcnfreshwatermollusks.pdf

Chart 5.4: Amphibians of the Niagara River/Lake Erie Watershed

Amphibians

Species	Status						Records				
	IUCN Red List	CITES Appendix	US (Endangered Species Act)	New York State (Environmental Conservation Law)	Canada (Species at Risk Act)	Ontario (Endangered Species Act)	A	B	C	D	E
Salamanders											
Jefferson Salamander *(Ambystoma jeffersonianum)*	Least concern	-	-	Special concern	Threatened	Endangered		X			
Spotted Salamander (*Ambystoma maculatum*)	Least concern	-	-	-	-	-		X			
Blue-spotted Salamander *(Ambystoma laterale)*	Least concern	-	-	Special concern	-	-		X	X	X	
Northern Dusky Salamander *(Desmognathus fuscus)*	Least concern	-	-	-	-	Endangered			X	X	
Allegheny Mountain Dusky Salamander *(Desmognathus ochrophaeus)*	Least concern	-	-	-	-	Endangered			X	X	
Northern Two-lined Salamander (*Eurycea bislineata*)	Least concern	-	-	-	-	-					
Northern Spring Salamander (*Gyrinophilus porphyriticus*)	Least concern	-	-	-	Special Concern	Extirpated					
Four-toed Salamander (*Hemidactylium scutatum*)	Least concern	-	-	SGCN*	-	-		X			
Mudpuppy *(Necturus maculosus)*	Least concern	-	-	SGCN	-	-		X	X		
Eastern Newt *(Notophthalmus viridescens)*	Least concern	-	-	-	-	-		X	X		
Red-backed Salamander *(Plethodon cinereus)*	Least concern	-	-	-	-	-		X	X	X	X
Northern Slimy Salamander (*Plethodon glutinosus*)	Least concern	-	-	-	-	-		X			
Frogs and Toads											
Eastern American Toad *(Anaxyrus americanus)*	Least concern	-	-	-	-	-	X	X	X	X	X
Fowler's Toad *(Anaxyrus fowleri)*	Least concern	-	-	SGCN	Endangered	Endangered			X	X	
Gray Treefrog *(Hyla versicolor)*	Least concern	-	-	-	-	-		X	X		
American Bullfrog *(Lithobates catesbeianus)*	Least concern	-	-	-	-	-	X	X	X		X
Green Frog *(Lithobates clamitans)*	Least concern	-	-	-	-	-	X	X	X	X	X
Pickerel Frog *(Lithobates palustris)*	Least concern	-	-	-	-	-		X	X		
Northern Leopard Frog *(Lithobates pipiens)*	Least concern	-	-	-	-	-	X	X	X	X	X
Wood Frog *(Lithobates sylvaticus)*	Least concern	-	-	-	-	-		X	X	X	X
Spring Peeper *(Pseudacris crucifer)*	Least concern	-	-	-	-	-	X	X	X	X	X
Western Chorus Frog *(Pseudacris triseriata)*	Least concern	-	-	SGCN	Threatened	-	X	X	X	X	X

Sources of Status

IUCN Red List - "International Union for the Conservation of Nature, Red List of Threatened Species" (http://www.iucnredlist.org/)

CITES Appendix- "Convention on the International Trade in Endangered Species of Wild Flora and Fauna" (http://www.cites.org/)

US (Endangered Species Act) - "U.S. Fish and Wildlife Service, Endangered Species" (http://www.fws.gov/ENDANGERED/species/us-species.html)

New York State (Environmental Conservation Law) - List of Endangered, Threatened and Special Concern Fish & Wildlife Species of New York State (http://www.dec.ny.gov/animals/7494.html)

Canada (Species at Risk Act) - "Species at Risk Public Registry" (http://www.sararegistry.gc.ca/sar/index/default_e.cfm)

Ontario (Endangered Species Act) - "Species at Risk in Ontario (SARO) List" (http://www.mnr.gov.on.ca/en/Business/Species/2ColumnSubPage/MNR_SAR_CSSR_SARO_LST_EN.html)

Sources of Records

A - Marsh Bird and Amphibian Communities in the Niagara River (Canada and USA) AOC, 1995 – 2002. Results of the Marsh Monitoring Program. (U.S records only)

B - NYS Department of Environmental Conservation website. "Herp Atlas Project". Retrieved on July 23, 2014. (http://www.dec.ny.gov/animals/7140.html) (U.S. records only)

C - Ontario Nature website. "Ontario Reptile and Amphibian Atlas Program". Retrieved on June 30, 2014. (http://www.ontarionature.org/protect/species/reptiles_and_amphibians/index.php#lizard) (Canada records only)

D - Yagi A.R, A.Brant and R.Tervo. 2009. Niagara Region Natural Areas Inventory Reptile and Amphibian Study 2006 to 2008. Ontario Ministry of Natural Resources and Land Care Niagara unpublished report for the Natural Areas Inventory prepared for the Niagara Peninsula Conservation Authority. (http://www.npca.ca/wp-content/uploads/12.0-Reptile-and-Amphibian-Study-2006-to-2008.pdf) (Canada records only)

Accessed 6/5/2017: https://npca.ca/sites/default/files/NAI-Vol-2.pdf **Source C**

Accessed 6/5/2017http://niagara.nypa.gov/RelicensingGreenwayFunds/EcologicalGreenway/NGR_AppendixB.pdf **Source D**

Additional Notes

Introduced species are a species living outside their native distributional range, which have arrived there by human activity, either deliberate or accidental.

SGCN* are species of greatest conservation need with high priority, those without asterisk are of conservation need, but not high priority (DEC)

SPCN are species of potential conservation need, may be declining but it is not well understood (DEC)

Marsh Monitoring Program- Ontario Herpetofaunal (Margaret)

Ontario Nature http://www.ontarionature.org/protect/species/reptiles_and_amphibians/index.php#turtles

Department of Environmental Conservation- New York http://www.dec.ny.gov/animals/7494.htm

Niagara Parks Commission Authority (NPCA) http://www.npca.ca/wp-content/uploads/12.0-Reptile-and-Amphibian-Study-2006-to-2008.pdf

Niagara River, amphibian communities exceeded expectations while Buffalo River sites showed species richness levels lower than that of reference communities.[14]

In 2012, a wildlife survey was conducted within the Lower Buffalo River AOC for the purpose of developing a baseline assessment of species to aid in determining management actions associated with the Buffalo River Remedial Action Plan. Herpetofauna observed were mostly species that are highly adaptive and can be found in urban settings with the exception of the eastern spiny softshell. This species is intolerant of degraded water quality and low oxygen conditions, making its presence and re-colonization within the area a good metric for water quality and river bank habitat conditions. No salamander species were observed although they have been previously documented in the area. Results from the survey suggest breeding pools for amphibians as a restoration opportunity in order to increase frog and toad populations.[15]

Salamanders prefer dark, damp areas as habitat, including vegetative stream banks, swampy woodland, and vernal pools, but have also been found in coniferous forests and fields. Like many other herpetiles, salamanders are extremely sensitive to water quality conditions. They can easily absorb toxins found in water because their skin is very thin and permeable to water, and they typically cannot survive in highly polluted waterways. Because of their sensitivity and environmental needs, salamanders are a good indicator of habitat and water quality where they are found.

Figure 5.9: Blue-spotted Salamander

As part of two studies conducted within the watershed,[16] three species of salamander have been documented; the blue-spotted salamander, the eastern redback salamander, and the Jefferson salamander. Only the blue-spotted salamander was found at Tifft Nature Preserve in the Buffalo River sub-watershed. Both the Jefferson and the blue spotted salamanders were found along the Niagara River and in its tributaries, from the southern tip of Grand Island downstream to its mouth at Lake Ontario. The blue-spotted salamander is significant because it is on the NYSDEC Special Concern species list, and requires a hearty organic layer of

[14] Bi National Assessments of Marsh Habitat Quality for the Niagara River and Buffalo River Areas of Concern (Archer, Rankin 2011)

[15] Eckel, P. Regional Economic Growth Through Ecological Restoration of the Niagara Gorge Rim, Niagara Falls, New York, Syracuse: EDR Companies, December 2011.

[16] Studies include the *Buffalo River Wildlife Survey* (Riverkeeper 2012) conducted for areas in and around the Buffalo River AOC; and the *Assessment of the Potential Effects of Water Level Fluctuations and Land Management Practices on Rare, Threatened, and Endangered Species and Significant Occurrences of Natural Communities at the Niagara Power Project* (Riveredge Associates, LLC 2005) conducted for the NYPA Greenway Commission communities.

Chart 5.5 Reptiles of the Niagara River/Lake Erie Watershed

Reptiles

Species	Status						Records					Introduced
	IUCN Red List	CITES Appendix	US (Endangered Species Act)	New York State (Environmental Conservation Law)	Canada (Species at Risk Act)	Ontario (Endangered Species Act)	A	B	C	D	E	
Turtles												
Eastern Spiny Softshell (*Apalone spinifera*)	Least concern	Appendix III		Special concern	Threatened	Threatened	X		X		X	
Snapping Turtle *(Chelydra serpentina)*	Least concern	Appendix III	-	SGCN	Special concern	Special concern	X	X	X	X	X	
Painted Turtle *(Chrysemys picta)*	Least concern	-	-	-	-	-	X	X	X		X	
Midland Painted Turtle *(Chrysemys picta marginata)*	-	-	-	-	-	-			X			
Spotted Turtle (*Clemmys guttata*)	Endangered	Appendix II	-	Special concern	Endangered	Endangered	X		X			
Common Map Turtle *(Graptemys geographica)*	Least concern	Appendix III	-	SGCN	Special concern	Special concern	X		X			
Wood Turtle (*Glyptemys insculpta*)	Endangered	Appendix II	-	Special concern	Threatened	Endangered	X					
Eastern Box Turtle *(Terrapene carolina)*	Vulnerable	Appendix II	-	Special concern	-	Extirpated		X	X			
Red-eared Slider *(Trachemys scripta elegans)*	-	-	-	-	-	-	X					X
Snakes												
Northern Ringneck Snake (*Diadophis punctatus*)	Least concern	-	-	-	-	-	X			X		
Black Rat Snake (*Elaphe alleganiensis*)	-	-	-	-	-	-	X			X		
Eastern Milksnake *(Lampropeltis triangulum)*	Least concern	-	-	-	Special concern	-	X	X	X			
Common Watersnake *(Nerodia sipedon)*	Least concern	-	-	-	Endangered	Endangered	X	X	X	X		
Smooth Green Snake (*Opheodrys vernalis*)	Least concern	-	-	SGCN	-	-	X	X	X			
Queensnake *(Regina septemvittata)*	Least concern	-	-	Endangered	Endangered	Endangered	X		X		X	
Northern Brownsnake *(Storeria dekayi)*	Least concern	-	-	-	-	-	X		X			
Northern Red-bellied Snake *(Storeria occipitomaculata)*	Least concern	-	-	-	-	-	X		X			
Shorthead Garter Snake (*Thamnophis brachystoma*)	Least concern	-	-	-	-	-					X	
Eastern Ribbon Snake *(Thamnophis sauritus)*	Least concern	-	-	SGCN	Special concern	Special concern	X					
Eastern Gartersnake *(Thamnophis sirtalis)*	Least concern	-	-	-	-	-	X	X	X	X	X	

Sources of Status

IUCN Red List - "International Union for the Conservation of Nature, Red List of Threatened Species" (http://www.iucnredlist.org/)

CITES Appendix - "Convention on the International Trade in Endangered Species of Wild Flora and Fauna" (http://www.cites.org/)

US (Endangered Species Act) - "U.S. Fish and Wildlife Service, Endangered Species" (http://www.fws.gov/ENDANGERED/species/us-species.html)

New York State (Environmental Conservation Law) - List of Endangered, Threatened and Special Concern Fish & Wildlife Species of New York State (http://www.dec.ny.gov/animals/7494.html)

Canada (Species at Risk Act) - "Species at Risk Public Registry" (http://www.sararegistry.gc.ca/sar/index/default_e.cfm)

Ontario (Endangered Species Act) - "Species at Risk in Ontario (SARO) List" (http://www.mnr.gov.on.ca/en/Business/Species/2ColumnSubPage/MNR_SAR_CSSR_SARO_LST_EN.html)

Sources of Records

A - NYS Department of Environmental Conservation website. "Herp Atlas Project". Retrieved on July 23, 2014. (http://www.dec.ny.gov/animals/7140.html) (U.S. records only)

B - Ontario Nature website. "Ontario Reptile and Amphibian Atlas Program". Retrieved on June 30, 2014. (http://www.ontarionature.org/protect/species/reptiles_and_amphibians/index.php#lizard) (Canada

C - Yagi A.R, A.Brant and R.Tervo. 2009. Niagara Region Natural Areas Inventory Reptile and Amphibian Study 2006 to 2008. Ontario Ministry of Natural Resources and Land Care Niagara unpublished report for the Natural Areas Inventory prepared for the Niagara Peninsula Conservation Authority. (http://www.npca.ca/wp-content/uploads/12.0-Reptile-and-Amphibian-Study-2006-to-2008.pdf) (Canada records only)

D - Environmental Design & Research, Landscape Architecture, Planning, Environmental Services, Engineering and Surveying, P.C. (EDR). 2010. Ecological Inventory of the Niagara River Gorge and Rim - Draft. (Species identified during on-site ecological surveys conducted by EDR in June 2010 only) (U.S. Records)

Accessed 6/5/2017: https://npca.ca/sites/default/files/NAI-Vol-2.pdf **Source C**

Accessed 6/5/2017http://niagara.nypa.gov/RelicensingGreenwayFunds/EcologicalGreenway/NGR_AppendixB.pdf **Source D**

E - Applied Ecological Services, Inc. 2012. A Wildlife Survey of the Lower Buffalo River Area of Concern, Buffalo, Erie County, New York. (http://www.bnriverkeeper.org/buffalo-river-wildlife-survey) (U.S. Records)

Additional Notes

Introduced species are a species living outside their native distributional range, which have arrived there by human activity, either deliberate or accidental.

Chrysemys picta marginata doesn't have any distribution data

DEC: SGCN - Species of Greatest Conservation Need List woody debris at various states of decay, plus fishless ephemeral ponds for breeding and egg laying.[17] The eastern red back salamander is a more adaptive species, tolerating a wider array of habitat conditions, but still requires decaying woody debris. The eastern redback salamander was documented in the Buffalo River AOC. For salamanders to increase their extent and numbers within the watershed, contiguous healthy forested riparian buffers are needed, along with low toxicity waters.

Mammals

Figure 5.10: Buck at Riverbend (Buffalo River)

Many of the mammals found within the watershed are common species found in similar northern suburban-rural areas of the United States, such as deer, mink, bats, mice, squirrels, and fox. Other less common species such as river otter, grey fox, some bat species, and opossum have also been documented in the Niagara River corridor. A full list of mammals is provided as Chart 5.6.

In recent years, some of the urban water courses have seen mammal populations return as water quality and food supplies have improved. One example of this is the Buffalo River AOC within the City of Buffalo. Once an industrialized corridor, vacant land has been replaced with vegetation, while populations of beaver, deer, and fox have become more prevalent in the area. This can be both good and bad, as certain rebounding species, such as deer and beaver, are good indicators for improved ecosystems. However these same populations can also threaten restoration projects with their excessive browsing and grazing.

According to a 2012 report, a total of 20 mammal species were identified in the Niagara River Watershed.[18] Chart 5.6 has been updated to reflect the inclusion of seven additional sub-watersheds flowing to Lake Erie, particularly because of the presence of black bears and bobcats in those areas. The 2012 survey outlined small mammals, mink, bats and deer as species that require various considerations as land use patterns change along the Buffalo River AOC. For example, mink were

[17] Petranka, J. W. Salamanders of the United States and Canada. Washington and London: Smithsonian Institution Press. 1998.
[18] Buffalo Niagara RIVERKEEPER, *A Wildlife Survey of the Lower Buffalo River Area of Concern*, Buffalo: (Applied Ecological Services, Inc.) 2012.

Chart 5.6 Mammals of the Niagara River/Lake Erie Watershed

Mammals												
Species	**Status**						**Records**					**Introduced**
	IUCN Red List	**CITES Appendix**	**US (Endangered Species Act)**	**New York State (Environmental Conservation Law)**	**Canada (Species at Risk Act)**	**Ontario (Endangered Species Act)**	**A**	**B**	**C**	**D**	**E**	
Bats												
Big Brown Bat (*Eptesicus fuscus*)	Least Concern	-	-	-	-	-	X	X				
Eastern Red Bat (*Lasiurus borealis*)	Least Concern	-	-	SGCN	-	-					X	
Hoary Bat (*Lasiurus cinereus*)	Least Concern	-	-	SGCN	-	-					X	
Silver-haired Bat (*Lasionycteris noctivagans*)	Least Concern	-	-	SGCN*	-	-	X					
Little Brown Bat (*Myotis lucifugus*)	Least Concern	-	-	SGCN	Endangered	Endangered		X	X			
Northern Long-eared Bat (*Myotis septentrionalis*)				Threatened	Endangered	Endangered				X		
Large Mammals												
Coyote (*Canis latrans*)	Least Concern	-	-	-	-	-	X					
Bobcat (*Lynx rufus*)	Least Concern	Appendix II								X		
Striped Skunk (*Mephitis mephitis*)	Least Concern	-	-	-	-	-	X	X	X			
Ermine (*Mustela erminea*)	Least Concern	-	-	-	-	-		X				
Canadian Lynx (*Lynx canadensis*)	Least Concern	Appendix II		Threatened						X		X[1]
White-tailed Deer (*Odocoileus virginianus*)	Least Concern	-	-	-	-	-	X	X	X			
Black Bear (*Ursus americanus*)	Least Concern	Appendix II	-	-	-	-				X		
Gray Fox (*Urocyon cinereoargenteus*)	Least Concern	-	-	-	Threatened	Threatened	X					
Red Fox (*Vulpes vulpes*)	Least Concern	-	-	-	-	-	X	X	X			
Small Mammals												
Northern Short-tailed Shrew (*Blarina brevicauda*)	Least Concern	-	-	-	-	-	X	X				
Beaver (*Castor canadensis*)	Least Concern	-	-	-	-	-	X	X				
Star-nosed Mole (*Condylura cristata*)	Least Concern	-	-	-	-	-		X	X			
Virginia Opossum (*Didelphis virginiana*)	Least Concern	-	-	-	-	-	X	X	X			
Ferel Cat (*Felis catus*)	Least Concern	-	-	-	-	-					X	X
River Otter (*Lontra canadensis*)	Least Concern	Appendix II	-	-	-	-				X		
Groundhog or Woodchuck (*Marmota monax*)	Least Concern	-	-	-	-	-	X	X	X		X	
Fisher (*Martes pennanti*)	Least Concern	-	-	-	-	-				X		
Meadow Vole (*Microtus pennsylvanicus*)	Least Concern	-	-	-	-	-	X	X	X			
Hoary Mouse (*Mus musculus*)	Least Concern	-	-	-	-	-					X	
Long-tailed Weasel (*Mustela frenata*)	Least Concern	-	-	-	-	-		X				
American Mink (*Mustela vison*)	Least Concern	-	-	-	-	-	X	X				
Woodland Jumping Mouse (*Napaeozapus insignis*)	Least Concern	-	-	-	-	-		X				
Muskrat (*Ondatra zibethicus*)	Least Concern	-	-	-	-	-	X	X				
Hairytail Mole (*Parascalops breweri*)	Least Concern	-	-	-	-	-			X			
White-footed Mouse (*Peromyscus leucopus*)	Least Concern	-	-	-	-	-	X	X				
Deer Mouse (*Peromyscus maniculatus*)	Least Concern	-	-	-	-	-		X	X			
Raccoon (*Procyon lotor*)	Least Concern	-	-	-	-	-	X	X	X			
Norway Rat (*Rattus norvegicus*)	Least Concern	-	-	-	-	-		X				X

Eastern Mole *(Scalopus aquaticus)*	Least Concern	-	-	-	Special Concern	Special Concern			X			
Gray Squirrel *(Sciurus carolinensis)*	Least Concern	-	-	-	-	-	X	X	X			
Fox Squirrel *(Sciurus niger)*	Least Concern	-	-	-	-	-				X		
Masked Shrew *(Sorex cinereus)*	Least Concern	-	-	-	-	-		X				
Smoky Shrew *(Sorex fumeus)*	Least Concern	-	-	-	-	-	X					
Pigmy Shrew *(Sorex hoyi)*	Least Concern	-	-	SPCN	-	-		X				
Eastern Cottontail Rabbit *(Sylvilagus floridanus)*	Least Concern	-	-	-	-	-	X	X	X			
Southern Bog Lemming *(Synaptomys cooperi)*	Least Concern	-	-	-	-	-		X				
Red Squirrel *(Tamiasciurus hudsonicus)*	Least Concern	-	-	-	-	-	X		X			
Eastern Chipmunk *(Tamias striatus)*	Least Concern	-	-	-	-	-	X	X	X			

Sources of Status

IUCN Red List - "International Union for the Conservation of Nature, Red List of Threatened Species" (http://www.iucnredlist.org/)

CITES Appendix - "Convention on the International Trade in Endangered Species of Wild Flora and Fauna" (http://www.cites.org/)

US (Endangered Species Act) - "U.S. Fish and Wildlife Service, Endangered Species" (http://www.fws.gov/ENDANGERED/species/us-species.html)

New York State (Environmental Conservation Law) - List of Endangered, Threatened and Special Concern Fish & Wildlife Species of New York State (http://www.dec.ny.gov/animals/7494.html)

Canada (Species at Risk Act) - "Species at Risk Public Registry" (http://www.sararegistry.gc.ca/sar/index/default_e.cfm)

Ontario (Endangered Species Act) - "Species at Risk in Ontario (SARO) List" (http://www.mnr.gov.on.ca/en/Business/Species/2ColumnSubPage/MNR_SAR_CSSR_SARO_LST_EN.html)

Sources of Records

A - Dobbyn, Jon. 1994. Atlas of the Mammals of Ontario. Ontario: Federation of Ontario Naturalists. (http://www.ontarionature.org/discover/resources/publications.php#atlases) (Canada Records)

B - Rising, Gerry, and Bob Andrle. Fauna of Times Beach Nature Preserve from 1994 to 2004. Unpublished. (U.S. Records)

C - Environmental Design & Research, Landscape Architecture, Planning, Environmental Services, Engineering and Surveying, P.C. (EDR). 2010. Ecological Inventory of the Niagara River Gorge and Rim - Draft. (Species identified during on-site ecological surveys conducted by EDR in June 2010 only) (U.S. Records)

D - DePriest, Tim. Recent NYS DEC Niagara River records. Unpublished. (U.S. Records)

E - Applied Ecological Services, Inc. 2012. A Wildlife Survey of the Lower Buffalo River Area of Concern, Buffalo, Erie County, New York. (http://www.bnriverkeeper.org/buffalo-river-wildlife-survey) (U.S. Records)

Additional Notes

Introduced species are a species living outside their native distributional range, which have arrived there by human activity, either deliberate or accidental.

X[1]: Canadian Lynx are occasional visitors because they can travel long distances and have been verified a few times, but they are not resident to NY identified as a factor in the Common Tern colony losses at the Lake Erie break wall, just outside of the AOC. As a mid-size carnivore, mink has the ability to influence prey source populations. However, the lack of apex predators (that would typically consume mink) causes an imbalance which exacerbates the effects of mink predation of prey species. The lack of shoreline connectivity creates fragmentation, and mink become concentrated in certain areas, leading to over predation of Common Terns and other valuable species.

Botanicals

The botanical species documented within the Niagara River Watershed are provided in Chart 5.7 and includes 734 species. Much of the literature within the region regarding vegetation was written by a botanist Patricia Eckel, who specialized in the unique gorge and island habitats of the Niagara River. Studies containing vegetation occurrences can also be found related to NYPA relicensing documents, habitat surveys in relation to Niagara and Buffalo River AOC work. Adding species to this list for the Lake Erie portion of the watershed was beyond the scope of work for this project.

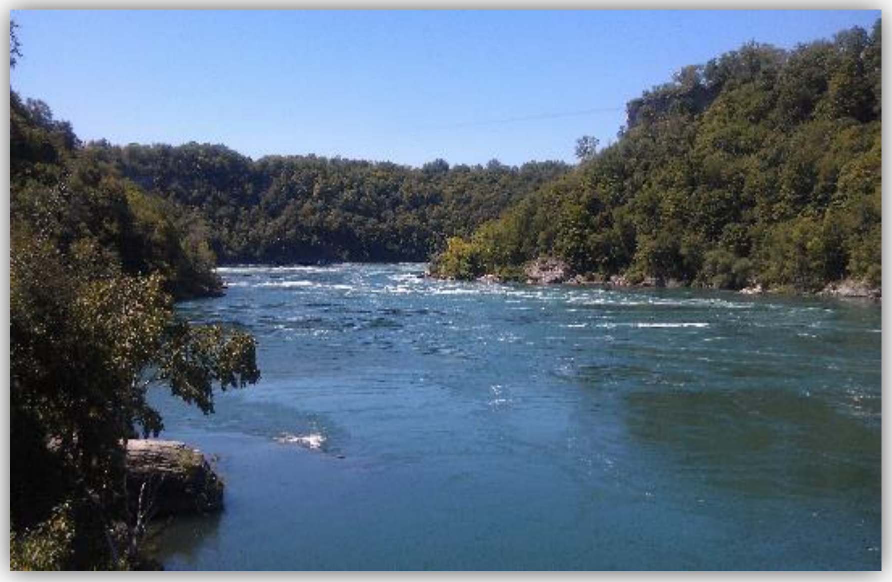


Figure 5.11: Niagara River Gorge

The Niagara Gorge and the Niagara Falls vicinity is noted for its exceptionally rich flora, which despite impacts from development and tourism is still in good condition, containing a variety of rare species. The forest communities (calcareous cliff community and talus slope woodland) along the gorge are of statewide significance regarding the specificity of the conditions required for their existence and the diversity of species that rely on them. The vegetative community on Goat Island is also of particular importance. Located directly above the falls, a river mist microclimate on the island presents conditions favorable for seed deposition, making its vegetative character of national significance.[19]

[19] Buffalo Niagara Rivers Habitat Assessment Strategy and Conservation Framework (Buffalo Niagara Riverkeeper, 2011)

Chart 5.7 Botanicals of the Niagara River/Lake Erie Watershed

PLANTS

Species		Status						Records		Introduced	
		IUCN Red List	CITES Appendix	US (Endangered Species Act)	New York State (Natural Heritage Program)	Canada (Species at Risk Act)	Ontario (Endangered Species Act)	A	B		Origin
Balsam Fir	*Abies balsamea (L.) Miller*	Least Concern	-	-	-	-	-	X		X	Native/Introduced
Three-seeded Mercury	*Acalypha rhomboidea Raf.*	-	-	-	-	-	-	X			Native
Manitoba Maple	*Acer negundo L.*	-	-	-	-	-	-	X	X		Native
Norway Maple	*Acer platanoides L.*	-	-	-	-	-	-	X	X	X	Invasive
Sycamore Maple	*Acer pseudoplatanus L.*	-	-	-	-	-	-	X	X	X	Invasive
Red Maple	*Acer rubrum L.*	-	-	-	-	-	-	X	X		Native
Silver Maple	*Acer saccharinum L.*	-	-	-	-	-	-	X			Native
Black Maple	*Acer saccharum Marshall subsp. nigrum (Michaux f.) Desmarais*	-	-	-	-	-	-	X	X		Native
Sugar Maple	*Acer saccharum Marshall subsp. saccharum*	-	-	-	-	-	-	X	X		Native
Mountain Maple	*Acer spicatum Lam.*	-	-	-	-	-	-	X	X		Native
Yarrow	*Achillea millefolium L.*	-	-	-	-	-	-	X	X	X	Native/Introduced
White Baneberry	*Actaea pachypoda Elliott*	-	-	-	-	-	-	X	X		Native
Black Cohosh	*Actaea racemosa L.*	-	-	-	-	-	-	X			Native
Red Baneberry	*Actaea rubra (Aiton) Willd.*	-	-	-	Vulnerable	-	-	X	X		Native
(A. pachypoda X A. rubra)	*Actaea x ludovicii B. Boivin*	-	-	-	-	-	-	X			Native
Northern Maidenhair	*Adiantum pedatum L.*	-	-	-	Vulnerable	-	-	X			Native
Horse-chestnut	*Aesculus hippocastanum L.*	Near Threatened	-	-	-	-	-	X	X	X	Introduced
Slender-leaved Agalinis	*Agalinis tenuifolia (M. Vahl) Raf.*	-	-	-	-	-	-	X			Native
Purple Giant Hyssop	*Agastache scrophulariifolia (Willd.) Kuntze*	-	-	-	-	-	-	X			Native
Agrimony	*Agrimonia gryposepala Wallr.*	-	-	-	-	-	-	X			Native
Small-flowered Agrimony	*Agrimonia parviflora Aiton*	-	-	-	Rare	-	-	X			Native
Creeping Bent Grass	*Agrostis stolonifera L.*	Least Concern	-	-	-	-	-	X			Native
Tree-of-Heaven	*Ailanthus altissima (Miller) Swingle*	-	-	-	-	-	-	X	X	X	Introduced
Garlic Mustard	*Alliaria petiolata (M. Bieb.) Cavara & Grande*	-	-	-	-	-	-	X	X	X	Invasive
Wild Garlic	*Allium canadense L.*	-	-	-	-	-	-	X			Native
Wild Leek	*Allium tricoccum Aiton*	-	-	-	-	-	-	X			Native
Black Alder	*Alnus glutinosa (L.) Gaertner*	Least Concern	-	-	-	-	-	X		X	Invasive
Foxtail	*Alopecurus sp.*	-	-	-	-	-	-		X	X	
Pale Alyssum	*Alyssum alyssoides (L.) L.*	-	-	-	-	-	-	X		X	Introduced
Common Ragweed	*Ambrosia artemisiifolia L.*	-	-	-	-	-	-	X	X		Native
Juneberry	*Amelanchier amabalis Wieg.*	-	-	-	-	-	-	X			Native
Juneberry	*Amelanchier arborea (Michaux f.) Fern.*	-	-	-	-	-	-	X			Native
Juneberry	*Amelanchier sanguinea (Pursh) DC.*	-	-	-	-	-	-	X			Native
Low Juneberry	*Amelanchier stolonifera Wieg.*	-	-	-	-	-	-	X			Native
Hog-peanut	*Amphicarpaea bracteata (L.) Fern.*	-	-	-	-	-	-	X			Native
Blue Bugloss	*Anchusa arvensis (L.) M. Bieb.*	-	-	-	-	-	-	X		X	Introduced
Big Bluestem	*Andropogon gerardii Vitman*	-	-	-	-	-	-	X			Native
Sharp-lobed Hepatica	*Anemone acutiloba (DC.) Lawson*	-	-	-	-	-	-	X			Native
Round-lobed Hepatica	*Anemone americana (DC.) Hara*	-	-	-	-	-	-	X			Native
Canada Anemone	*Anemone canadensis L.*	-	-	-	-	-	-	X			Native
Long-fruited Thimbleweed	*Anemone cylindrica A. Gray*	-	-	-	-	-	-	X			Native
Wood Anemone	*Anemone quinquefolia L. var. quinquefolia*	-	-	-	-	-	-	X			Native
Thimbleweed	*Anemone virginiana L. var. alba (Oakes) Wood*	-	-	-	-	-	-	X			Native
Thimbleweed	*Anemone virginiana L. var. virginiana*	-	-	-	-	-	-	X			Native
Pussytoes	*Antennaria howellii E. Greene*	-	-	-	-	-	-	X			Native
Field Pussytoes	*Antennaria neglecta*	-	-	-	-	-	-		X		
Plantain-leaved Everlasting	*Antennaria parlinii Fern. subsp. fallax (E. Greene) R.J. Bayer &*	-	-	-	-	-	-	X			Native

Groundnut	*Apios americana Medicus*	-	-	-	-	-	-	X			Native
Putty-root	*Aplectrum hyemale (Muhlenb. ex Willd.) Nutt*	-	Appendix II	-	Endangered	-	-	X			Native
Spreading Dogbane	*Apocynum androsaemifolium L. subsp. androsaemifolium*	-	-	-	-	-	-	X	X		Native
Indian Hemp	*Apocynum cannabinum L.*	-	-	-	-	-	-	X			Native
Wild Columbine	*Aquilegia canadensis L.*	-	-	-	-	-	-	X	X		Native
Garden Columbine	*Aquilegia vulgaris L.*	-	-	-	-	-	-	X		X	Introduced
Sickle-pod	*Arabis canadensis L.*	-	-	-	-	-	-	X			Native
Divaricate Rock-cress	*Arabis divaricarpa A. Nels.*	-	-	-	-	-	-	X			Native
Drummond's Rock-cress	*Arabis drummondii A. Gray*	-	-	-	-	-	-	X			Native
Hairy Rock-cress	*Arabis hirsuta (L.) Scop.*	-	-	-	-	-	-	X			Native
Holboel's Rock-cress	*Arabis holboelii Hornem.*	-	-	-	-	-	-	X			Native
Smooth Rock-cress	*Arabis laevigata (Muhlenb. ex Willd.) Poiret*	-	-	-	-	-	-	X			Native
Lyre-leaved Rock-cress	*Arabis lyrata L. var. lyrata*	-	-	-	-	-	-	X			Native
Wild Sarsaparilla	*Aralia nudicaulis L.*	-	-	-	-	-	-	X	X		Native
Spikenard	*Aralia racemosa L. subsp. racemosa*	-	-	-	-	-	-	X	X		Native
Common Burdock	*Arctium minus (Hill) Bernh. subsp. minus*	-	-	-	-	-	-	X		X	Introduced
Bear-berry	*Arctostaphylos uva-ursi (L.) Sprengel*	-	-	-	-	-	-	X			Native
Thyme-leaved Sandwort	*Arenaria serpyllifolia L.*	-	-	-	-	-	-	X		X	Introduced
Jack-in-the-pulpit	*Arisaema triphyllum (L.) Schott*	-	-	-	Vulnerable	-	-	X	X		Native
Tall Oat Grass	*Arrhenatherum elatius (L.) P. Beauv. ex J.S. & C. Presl*	-	-	-	-	-	-	X		X	Introduced
Mugwort	*Artemisia vulgaris L.*	-	-	-	-	-	-	X	X	X	Introduced
Wild-ginger	*Asarum canadense L.*	-	-	-	-	-	-	X	X		Native
Poke Milkweed	*Asclepias exaltata L.*	-	-	-	-	-	-	X			Native
Swamp Milkweed	*Asclepias incarnata L. subsp. incarnata*	-	-	-	-	-	-	X	X		Native
Four-leaved Milkweed	*Asclepias quadrifolia Jacq.*	-	-	-	-	-	Endangered	X			Native
Common Milkweed	*Asclepias syriaca L.*	-	-	-	-	-	-	X	X		Native
Butterfly-weed	*Asclepias tuberosa L.*	-	-	-	Vulnerable	-	-	X			Native
Whorled Milkweed	*Asclepias verticillata L.*	-	-	-	Rare	-	-	X			Native
Garden Asparagus	*Asparagus officinalis L.*	-	-	-	-	-	-	X		X	Introduced
Ebony Spleenwort	*Asplenium platyneuron (L.) Britton, Sterns*	-	-	-	Vulnerable	-	-	X			Native
Walking Fern	*Asplenium rhizophyllum L.*	-	-	-	Vulnerable	-	-	X			Native
American Hart's-tongue	*Asplenium scolopendrium L. var. americanum (Fern.) Kartesz &*	-	-	-	Threatened	-	-	X		X	Introduced
Maidenhair Spleenwort	*Asplenium trichomanes L.*	-	-	-	Vulnerable	-	-	X	X		Native
Cooper's Milk-vetch	*Astragalus neglectus (Torrey & A. Gray) E.*	-	-	-	Endangered	-	-	X			Native
Northeastern Lady Fern	*Athyrium filix-femina (L.) Roth subsp. angustum (Willd.) Clausen*	-	-	-	-	-	-	X			Native
Yellow False Foxglove	*Aureolaria flava (L.) Farw.*	-	-	-	-	-	-	X			Native
Downy False Foxglove	*Aureolaria virginica (L.) Pennell*	-	-	-	-	-	-	X			Native
Winter Cress	*Barbarea vulgaris R. Br.*	-	-	-	-	-	-	X	X	X	Invasive
English Daisy	*Bellis perennis*	-	-	-	-	-	-		X	X	
Japanese Barberry	*Berberis thunbergii DC.*	-	-	-	-	-	-	X	X	X	Invasive
Common Barberry	*Berberis vulgaris L.*	-	-	-	-	-	-	X	X	X	Introduced
Yellow Birch	*Betula alleghaniensis Britton*	-	-	-	-	-	-	X	X		Native
Cherry Birch	*Betula lenta L.*	-	-	-	-	Endangered	Endangered	X			Native
River Birch	*Betula nigra*	-	-	-	Rare	-	-		X	X	
Paper Birch	*Betula papyrifera Marshall*	-	-	-	-	-	-	X	X		Native
Gray Birch	*Betula populifolia*	-	-	-	-	-	-		X		
Nodding Beggarticks	*Bidens cernuus L.*	-	-	-	-	-	-	X			Native
Devil's Beggarticks	*Bidens frondosus L.*	-	-	-	-	-	-	X			Native
Dissected Grapefern	*Botrychium dissectum Sprengel*	-	-	-	Vulnerable	-	-	X			Native
Common Moonwort	*Botrychium lunaria (L.) Sw.*	-	-	-	Endangered	-	-	X			Native

Rattlesnake Fern	*Botrychium virginianum (L.) Sw.*	-	-	-	Vulnerable	-	-	X	X		Native
Bearded Shorthusk	*Brachyelytrum erectum (Schreber) Beauv. var. erectum*	-	-	-	-	-	-	X			Native
Fringed Brome	*Bromus ciliatus L.*	-	-	-	-	-	-	X			Native
Smooth Brome	*Bromus inermis*	-	-	-	-	-	-		X	X	
Kalm's Brome	*Bromus kalmii A. Gray*	-	-	-	-	-	-	X			Native
Brome Grass	*Bromus nottowayanus Fern.*	-	-	-	Endangered	-	-	X			Native
Canada Brome	*Bromus pubescens Muhlenb. ex Willd.*	-	-	-	-	-	-	X			Native
Downy Chess	*Bromus tectorum L.*	-	-	-	-	-	-	X		X	Invasive
Largeleaf Brunnera	*Brunnera macrophylla*	-	-	-	-	-	-		X	X	
Corn Gromwell	*Buglossoides arvensis (L.) I.M. Johnston*	-	-	-	-	-	-	X		X	Introduced
Canada Blue-joint	*Calamagrostis canadensis (Michaux) P. Beauv*	-	-	-	-	-	-	X			Native
Low Bindweed	*Calystegia spithamaea (L.) R.Br. subsp. spithamaea*	-	-	-	-	-	-	X			Native
Tall Bellflower	*Campanula americana L.*	-	-	-	-	-	-	X			Native
Harebell	*Campanula rotundifolia L.*	-	-	-	Vulnerable	-	-	X			Native
Shepherd's-purse	*Capsella bursa-pastoris (L.) Medicus*	-	-	-	-	-	-	X		X	Introduced
Spring Cress	*Cardamine bulbosa (Schreber ex Muhl.) Britton, Sterns & Pogg.*	-	-	-	-	-	-	X			Native
Cut-leaved Toothwort	*Cardamine concatenata (Michaux) Schwein.*	-	-	-	-	-	-	X	X		Native
Two-leaved Toothwort	*Cardamine diphylla (Michaux) Wood*	-	-	-	-	-	-	X	X		Native
Purple Spring Cress	*Cardamine douglassii (Torr.) Britton*	-	-	-	Threatened	-	-	X	X		Native
Sedge	*Carex albicans Willd. ex Spreng. var. albicans*	-	-	-	-	-	-	X			Native
White-bear Sedge	*Carex albursina E. Sheldon*	-	-	-	-	-	-	X			Native
Golden-fruit Sedge	*Carex aurea Nutt.*	-	-	-	-	-	-	X			Native
Woodland Sedge	*Carex blanda Dewey*	-	-	-	-	-	-	X			Native
Oval-leaf Sedge	*Carex cephalophora Muhlenb. ex Willd.*	-	-	-	-	-	-	X			Native
Common Sedge	*Carex communis L. Bailey var. communis*	-	-	-	-	-	-	X			Native
Bearded Sedge	*Carex comosa Boott*	-	-	-	-	-	-	X			Native
Crawe's Sedge	*Carex crawei Dewey*	-	-	-	Threatened	-	-	X			Native
Fringed Sedge	*Carex crinita Lam.*	-	-	-	-	-	-	X			Native
Finger Sedge	*Carex digitalis Willd.*	-	-	-	-	-	-	X			Native
Bristle-leaf Sedge	*Carex eburnea Boott ex Hooker*	-	-	-	-	-	-	X			Native
Elk Sedge	*Carex garberi Fern.*	-	-	-	Endangered	-	-	X			Native
Sedge	*Carex gracilescens Steudel*	-	-	-	-	-	-	X			Native
Meadow Sedge	*Carex granularis Muhlenb. ex Willd.*	-	-	-	-	-	-	X			Native
Sedge	*Carex grisea Wahlenb.*	-	-	-	-	-	-	X			Native
Sedge	*Carex hirsutella Mackenzie*	-	-	-	-	-	-	X			Native
Hitchcock's Sedge	*Carex hitchcockiana Dewey*	-	-	-	-	-	-	X			Native
Porcupine Sedge	*Carex hystericina Muhlenb. ex Willd.*	-	-	-	-	-	-	X			Native
Inland Sedge	*Carex interior L. Bailey*	-	-	-	-	-	-	X			Native
Distant-flowered Sedge	*Carex laxiflora Lam.*	-	-	-	-	-	-	X			Native
Muhlenberg's Sedge	*Carex muehlenbergii Schkuhr ex Willd.*	-	-	-	Rare	-	-	X			Native
Few-flowered Sedge	*Carex oligocarpa Schk. ex Willd.*	-	-	-	-	-	-	X			Native
Peduncled Sedge	*Carex pedunculata Muhlenb. ex Willd.*	-	-	-	-	-	-	X			Native
Pennsylvania Sedge	*Carex pensylvanica Lam.*	-	-	-	-	-	-	X	X		Native
Plantain-leaved Sedge	*Carex plantaginea Lam.*	-	-	-	-	-	-	X			Native
Broad-leaved Sedge	*Carex platyphylla J. Carey*	-	-	-	-	-	-	X			Native
Drooping Sedge	*Carex prasina Wahlenb.*	-	-	-	-	-	-	X			Native
Sedge	*Carex radiata (Wahlenb.) Small*	-	-	-	-	-	-	X			Native
Sedge	*Carex rosea Schkuhr ex Willd.*	-	-	-	-	-	-	X			Native
Rough Sedge	*Carex scabrata Schwein.*	-	-	-	-	-	-	X			Native
Spiked Sedge	*Carex spicata Hudson*	-	-	-	-	-	-	X		X	Introduced

Awl-fruited Sedge	*Carex stipata Muhlenb. ex Willd.*	-	-	-	-	-	-	X			Native
Slender Sedge	*Carex tenera Dewey var. tenera*	-	-	-	-	-	-	X			Native
Rigid Sedge	*Carex tetanica Schk. ex Willd.*	-	-	-	-	-	-	X			Native
Wrinkled-seeded Sedge	*Carex tonsa (Fern.) Bickn. var. rugosperma (Mack.) Crins*	-	-	-	-	-	-	X			Native
Hairy-fruited Sedge	*Carex trichocarpa Muhlenb. ex Willd.*	-	-	-	-	-	-	X			Native
Umbellate Sedge	*Carex umbellata Schkuhr ex Willd.*	-	-	-	-	-	-	X			Native
Fox Sedge	*Carex vulpinoidea Michaux*	-	-	-	-	-	-	X			Native
Wood's Sedge	*Carex woodii Dewey*	-	-	-	-	-	-	X			Native
Blue-beech	*Carpinus caroliniana Walter subsp. virginiana (Marsh.) Furlow*	-	-	-	-	-	-	X			Native
Bitternut Hickory	*Carya cordiformis (Wang.) K. Koch*	-	-	-	-	-	-	X	X		Native
Shagbark Hickory	*Carya ovata (Miller) K. Koch var. ovata*	-	-	-	-	-	-	X	X		Native
Indian Paintbrush	*Castilleja coccinea (L.) Sprengel*	-	-	-	Endangered	-	-	X			Native
Catalpa	*Catalpa speciosa*	-	-	-	-	-	-		X	X	
Blue Cohosh	*Caulophyllum giganteum (Farw.) Leconte & Blackwell*	-	-	-	-	-	-	X			Native
New Jersey Tea	*Ceanothus americanus L.*	-	-	-	-	-	-	X			Native
Oriental Bittersweet	*Celastrus orbiculatus Thunb.*	-	-	-	-	-	-	X	X	X	Invasive
Climbing Bittersweet	*Celastrus scandens L.*	-	-	-	Rare	-	-	X			Native
Common Hackberry	*Celtis occidentalis L.*	-	-	-	-	-	-	X	X		Native
Spotted Knapweed	*Centaurea maculosa Lam.*	-	-	-	-	-	-	X	X	X	Invasive
Buttonbush	*Cephalanthus occidentalis L.*	-	-	-	-	-	-	X			Native
Field Chickweed	*Cerastium arvense L.*	-	-	-	-	-	-	X		X	Introduced
Mouse-eared Chickweed	*Cerastium fontanum Baumg.*	-	-	-	-	-	-	X	X	X	Introduced
Chickweed	*Cerastium glomeratum Thuill.*	-	-	-	-	-	-	X		X	Introduced
Nodding Chickweed	*Cerastium nutans Raf. var. nutans*	-	-	-	-	-	-	X			Native
Curtis Mouse-eared Chickweed	*Cerastium pumilum Curtis*	-	-	-	-	-	-	X		X	Introduced
Spring Mouse-eared Chickweed	*Cerastium semidecandrum L.*	-	-	-	-	-	-	X		X	Introduced
Eastern Redbud	*Cercis canadensis*	Least Concern	-	-	-	-	-		X	X	
Dwarf Snapdragon	*Chaenorrhinum minus (L.) Lange*	-	-	-	-	-	-	X		X	Introduced
Devil's Bit	*Chamaelirium luteum (L.) A. Gray*	-	-	-	Endangered	-	-	X			Native
Hairy-fruited Spurge	*Chamaesyce maculata (L.) Small*	-	-	-	-	-	-	X		X	Introduced
Eyebane	*Chamaesyce nutans (Lagasca) Small*	-	-	-	-	-	-	X		X	Native/Introduced
Celandine	*Chelidonium majus L.*	-	-	-	-	-	-	X	X	X	Invasive
Turtlehead	*Chelone glabra L.*	-	-	-	Vulnerable	-	-	X			Native
Lamb's-quarters	*Chenopodium album L. var. album*	-	-	-	-	-	-	X	X	X	Introduced
Oak-leaved Goosefoot	*Chenopodium glaucum L. subsp. glaucum*	-	-	-	-	-	-	X		X	Introduced
Maple-leaved Goosefoot	*Chenopodium simplex (Torrey) Raf.*	-	-	-	-	-	-	X			Native
Ox-eye Daisy	*Chrysanthemum leucanthemum L.*	-	-	-	-	-	-	X	X	X	Invasive
Chicory	*Cichorium intybus L.*	-	-	-	-	-	-	X	X	X	Introduced
Small Enchanter's-nightshade	*Circaea alpina L.*	-	-	-	-	-	-	X			Native
Enchanter's-nightshade	*Circaea lutetiana L.*	-	-	-	-	-	-	X	X		Native
Canada Thistle	*Cirsium arvense (L.) Scop.*	-	-	-	-	-	-	X	X	X	Invasive
Swamp Thistle	*Cirsium muticum*	-	-	-	-	-	-		X		
Bull Thistle	*Cirsium vulgare (Savi) Tenore*	-	-	-	-	-	-	X	X	X	Invasive
Spring Beauty	*Claytonia caroliniana Michaux*	-	-	-	-	-	-	X			Native
Narrow-leaved Spring Beauty	*Claytonia virginica L.*	-	-	-	-	-	-	X	X		Native
Virgin's-bower	*Clematis virginiana L.*	-	-	-	-	-	-	X	X		Native
Bluebead Lily	*Clintonia borealis (Aiton) Raf.*	-	-	-	-	-	-	X			Native
Horsebalm	*Collinsonia canadensis L.*	-	-	-	-	-	-	X			Native
Bastard-toadflax	*Comandra umbellata (L.) Nutt.*	-	-	-	-	-	-	X			Native
Squawroot	*Conopholis americana (L.) Wallr.*	-	-	-	Vulnerable	-	-	X	X		Native

Lily-of-the-valley	*Convallaria majalis L.*	-	-	-	-	-	-	X		X	Introduced
Field Bindweed	*Convolvulus arvensis*	-	-	-	-	-	-		X	X	
Horseweed	*Conyza canadensis (L.) Cronq.*	-	-	-	-	-	-	X			Native
Goldthread	*Coptis trifolia (L.) Salisb.*	-	-	-	-	-	-	X			Native
Spotted Coral-root	*Corallorhiza maculata (Raf.) Raf.*	-	-	-	Vulnerable	-	-	X			Native
Lance-leaved Coreopsis	*Coreopsis lanceolata L.*	-	-	-	-	-	-	X		X	Introduced
Alternate-leaved Dogwood	*Cornus alternifolia L.f.*	-	-	-	-	-	-	X	X		Native
Silky Dogwood	*Cornus amomum*	-	-	-	-	-	-		X		
Bunchberry	*Cornus canadensis L.*	-	-	-	-	-	-	X			Native
Rough-leaved Dogwood	*Cornus drummondii C. Meyer*	-	-	-	Endangered	-	-	X			Native
Flowering Dogwood	*Cornus florida L.*	-	-	-	Vulnerable	Endangered	Endangered	X			Native
Grey Dogwood	*Cornus foemina Miller subsp. racemosa (Lam.) J.S. Wilson*	-	-	-	-	-	-	X	X		Native
Round-leaved Dogwood	*Cornus rugosa Lam.*	-	-	-	-	-	-	X	X		Native
Red-osier Dogwood	*Cornus stolonifera Michaux*	-	-	-	-	-	-	X			Native
Crown Vetch	*Coronilla varia*	-	-	-	-	-	-		X	X	
European Hazelnut	*Corylus avellana*	Least Concern	-	-	-	-	-		X	X	
Beaked Hazel	*Corylus cornuta Marshall subsp. cornuta*	-	-	-	-	-	-	X			Native
Hawthorn	*Crataegus intricata Lange*	-	-	-	-	-	-	X			Native
Oneseed Hawthorn	*Crataegus monogyna*	-	-	-	-	-	-		X	X	
Slender Cliff-brake	*Cryptogramma stelleri (S. Gmelin) Prantl*	-	-	-	Vulnerable	-	-	X			Native
Ivy-leaved Toadflax	*Cymbalaria muralis P. Gaertner, Meyer & Scherb.*	-	-	-	-	-	-	X		X	Introduced
Northern Wild Comfrey	*Cynoglossum boreale Fern.*	-	-	-	Endangered	-	-	X			Native
Hound's-tongue	*Cynoglossum officinale L.*	-	-	-	-	-	-	X		X	Invasive
Yellow Lady's-slipper	*Cypripedium calceolus L.*	Least Concern	Appendix II	-	-	-	-	X	X		Native
Bulblet Bladder Fern	*Cystopteris bulbifera (L.) Bernh.*	-	-	-	Vulnerable	-	-	X	X		Native
Mackay's Brittle Fern	*Cystopteris tenuis (Michaux) Desv.*	-	-	-	Vulnerable	-	-	X			Native
Orchard Grass	*Dactylis glomerata L.*	-	-	-	-	-	-	X	X	X	Introduced
Flat-stemmed Danthonia	*Danthonia compressa Austin*	-	-	-	-	-	-	X			Native
Poverty Oat Grass	*Danthonia spicata (L.) P. Beauv. ex Roemer & Schultes*	-	-	-	-	-	-	X			Native
Wild Carrot	*Daucus carota L.*	-	-	-	-	-	-	X	X	X	Invasive
Hay-scented Fern	*Dennstaedtia punctilobula (Michaux) T. Moore*	-	-	-	-	-	-	X			Native
Silvery-spleenwort	*Deparia acrostichoides (Swartz) M. Kato*	-	-	-	Vulnerable	-	-	X			Native
Showy Tick-trefoil	*Desmodium canadense (L.) DC.*	-	-	-	-	-	-	X			Native
Tick-trefoil	*Desmodium cuspidatum (Muhlenb. ex Willd.) DC. ex Loudon*	-	-	-	-	-	-	X			Native
Pointed-leaved Tick-trefoil	*Desmodium glutinosum (Muhlenb. ex Willd.) Alph. Wood*	Least Concern	-	-	-	-	-	X	X		Native
Deptford Pink	*Dianthus armeria L.*	-	-	-	-	-	-	X		X	Introduced
Squirrel-corn	*Dicentra canadensis (Goldie) Walp.*	-	-	-	-	-	-	X			Native
Dutchman's-breeches	*Dicentra cucullaria (L.) Bernh.*	-	-	-	-	-	-	X			Native
Bush-honeysuckle	*Diervilla lonicera Miller*	-	-	-	-	-	-	X	X		Native
Smooth Crab Grass	*Digitaria ischaemum (Schreber ex Schwein.) Schreber ex Muhlenb.*	-	-	-	-	-	-	X		X	Introduced
Wild Yam	*Dioscorea quaternata J. Gmelin*	-	-	-	-	-	-	X			Native
Northern Running-pine	*Diphasiastrum complanatum (L.) Holub*	-	-	-	Endangered	-	-	X			Native
Narrow-leaved Glade Fern	*Diplazium pycnocarpon (Sprengel) M. Broun*	-	-	-	Vulnerable	-	-	X			Native
Narrow-leaved Wall Rocket	*Diplotaxis tenuifolia (L.) DC.*	-	-	-	-	-	-	X		X	Introduced
Common Teasel	*Dipsacus fullonum L.*	-	-	-	-	-	-	X	X	X	Invasive
Leatherwood	*Dirca palustris L.*	-	-	-	-	-	-	X			Native
Yellow Mandarin	*Disporum lanuginosum (Michaux) Nicholson*	-	-	-	-	-	-	X			Native
Flat-topped White Aster	*Doellingeria umbellata (Mill.) Nees*	-	-	-	-	-	-	X			Native
Spinulose Wood Fern	*Dryopteris carthusiana (Villars) H.P. Fuchs*	-	-	-	-	-	-	X	X		Native
Crested Wood Fern	*Dryopteris cristata (L.) A. Gray*	-	-	-	Vulnerable	-	-	X			Native

Goldie's Wood Fern	*Dryopteris goldiana (Hook. ex Goldie) A. Gray*	-	-	-	Vulnerable	-	-	X			Native
Evergreen Wood Fern	*Dryopteris intermedia (Muhlenb. ex Willd.) A. Gray*	-	-	-	Vulnerable	-	-	X			Native
Marginal Wood Fern	*Dryopteris marginalis (L.) A. Gray*	-	-	-	Vulnerable	-	-	X	X		Native
Indian Strawberry	*Duchesnea indica (Andrz.) Focke*	-	-	-	-	-	-	X	X	X	Introduced
Barnyard Grass	*Echinochloa crusgalli (L.) P. Beauv.*	-	-	-	-	-	-	X		X	Introduced
Viper's-bugloss	*Echium vulgare L.*	-	-	-	-	-	-	X		X	Invasive
Autumn Olive	*Elaeagnus umbellata*	-	-	-	-	-	-		X	X	
Intermediate Spike-rush	*Eleocharis intermedia (Muhl.) Schult.*	-	-	-	-	-	-	X			Native
Canada Wild-rye	*Elymus canadensis L.*	-	-	-	-	-	-	X			Native
Bottlebrush Grass	*Elymus hystrix L.*	-	-	-	-	-	-	X			Native
Western Wheat Grass	*Elymus smithii (Rydb.) Gould*	-	-	-	-	-	-	X		X	Introduced
Hairy Wild-rye	*Elymus villosus Muhlenb. ex Willd.*	-	-	-	-	-	-	X			Native
Virginia Wild-rye	*Elymus virginicus L. var. virginicus*	-	-	-	-	-	-	X			Native
Wiegand's Wild-rye	*Elymus wiegandii Fern.*	-	-	-	-	-	-	X			Native
Purple-leaved Willow-herb	*Epilobium coloratum Biehler*	-	-	-	-	-	-	X			Native
Small-flowered Willow-herb	*Epilobium parviflorum Schreber*	-	-	-	-	-	-	X		X	Introduced
Helleborine	*Epipactis helleborine (L.) Crantz*	-	Appendix II	-	-	-	-	X	X	X	Introduced
Field Horsetail	*Equisetum arvense L.*	-	-	-	-	-	-	X	X		Native
Common Scouring-rush	*Equisetum hyemale L. subsp. affine (Engelm.) Stone*	Least Concern	-	-	-	-	-	X			Native
Variegated Scouring-rush	*Equisetum variegatum Schleicher ex Weber & Mohr*	-	-	-	-	-	-	X			Native
Tufted Love Grass	*Eragrostis pectinacea (Michaux) Nees var. pectinacea*	-	-	-	-	-	-	X			Native
Daisy Fleabane	*Erigeron annuus (L.) Pers.*	-	-	-	-	-	-	X	X		Native
Philadelphia Fleabane	*Erigeron philadelphicus L. subsp. philadelphicus*	-	-	-	-	-	-	X	X		Native
Robin's-plantain	*Erigeron pulchellus Michaux*	-	-	-	-	-	-	X			Native
Spreading Fleabane	*Erigeron strigosus Muhlenb. ex Willd.*	-	-	-	-	-	-	X			Native
Stork's-bill	*Erodium cicutarium (L.) L'Her. subsp. cicutarium*	-	-	-	-	-	-	X		X	Introduced
Whitlow-grass	*Erophila verna (L.) Chevall.*	-	-	-	-	-	-	X		X	Introduced
White Trout Lily	*Erythronium albidum Nutt.*	-	-	-	-	-	-	X			Native
Yellow Trout Lily	*Erythronium americanum Ker Gawler subsp. americanum*	-	-	-	-	-	-	X	X		Native
Winged Euonymus	*Euonymus alata (Thunb.) Siebold*	-	-	-	-	-	-	X		X	Invasive
Burning Bush	*Euonymus atropurpurea Jacq. var. atropurpurea*	-	-	-	-	-	-	X			Native
Wintercreeper	*Euonymus fortunei (Turcz.) Hand.-Mazz.*	-	-	-	-	-	-	X		X	Introduced
Running Strawberry-bush	*Euonymus obovata Nutt.*	-	-	-	Vulnerable	-	-	X			Native
Spotted Joe-Pye-weed	*Eupatorium maculatum L.*	-	-	-	-	-	-	X	X		Native
Boneset	*Eupatorium perfoliatum L.*	-	-	-	-	-	-	X	X		Native
Sweet Joe-Pye-weed	*Eupatorium purpureum L. var. purpureum*	-	-	-	-	-	-	X			Native
White Snakeroot	*Eupatorium rugosum Houtt.*	-	-	-	-	-	-	X			Native
Cypress Spurge	*Euphorbia cyparissias L.*	-	-	-	-	-	-	X		X	Introduced
Sun Spurge	*Euphorbia helioscopia L.*	-	-	-	-	-	-	X		X	Introduced
White Wood Aster	*Eurybia divaricata (L.) Nesom*	-	-	-	-	Threatened	Threatened	X			Native
Large-leaved Aster	*Eurybia macrophylla (L.) Cass. in Cuvier*	-	-	-	-	-	-	X	X		Native
Grass-leaved Goldenrod	*Euthamia graminifolia (L.) Nutt. ex Cass.*	-	-	-	-	-	-	X			Native
American Beech	*Fagus grandifolia Ehrh.*	-	-	-	-	-	-	X	X		Native
European Beech	*Fagus sylvatica*	-	-	-	-	-	-		X	X	
Red Fescue	*Festuca rubra L.*	-	-	-	-	-	-	X		X	Introduced
Nodding Fescue	*Festuca subverticillata (Pers.) E. Alexeev*	-	-	-	-	-	-	X			Native
Woodland Strawberry	*Fragaria vesca L. subsp. americana (Porter) Staudt*	-	-	-	-	-	-	X			Native
Wild Strawberry	*Fragaria virginiana Miller*	-	-	-	-	-	-	X	X		Native
White Ash	*Fraxinus americana L.*	-	-	-	-	-	-	X	X		Native
European Ash	*Fraxinus excelsior L.*	-	-	-	-	-	-	X		X	Introduced

Black Ash	*Fraxinus nigra Marshall*	-	-	-	-	-	-	X			Native
Red/Green Ash	*Fraxinus pennsylvanica Marshall*	-	-	-	-	-	-	X	X		Native
Showy Orchis	*Galearis spectabilis (L.) Raf.*	-	-	-	Vulnerable	-	-	X			Native
Cleavers	*Galium aparine L.*	-	-	-	-	-	-	X		X	Native/Introduced
Northern Bedstraw	*Galium boreale L.*	-	-	-	-	-	-	X			Native
Wild Licorice	*Galium circaezans Michaux*	-	-	-	-	-	-	X			Native
Lance-leaved Wild Licorice	*Galium lanceolatum Torrey*	-	-	-	-	-	-	X			Native
Wild Madder	*Galium mollugo*	-	-	-	-	-	-		X	X	
Sweet-scented Bedstraw	*Galium triflorum Michaux*	-	-	-	-	-	-	X			Native
Wintergreen	*Gaultheria procumbens L.*	-	-	-	-	-	-	X			Native
Black Huckleberry	*Gaylussacia baccata (Wang.) K. Koch*	-	-	-	-	-	-	X			Native
Closed Gentian	*Gentiana andrewsii Griseb. var. andrewsii*	-	-	-	Vulnerable	-	-	X			Native
Narrow-leaved Fringed Gentian	*Gentianopsis virgata (Raf.) Holub*	-	-	-	Endangered	-	-	X			Native
Wild Geranium	*Geranium maculatum L.*	-	-	-	-	-	-	X	X		Native
Herb Robert	*Geranium robertianum L.*	-	-	-	-	-	-	X	X	X	Introduced
Yellow Avens	*Geum aleppicum Jacq.*	-	-	-	-	-	-	X	X		Native
White Avens	*Geum canadense Jacq.*	-	-	-	-	-	-	X	X		Native
Cut-leaved Avens	*Geum laciniatum Murray*	-	-	-	-	-	-	X			Native
Herb Bennett	*Geum urbanum L.*	-	-	-	-	-	-	X		X	Invasive
Gill-over-the-ground	*Glechoma hederacea L.*	-	-	-	-	-	-	X	X	X	Invasive
Honey Locust	*Gleditsia triacanthos*	-	-	-	-	-	-		X	X	
Fowl Manna Grass	*Glyceria striata (Lam.) A.S. Hitchc.*	-	-	-	-	-	-	X			Native
Fragrant Cudweed	*Gnaphalium obtusifolium L.*	-	-	-	-	-	-	X			Native
Stickseed	*Hackelia virginiana (L.) I.M. Johnston*	-	-	-	-	-	-	X			Native
Witch-hazel	*Hamamelis virginiana L.*	-	-	-	-	-	-	X	X		Native
American Pennyroyal	*Hedeoma pulegioides (L.) Pers.*	-	-	-	-	-	-	X			Native
English Ivy	*Hedera helix*	-	-	-	-	-	-		X	X	
Sneezeweed	*Helenium autumnale L.*	-	-	-	-	-	-	X			Native
Common Sunflower	*Helianthus annuus L.*	-	-	-	-	-	-	X		X	Introduced
Thin-leaved Sunflower	*Helianthus decapetalus L.*	-	-	-	-	-	-	X			Native
Woodland Sunflower	*Helianthus divaricatus L.*	-	-	-	-	-	-	X			Native
Orange Day Lily	*Hemerocallis fulva (L.) L.*	-	-	-	-	-	-	X	X	X	Introduced
Dame's Rocket	*Hesperis matronalis L.*	-	-	-	-	-	-	X	X	X	Invasive
King Devil	*Hieracium caespitosum Dum.*	-	-	-	-	-	-	X	X	X	Introduced
Canada Hawkweed	*Hieracium canadense Michaux*	-	-	-	-	-	-	X			Native
Hawkweed	*Hieracium gronovii L.*	-	-	-	-	-	-	X			Native
Yellow Hawkweed	*Hieracium piloselloides Villars*	-	-	-	-	-	-	X	X	X	Introduced
Rattlesnake Weed	*Hieracium venosum L. var. nudicaule (Michx.) Farw.*	-	-	-	-	-	-	X			Native
(H. caespitosum X H. lactucella)	*Hieracium x floribundum Wimmer & Graeb.*	-	-	-	-	-	-	X		X	Introduced
Foxtail Barley	*Hordeum jubatum L. subsp. jubatum*	-	-	-	-	-	-	X		X	Invasive
Fringed Houstonia	*Houstonia canadensis Willd.*	-	-	-	-	-	-	X			Native
Longleaf Bluet	*Houstonia longifolia*	-	-	-	-	-	-		X		
Shining Fir-moss	*Huperzia lucidula (Michaux) Trevisan*	-	-	-	Vulnerable	-	-	X			Native
Green Violet	*Hybanthus concolor (T. Forster) Sprengel*	-	-	-	-	-	-	X			Native
GoldenSeal	*Hydrastis canadensis L.*	-	Appendix II	-	Threatened	Threatened	Threatened	X			Native
Canada Waterleaf	*Hydrophyllum canadense L.*	-	-	-	-	-	-	X			Native
Virginia Waterleaf	*Hydrophyllum virginianum L.*	-	-	-	-	-	-	X	X		Native
Common St. John's-wort	*Hypericum perforatum L.*	-	-	-	-	-	-	X	X	X	Invasive
Spotted St. John's-wort	*Hypericum punctatum Lam.*	-	-	-	-	-	-	X			Native
Yellow Stargrass	*Hypoxis hirsuta (L.) Coville*	-	-	-	-	-	-	X			Native

American Holly	*Ilex opaca*	-	-	-	Vulnerable	-	-		X		
Spotted Touch-me-not	*Impatiens capensis Meerb.*	-	-	-	-	-	-	X	X		Native
Pale Touch-me-not	*Impatiens pallida Nutt.*	-	-	-	-	-	-	X	X		Native
Yellow-flag	*Iris pseudacorus L.*	-	-	-	-	-	-	X		X	Invasive
Butternut	*Juglans cinerea L.*	-	-	-	Vulnerable	Endangered	Endangered	X	X		Native
Black Walnut	*Juglans nigra L.*	-	-	-	-	-	-	X	X		Native
Jointed Rush	*Juncus articulatus L.*	Least Concern	-	-	-	-	-	X			Native
Baltic Rush	*Juncus balticus Willd.*	-	-	-	-	-	-	X			Native
Dudley's Rush	*Juncus dudleyi Wieg.*	-	-	-	-	-	-	X			Native
Soft Rush	*Juncus effusus L.*	Least Concern	-	-	-	-	-	X	X		Native
Path Rush	*Juncus tenuis Willd. var. tenuis*	-	-	-	-	-	-	X	X		Native
Torrey's Rush	*Juncus torreyi Cov.*	-	-	-	-	-	-	X			Native
Common Juniper	*Juniperus communis L.*	Least Concern	-	-	-	-	-	X			Native
Red Cedar	*Juniperus virginiana L. var. virginiana*	Least Concern	-	-	-	-	-	X	X		Native
Canada-lettuce	*Lactuca canadensis L.*	-	-	-	-	-	-	X			Native
Prickly-lettuce	*Lactuca serriola L.*	-	-	-	-	-	-	X		X	Introduced
Henbit	*Lamium amplexicaule L.*	-	-	-	-	-	-	X		X	Introduced
Purple Dead-nettle	*Lamium purpureum L.*	-	-	-	-	-	-	X		X	Introduced
Wood-nettle	*Laportea canadensis (L.) Wedd.*	-	-	-	-	-	-	X			Native
Burseed	*Lappula squarrosa (Retz.) Dumort. subsp. squarrosa*	-	-	-	-	-	-	X		X	Introduced
Nipplewort	*Lapsana communis L.*	-	-	-	-	-	-	X	X	X	Introduced
Tamarack	*Larix laricina (Du Roi) K. Koch*	Least Concern	-	-	-	-	-	X			Native
Pale Vetchling	*Lathyrus ochroleucus Hook.*	-	-	-	Rare	-	-	X			Native
Rice Cut Grass	*Leersia oryzoides (L.) Swartz*	-	-	-	-	-	-	X			Native
White Grass	*Leersia virginica Willd.*	-	-	-	-	-	-	X			Native
Motherwort	*Leonurus cardiaca L. subsp. cardiaca*	-	-	-	-	-	-	X	X	X	Introduced
Field Pepper-grass	*Lepidium campestre (L.) R. Br.*	-	-	-	-	-	-	X	X	X	Introduced
Wandlike Bush-clover	*Lespedeza intermedia (S. Watson) Britton*	-	-	-	-	-	-	X			Native
Violet Bush-clover	*Lespedeza violacea (L.) Pers.*	-	-	-	-	-	-	X			Native
Cylindric Blazing-star	*Liatris cylindracea Michaux*	-	-	-	Endangered	-	-	X			Native
Privet	*Ligustrum vulgare L.*	-	-	-	-	-	-	X	X	X	Invasive
Canada Lily	*Lilium canadense L.*	-	-	-	Vulnerable	-	-	X			Native
Wood Lily	*Lilium philadelphicum L.*	-	-	-	Vulnerable	-	-	X			Native
Butter-and-eggs	*Linaria vulgaris Miller*	-	-	-	-	-	-	X	X	X	Invasive
Spicebush	*Lindera benzoin (L.) Blume*	-	-	-	-	-	-	X	X		Native
Tulip-tree	*Liriodendron tulipifera L.*	-	-	-	-	-	-	X	X		Native
European Gromwell	*Lithospermum officinale L.*	-	-	-	-	-	-	X		X	Introduced
Indian-tobacco	*Lobelia inflata L.*	-	-	-	-	-	-	X			Native
Kalm's Lobelia	*Lobelia kalmii L.*	-	-	-	-	-	-	X			Native
Great Lobelia	*Lobelia siphilitica L.*	-	-	-	-	-	-	X			Native
Tall Fescue	*Lolium arundinaceus (Schreber) Darbysh.*	-	-	-	-	-	-	X		X	Introduced
Perennial Rye Grass	*Lolium perenne L.*	-	-	-	-	-	-	X		X	Introduced
Fly Honeysuckle	*Lonicera canadensis Bartram*	-	-	-	-	-	-	X			Native
Wild Honeysuckle	*Lonicera dioica L.*	-	-	-	-	-	-	X			Native
Amur Honeysuckle	*Lonicera maackii (Rupr.) Maxim.*	-	-	-	-	-	-	X	X	X	Invasive
Morrow's Honeysuckle	*Lonicera morrowii A. Gray*	-	-	-	-	-	-	X	X	X	Invasive
Tartarian Honeysuckle	*Lonicera tatarica L.*	-	-	-	-	-	-	X	X	X	Invasive
Bird's Foot Trefoil	*Lotus corniculatus*	-	-	-	-	-	-		X	X	
Money Plant	*Lunaria annua*	-	-	-	-	-	-		X	X	
Wild Lupine	*Lupinus perennis L. subsp. perennis*	-	-	-	Rare	-	-	X			Native

Flat-branched Tree Club-moss	*Lycopodium obscurum L.*	-	-	-	-	-	-	X			Native
American Water-horehound	*Lycopus americanus Muhlenb. ex Bartram*	-	-	-	-	-	-	X			Native
European Water-horehound	*Lycopus europaeus L.*	-	-	-	-	-	-	X		X	Introduced
Bugleweed	*Lycopus uniflorus Michaux*	-	-	-	-	-	-	X			Native
Virginia Water-horehound	*Lycopus virginicus L.*	-	-	-	-	-	-	X			Native
Fringed Loosestrife	*Lysimachia ciliata L.*	-	-	-	-	-	-	X	X		Native
Creeping Jennie	*Lysimachia nummularia*	-	-	-	-	-	-		X	X	
Spotted Loosestrife	*Lysimachia punctata L.*	-	-	-	-	-	-	X		X	Introduced
Purple Loosestrife	*Lythrum salicaria L.*	Least Concern	-	-	-	-	-	X	X	X	Invasive
Wild Lily-of-the-valley	*Maianthemum canadense Desf.*	-	-	-	-	-	-	X			Native
False Solomon's-seal	*Maianthemum racemosum (L.) Link subsp. racemosum*	-	-	-	-	-	-	X	X		Native
Starry False Solomon's-seal	*Maianthemum stellatum (L.) Link*	-	-	-	-	-	-	X	X		Native
Wild Crab	*Malus coronaria (L.) Miller*	-	-	-	-	-	-	X			Native
Apple	*Malus pumila Miller*	-	-	-	-	-	-	X		X	Introduced
Common Mallow	*Malva neglecta*	-	-	-	-	-	-		X	X	
Pineapple Weed	*Matricaria matricarioides (Less.) Porter*	-	-	-	-	-	-	X		X	Introduced
Indian Cucumber-root	*Medeola virginiana L.*	-	-	-	-	-	-	X			Native
Black Medick	*Medicago lupulina L.*	-	-	-	-	-	-	X		X	Invasive
Cow-wheat	*Melampyrum lineare Desr.*	-	-	-	-	-	-	X			Native
White Sweet-clover	*Melilotus alba Medicus*	-	-	-	-	-	-	X		X	Invasive
Common Balm	*Melissa officinalis L. subsp. officinalis*	-	-	-	-	-	-	X	X	X	Introduced
Moonseed	*Menispermum canadense L.*	-	-	-	-	-	-	X			Native
Field Mint	*Mentha arvensis L.*	-	-	-	-	-	-	X			Native
Wood Millet	*Milium effusum L.*	-	-	-	-	-	-	X			Native
Partridge-berry	*Mitchella repens L.*	-	-	-	-	-	-	X			Native
Bishop's-cap	*Mitella diphylla L.*	-	-	-	-	-	-	X			Native
Oswego Tea	*Monarda didyma L.*	-	-	-	Vulnerable	-	-	X			Native
Wild Bergamot	*Monarda fistulosa L.*	-	-	-	-	-	-	X			Native
Indian Pipe	*Monotropa uniflora L.*	-	-	-	-	-	-	X			Native
White Mulberry	*Morus alba L.*	-	-	-	-	-	-	X	X	X	Invasive
Red Mulberry	*Morus rubra L.*	-	-	-	-	Endangered	Endangered	X			Native
Wire-stemmed Muhly	*Muhlenbergia frondosa (Poiret) Fern.*	-	-	-	-	-	-	X			Native
Satin Grass	*Muhlenbergia mexicana (L.) Trin.*	-	-	-	-	-	-	X			Native
Nimble Will	*Muhlenbergia schreberi J.F. Gmelin*	-	-	-	-	-	-	X			Native
Muhly	*Muhlenbergia sylvatica (Torrey) Torrey ex A. Gray*	-	-	-	-	-	-	X			Native
Slender Satin Grass	*Muhlenbergia tenuiflora (Willd.) BSP.*	-	-	-	-	-	-	X			Native
Field Scorpion Grass	*Myosotis arvensis (L) Hill*	-	-	-	-	-	-	X		X	Introduced
Catnip	*Nepeta cataria L.*	-	-	-	-	-	-	X	X	X	Introduced
Black-gum	*Nyssa sylvatica Marshall*	-	-	-	-	-	-	X			Native
Hairy Yellow Evening-primrose	*Oenothera biennis L.*	-	-	-	-	-	-	X	X		Native
Sundrops	*Oenothera perennis L.*	-	-	-	-	-	-	X			Native
One-flowered Cancer-root	*Orobanche uniflora L.*	-	-	-	-	-	-	X			Native
One-sided Pyrola	*Orthilia secunda (L.) House*	-	-	-	-	-	-	X			Native
Rough-leaved Mountain-rice	*Oryzopsis asperifolia Michaux*	-	-	-	-	-	-	X			Native
Mountain-rice	*Oryzopsis racemosa (Smith) Ricker ex A. Hitchc.*	-	-	-	-	-	-	X			Native
Sweet-cicely	*Osmorhiza claytonii (Michaux) C.B. Clarke*	-	-	-	-	-	-	X			Native
Long-styled Sweet-cicely	*Osmorhiza longistylis (Torrey) DC.*	-	-	-	-	-	-	X			Native
Interrupted Fern	*Osmunda claytoniana L.*	-	-	-	Vulnerable	-	-	X			Native
American Royal Fern	*Osmunda regalis L. var. spectabilis (Willd.) Gray*	-	-	-	-	-	-	X			Native
Hop-hornbeam	*Ostrya virginiana (Miller) K. Koch*	-	-	-	-	-	-	X	X		Native

European Wood-sorrel	*Oxalis stricta L.*	-	-	-	-	-	-	X	X		Native
American Ginseng	*Panax quinquefolius*	-	Appendix II	-	Vulnerable	Endangered	Endangered	X			Native
Dwarf Ginseng	*Panax trifolius L.*	-	-	-	-	-	-	X			Native
Panic Grass	*Panicum acuminatum Sw.*	-	-	-	-	-	-	X			Native
Forked Panic Grass	*Panicum dichotomum L. var. dichotomum*	-	-	-	-	-	-	X			Native
Broadleaf Panic Grass	*Panicum latifolium L.*	-	-	-	-	-	-	X			Native
Lindheimer's Panic Grass	*Panicum lindheimeri Nash*	-	-	-	-	-	-	X			Native
Switch Grass	*Panicum virgatum L.*	-	-	-	-	-	-	X			Native
Pellitory	*Parietaria pensylvanica Muhlenb. ex Willd.*	-	-	-	-	-	-	X			Native
Grass-of-Parnassus	*Parnassia glauca Raf.*	-	-	-	Vulnerable	-	-	X			Native
Virginia Creeper	*Parthenocissus inserta (A. Kerner) Fritsch*	-	-	-	-	-	-	X			Native
Virginia Creeper	*Parthenocissus quinquefolia (L.) Planchon ex DC.*	-	-	-	-	-	-	X	X		Native
Purple-stemmed Cliff-brake	*Pellaea atropurpurea (L.) Link*	-	-	-	Vulnerable	-	-	X			Native
Smooth Cliff-brake	*Pellaea glabella Mett. ex Kuhn subsp. glabella*	-	-	-	Threatened	-	-	X	X		Native
Foxglove Beard-tongue	*Penstemon digitalis Nutt. ex Sims*	-	-	-	-	-	-	X			Native
Hairy Beard-tongue	*Penstemon hirsutus (L.) Willd.*	-	-	-	-	-	-	X	X		Native
Mock-orange	*Philadelphus coronarius*								X	X	
Timothy	*Phleum pratense L.*	-	-	-	-	-	-	X	X	X	Introduced
Blue Phlox	*Phlox divaricata L.*	-	-	-	-	-	-	X			Native
Common Reed	*Phragmites australis (Cav.) Trin. ex Steudel*	Least Concern	-	-	-	-	-	X	X	X	Invasive
Ninebark	*Physocarpus opulifolius (L.) Maxim.*	-	-	-	-	-	-	X	X		Native
False Dragonhead	*Physostegia virginiana (L.) Benth.*	-	-	-	-	-	-	X			Native
Pokeweed	*Phytolacca americana L.*	-	-	-	-	-	-	X			Native
Blue Spruce	*Picea pungens*	Least Concern	-	-	-	-	-		X	X	
Black-seeded Clearweed	*Pilea fontana (Lunell) Rydb.*	-	-	-	-	-	-	X			Native
Clearweed	*Pilea pumila (L.) A. Gray*	-	-	-	-	-	-	X			Native
Jack Pine	*Pinus banksiana Lambert*	Least Concern	-	-	Rare	-	-	X		X	Introduced
Red Pine	*Pinus resinosa*	Least Concern	-	-	-	-	-		X		
Eastern White Pine	*Pinus strobus L.*	Least Concern	-	-	-	-	-	X	X		Native
Scots Pine	*Pinus sylvestris L.*	Least Concern	-	-	-	-	-	X	X	X	Invasive
English Plantain	*Plantago lanceolata L.*	-	-	-	-	-	-	X	X	X	Introduced
Common Plantain	*Plantago major L.*	-	-	-	-	-	-	X	X	X	Introduced
Rugel's Plantain	*Plantago rugelii Decne.*	-	-	-	-	-	-	X	X		Native
Tubercled Orchid	*Platanthera flava (L.) Lindley var. herbiola (R. Br. ex Ait. f.) Luer*	-	Appendix II	-	Vulnerable	-	-	X			Native
Hooker's Orchid	*Platanthera hookeri (Torr. ex Gray) Lindl.*	-	Appendix II	-	Endangered	-	-	X			Native
Tall Northern Green Orchid	*Platanthera hyperborea (L.) Lindley var. hyperborea*	-	Appendix II	-	-	-	-	X			Native
Ragged Fringed-orchid	*Platanthera lacera (Michaux) G. Don var. lacera*	-	Appendix II	-	Vulnerable	-	-	X			Native
Sycamore	*Platanus occidentalis L.*	-	-	-	-	-	-	X	X		Native
Annual Blue Grass	*Poa annua L.*	-	-	-	-	-	-	X		X	Introduced
Bulbous Poa	*Poa bulbosa L.*	-	-	-	-	-	-	X		X	Introduced
Canada Blue Grass	*Poa compressa L.*	-	-	-	-	-	-	X			Native
Wood Blue Grass	*Poa nemoralis L.*	-	-	-	-	-	-	X		X	Introduced
Kentucky Blue Grass	*Poa pratensis L. subsp. pratensis*	-	-	-	-	-	-	X			Native
Rough Blue Grass	*Poa trivialis L.*	-	-	-	-	-	-	X		X	Introduced
May-apple	*Podophyllum peltatum L.*	-	-	-	-	-	-	X	X		Native
Seneca Snakeroot	*Polygala senega L.*	-	-	-	-	-	-	X			Native
Solomon's-seal	*Polygonatum biflorum (Walter) Elliott*	-	-	-	-	-	-	X	X		Native
Hairy Solomon's-seal	*Polygonatum pubescens (Willd.) Pursh*	-	-	-	-	-	-	X	X		Native
Halberd-leaved Tear-thumb	*Polygonum arifolium L.*	-	-	-	-	-	-	X			Native
Prostrate Knotweed	*Polygonum aviculare L.*	-	-	-	-	-	-	X		X	Introduced

Japanese Knotweed	*Polygonum cuspidatum Siebold & Zucc.*	-	-	-	-	-	-	X	X	X	Invasive
Pinkweed	*Polygonum pensylvanicum L.*	-	-	-	-	-	-	X			Native
Lady's-thumb	*Polygonum persicaria L.*	-	-	-	-	-	-	X		X	Introduced
Jumpseed	*Polygonum virginianum L.*	-	-	-	Vulnerable	-	-	X	X		Native
Leafcup	*Polymnia canadensis L.*	-	-	-	-	-	-	X	X		Native
Rock Polypody	*Polypodium virginianum L.*	-	-	-	Vulnerable	-	-	X			Native
Christmas Fern	*Polystichum acrostichoides (Michaux) Schott*	-	-	-	Vulnerable	-	-	X			Native
Holly Fern	*Polystichum lonchitis (L.) Roth*	-	-	-	Endangered	-	-	X			Native
White Poplar	*Populus alba L.*	-	-	-	-	-	-	X		X	Invasive
Balsam Poplar	*Populus balsamifera L. subsp. balsamifera*	-	-	-	-	-	-	X			Native
Cottonwood	*Populus deltoides Bartram ex Marshall*	-	-	-	-	-	-	X	X		Native
Large-toothed Aspen	*Populus grandidentata Michaux*	-	-	-	-	-	-	X	X		Native
Trembling Aspen	*Populus tremuloides Michaux*	-	-	-	-	-	-	X	X		Native
Silverweed	*Potentilla anserina L. subsp. anserina*	-	-	-	-	-	-	X			Native
Silvery Cinquefoil	*Potentilla argentea L.*	-	-	-	-	-	-	X		X	Introduced
Rough Cinquefoil	*Potentilla norvegica L.*	-	-	-	-	-	-	X		X	Introduced
Rough-fruited Cinquefoil	*Potentilla recta L.*	-	-	-	-	-	-	X	X	X	Invasive
Common Cinquefoil	*Potentilla simplex Michaux*	-	-	-	-	-	-	X	X		Native
White-lettuce	*Prenanthes alba L.*	-	-	-	-	-	-	X			Native
Tall White-lettuce	*Prenanthes altissima L.*	-	-	-	-	-	-	X			Native
Heal-all	*Prunella vulgaris L.*	-	-	-	-	-	-	X	X	X	Introduced
Wild Plum	*Prunus americana Marshall*	-	-	-	-	-	-	X			Native
Sweet Cherry	*Prunus avium (L.) L.*	-	-	-	-	-	-	X	X	X	Introduced
Perfumed Cherry	*Prunus mahaleb L.*	-	-	-	-	-	-	X	X	X	Introduced
Peach	*Prunus persica (L.) Batsch*	-	-	-	-	-	-	X		X	Introduced
Wild Black Cherry	*Prunus serotina Ehrh.*	-	-	-	-	-	-	X	X		Native
Choke Cherry	*Prunus virginiana L. subsp. virginiana*	-	-	-	-	-	-	X	X		Native
Hop-tree	*Ptelea trifoliata L. var. trifoliata*	-	-	-	Endangered	Threatened	Threatened	X		X	Native/Introduced
Eastern Bracken	*Pteridium aquilinum (L.) Kuhn var. latiusculum (Desv.) Underw. ex*	-	-	-	-	-	-	X			Native
Reflexed Saltmarsh Grass	*Puccinellia distans (Jacq.) Parl. subsp. distans*	-	-	-	-	-	-	X		X	Introduced
Virginia Mountain-mint	*Pycnanthemum virginianum (L.) Durand & Jackson ex Fernald &*	-	-	-	-	-	-	X			Native
Round-leaved Pyrola	*Pyrola americana Sweet*	-	-	-	-	-	-	X			Native
Greenish Pyrola	*Pyrola chlorantha Sw.*	-	-	-	-	-	-	X			Native
Shinleaf	*Pyrola elliptica Nutt.*	-	-	-	-	-	-	X			Native
White Oak	*Quercus alba L.*	-	-	-	-	-	-	X	X		Native
Swamp White Oak	*Quercus bicolor Willd.*	-	-	-	-	-	-	X			Native
Bur Oak	*Quercus macrocarpa Michaux*	Least Concern	-	-	-	-	-	X			Native
Chinquapin Oak	*Quercus muhlenbergii Engelm.*	-	-	-	-	-	-	X			Native
Pin Oak	*Quercus palustris Muenchh.*	-	-	-	-	-	-	X			Native
Northern Red Oak	*Quercus rubra L.*	-	-	-	-	-	-	X	X		Native
Black Oak	*Quercus velutina Lam.*	-	-	-	-	-	-	X			Native
Kidney-leaved Buttercup	*Ranunculus abortivus L.*	-	-	-	-	-	-	X	X		Native
Common Buttercup	*Ranunculus acris L.*	-	-	-	-	-	-	X	X	X	Invasive
Fig Buttercup	*Ranunculus ficaria*	-	-	-	-	-	-		X	X	
Hispid Buttercup	*Ranunculus hispidus Michaux var. hispidus*	-	-	-	-	-	-	X			Native
Bristly Crowfoot	*Ranunculus pensylvanicus L.f.*	-	-	-	-	-	-	X	X		Native
Hooked Buttercup	*Ranunculus recurvatus Poiret var. recurvatus*	-	-	-	-	-	-	X			Native
Creeping Buttercup	*Ranunculus repens L.*	-	-	-	-	-	-	X		X	Invasive
Cursed Crowfoot	*Ranunculus sceleratus L. var. sceleratus*	-	-	-	-	-	-	X			Native
Common Buckthorn	*Rhamnus cathartica L.*	-	-	-	-	-	-	X	X	X	Invasive

Glossy Buckthorn	*Rhamnus frangula L.*	-	-	-	-	-	-	X	X	X	Invasive
Jetbead	*Rhodotypos scandens (Thunb.) Makino*	-	-	-	-	-	-	X		X	Introduced
Fragrant Sumac	*Rhus aromatica Aiton*	-	-	-	-	-	-	X	X		Native
Climbing Poison-ivy	*Rhus radicans L. subsp. negundo (E. Greene) McNeill*	-	-	-	-	-	-	X			Native
Rydberg's Poison-ivy	*Rhus radicans L. subsp. rydbergii (Small ex Rydb.) McNeill*	-	-	-	-	-	-	X			Native
Staghorn Sumac	*Rhus typhina L.*	-	-	-	-	-	-	X	X		Native
Hair-like Beak-rush	*Rhynchospora capillacea Torrey*	-	-	-	-	-	-	X			Native
Wild Black Currant	*Ribes americanum Miller*	-	-	-	-	-	-	X	X		Native
Prickly Gooseberry	*Ribes cynosbati L.*	-	-	-	-	-	-	X			Native
Garden Red Currant	*Ribes rubrum L.*	-	-	-	-	-	-	X		X	Introduced
Black Locust	*Robinia pseudoacacia L.*	Least Concern	-	-	-	-	-	X	X	X	Invasive
Clammy Locust	*Robinia viscosa Vent. ex Vauq.*	-	-	-	-	-	-	X		X	Invasive
Dog Rose	*Rosa canina L.*	-	-	-	-	-	-	X		X	Introduced
Carolina Rose	*Rosa carolina L.*	-	-	-	-	-	-	X			Native
Small-flower Sweetbrier	*Rosa micrantha Borrer ex Smith in Sowerby*	-	-	-	-	-	-	X		X	Introduced
Multiflora Rose	*Rosa multiflora Thunb. ex Murray*	-	-	-	-	-	-	X	X	X	Invasive
Sweetbrier	*Rosa rubiginosa L.*	-	-	-	-	-	-	X		X	Introduced
Common Blackberry	*Rubus allegheniensis Porter*	-	-	-	-	-	-	X	X		Native
Northern Dewberry	*Rubus flagellaris Willd.*	-	-	-	-	-	-	X			Native
Wild Red Raspberry	*Rubus idaeus L. subsp. melanolasius (Dieck) Focke*	-	-	-	-	-	-	X			Native
Black Raspberry	*Rubus occidentalis L.*	-	-	-	-	-	-	X	X		Native
Purple-flowering Raspberry	*Rubus odoratus L.*	-	-	-	-	-	-	X	X		Native
Wineberry	*Rubus phoenicolasius*	-	-	-	-	-	-		X	X	
Curly Dock	*Rumex crispus L.*	-	-	-	-	-	-	X	X	X	Introduced
Bitter Dock	*Rumex obtusifolius L. subsp.. obtusifolius*	-	-	-	-	-	-	X		X	Introduced
Pearlwort	*Sagina procumbens L.*	-	-	-	-	-	-	X		X	Introduced
White Willow	*Salix alba L.*	Least Concern	-	-	-	-	-	X		X	Introduced
Bebb's Willow	*Salix bebbiana Sarg.*	-	-	-	-	-	-	X			Native
Pussy Willow	*Salix discolor Muhlenb.*	-	-	-	-	-	-	X			Native
Heart-leaved Willow	*Salix eriocephala Michaux*	-	-	-	-	-	-	X			Native
Sandbar Willow	*Salix exigua Nutt. subsp. interior (Rowlee)*	-	-	-	-	-	-	X			Native
Upland Willow	*Salix humilis Marshall*	-	-	-	-	-	-	X			Native
(S. alba X S. fragilis)	*Salix x rubens Schrank*	-	-	-	-	-	-	X		X	Introduced
Common Elder	*Sambucus canadensis L.*	-	-	-	-	-	-	X			Native
Red-berried Elder	*Sambucus racemosa L.*	-	-	-	-	-	-	X	X		Native
Bloodroot	*Sanguinaria canadensis L.*	-	-	-	Vulnerable	-	-	X	X		Native
Garden Burnet	*Sanguisorba minor Scop.*	-	-	-	-	-	-	X		X	Introduced
Black Snakeroot	*Sanicula marilandica L.*	-	-	-	-	-	-	X			Native
Large-fruited Snakeroot	*Sanicula trifoliata Bickn.*	-	-	-	-	-	-	X			Native
Bouncing Bet	*Saponaria officinalis L.*	-	-	-	-	-	-	X		X	Introduced
Pitcher-plant	*Sarracenia purpurea L.*	-	Appendix II	-	Vulnerable	-	-	X			Native
Sassafras	*Sassafras albidum (Nutt.) Nees*	-	-	-	-	-	-	X	X		Native
Early Saxifrage	*Saxifraga virginiensis Michaux*	-	-	-	-	-	-	X	X		Native
Purple Melic Grass	*Schizachne purpurascens (Torrey) Swallen*	-	-	-	-	-	-	X			Native
Little Bluestem	*Schizachyrium scoparium (Michaux) Nees*	-	-	-	-	-	-	X			Native
Dark Green Bulrush	*Scirpus atrovirens Willd.*	-	-	-	-	-	-	X	X		Native
Wool Grass	*Scirpus cyperinus*	-	-	-	-	-	-		X		
Nodding Bulrush	*Scirpus pendulus Muhlenb. ex Willd.*	-	-	-	-	-	-	X			Native
Carpenter's-square	*Scrophularia marilandica L.*	-	-	-	-	-	-	X			Native
Common Skullcap	*Scutellaria galericulata L.*	-	-	-	Rare	-	-	X			Native

Mad-dog Skullcap	*Scutellaria lateriflora L.*	-	-	-	-	-	-	X			Native
Small Skullcap	*Scutellaria parvula Michx. var. parvula*	-	-	-	-	-	-	X			Native
Mossy Stonecrop	*Sedum acre L.*	-	-	-	-	-	-	X		X	Introduced
Live-forever	*Sedum sarmentosum Bunge*	-	-	-	-	-	-	X		X	Introduced
Buck's Meadow Spikemoss	*Selaginella eclipes Buck*	-	-	-	-	-	-	X			Native
Golden Ragwort	*Senecio aureus L.*	-	-	-	-	-	-	X			Native
Balsam Ragwort	*Senecio pauperculus Michaux*	-	-	-	-	-	-	X			Native
Common Groundsel	*Senecio vulgaris L.*	-	-	-	-	-	-	X		X	Introduced
Yellow Foxtail	*Setaria pumila (Poiret) Schultes*	-	-	-	-	-	-	X		X	Introduced
Green Foxtail	*Setaria viridis (L.) P. Beauv.*	-	-	-	-	-	-	X		X	Introduced
Soapberry	*Shepherdia canadensis (L.) Nutt.*	-	-	-	-	-	-	X			Native
Sleepy Catchfly	*Silene antirrhina L.*	-	-	-	-	-	-	X			Native
Tall Tumblemustard	*Sisymbrium altissimum*	-	-	-	-	-	-		X	X	
Narrow-leaved Blue-eyed Grass	*Sisyrinchium angustifolium Miller*	-	-	-	-	-	-	X			Native
Water-parsnip	*Sium suave Walter*	-	-	-	-	-	-	X			Native
Carrion-flower	*Smilax herbacea L.*	-	-	-	-	-	-	X			Native
Bristly Greenbrier	*Smilax hispida Muhlenb. ex Torrey*	-	-	-	-	-	-	X			Native
Climbing Nightshade	*Solanum dulcamara L.*	-	-	-	-	-	-	X	X	X	Introduced
Eastern Black Nightshade	*Solanum ptycanthum Dunal ex DC.*	-	-	-	-	-	-	X			Native
Late Goldenrod	*Solidago altissima L.*	-	-	-	-	-	-	X			Native
Sharp-leaved Goldenrod	*Solidago arguta Aiton var. arguta*	-	-	-	-	-	-	X			Native
Silverrod	*Solidago bicolor L.*	-	-	-	-	-	-	X			Native
Blue-stem Goldenrod	*Solidago caesia L.*	-	-	-	-	-	-	X			Native
Canada Goldenrod	*Solidago canadensis L.*	-	-	-	-	-	-	X			Native
Zig-zag Goldenrod	*Solidago flexicaulis L.*	-	-	-	-	-	-	X	X		Native
Hairy Goldenrod	*Solidago hispida Muhl.*	-	-	-	-	-	-	X			Native
Early Goldenrod	*Solidago juncea Aiton*	-	-	-	-	-	-	X			Native
Gray Goldenrod	*Solidago nemoralis Aiton subsp. nemoralis*	-	-	-	-	-	-	X			Native
Upland White Goldenrod	*Solidago ptarmicoides (Nees) B. Boivin*	-	-	-	-	-	-	X			Native
Stout Goldenrod	*Solidago squarrosa Muhlenb. ex Nutt.*	-	-	-	-	-	-	X			Native
Perennial Sow-thistle	*Sonchus arvensis L. subsp. arvensis*	-	-	-	-	-	-	X		X	Introduced
Spiny-leaved Sow-thistle	*Sonchus asper (L.) Hill subsp. asper*	-	-	-	-	-	-	X		X	Introduced
American Mountain-ash	*Sorbus americana Marshall*	-	-	-	-	-	-	X			Native
European Mountain-ash	*Sorbus aucuparia L.*	-	-	-	-	-	-	X	X	X	Introduced
Indian Grass	*Sorghastrum nutans (L.) Nash*	-	-	-	-	-	-	X			Native
Sand-spurrey	*Spergularia media (L.) C. Presl ex Griseb.*	-	-	-	-	-	-	X		X	Introduced
Sand-spurrey	*Spergularia salina J. & C. Presl.*	-	-	-	-	-	-	X		X	Introduced
Slender Wedge Grass	*Sphenopholis intermedia (Rydb.) Rydb.*	-	-	-	-	-	-	X			Native
Shining Ladies'-tresses	*Spiranthes lucida (H. Eaton) Ames*	-	Appendix II	-	Vulnerable	-	-	X			Native
Rough Dropseed	*Sporobolus asper (Michx.) Kunth*	-	-	-	-	-	-	X		X	Native/Introduced
Overlooked Dropseed	*Sporobolus neglectus Nash*	-	-	-	-	-	-	X			Native
Ensheathed Dropseed	*Sporobolus vaginiflorus (Torrey ex A. Gray) Torrey ex A. Wood*	-	-	-	-	-	-	X			Native
Bladdernut	*Staphylea trifolia L.*	-	-	-	-	-	-	X	X		Native
Common Chickweed	*Stellaria media (L.) Villars*	-	-	-	-	-	-	X		X	Introduced
Lesser Chickweed	*Stellaria pallida (Dumort) Crepin*	-	-	-	-	-	-	X		X	Introduced
Rose Twisted-stalk	*Streptopus roseus Michaux*	-	-	-	-	-	-	X			Native
Snowberry	*Symphoricarpos albus (L.) S.F. Blake*	-	-	-	-	-	-	X		X	Native/Introduced
Smooth Aster	*Symphyotrichum laeve (L.) Love & Love*	-	-	-	-	-	-	X			Native
Panicled Aster	*Symphyotrichum lanceolatum (Willd.) Nesom*	-	-	-	-	-	-	X			Native
Calico Aster	*Symphyotrichum lateriflorum (L.) Love & Love*	-	-	-	-	-	-	X			Native

New England Aster	*Symphyotrichum novae-angliae (L.) Nesom*	-	-	-	-	-	-	X			Native
Ontario Aster	*Symphyotrichum ontarione (Wieg.) Nesom*	-	-	-	Rare	-	-	X			Native
Azure Aster	*Symphyotrichum oolentangiense (Riddell) Nesom*	-	-	-	Endangered	-	-	X			Native
Hairy Aster	*Symphyotrichum pilosum (Willd.) Nesom var. pilosum*	-	-	-	-	-	-	X			Native
Pringle's Aster	*Symphyotrichum pilosum (Willd.) Nesom var. pringlei (A. Gray)*	-	-	-	-	-	-	X			Native
Arrow-leaved Aster	*Symphyotrichum urophyllum (Lindl. in DC.) Nesom*	-	-	-	-	-	-	X			Native
Common Lilac	*Syringa vulgaris L.*	-	-	-	-	-	-	X	X	X	Invasive
Yellow-pimpernel	*Taenidia integerrima (L.) Drude*	-	-	-	-	-	-	X			Native
Red-seeded Dandelion	*Taraxacum erythrospermum Andrz. ex Besser*	-	-	-	-	-	-	X		X	Introduced
Common Dandelion	*Taraxacum officinale G. Weber*	-	-	-	-	-	-	X	X	X	Introduced
Marsh Dandelion	*Taraxacum palustre (Lyons) DC. sensu lato*	-	-	-	-	-	-	X		X	Introduced
Canada Yew	*Taxus canadensis Marshall*	-	-	-	-	-	-	X	X		Native
Early Meadow-rue	*Thalictrum dioicum L.*	-	-	-	-	-	-	X	X		Native
Rue-anemone	*Thalictrum thalictroides (L.) Eames & B. Boivin*	-	-	-	-	-	-	X			Native
Hairy-jointed Meadow Parsnip	*Thaspium barbinode (Michaux) Nutt.*	-	-	-	Endangered	-	-	X			Native
White Cedar	*Thuja occidentalis L.*	Least Concern	-	-	-	-	-	X	X		Native
Foamflower	*Tiarella cordifolia L.*	-	-	-	-	-	-	X			Native
Basswood	*Tilia americana L.*	-	-	-	-	-	-	X	X		Native
Littleleaf Linden	*Tilia cordata*	-	-	-	-	-	-		X	X	
Poison Ivy	*Toxicodendron radicans*	-	-	-	-	-	-		X		
Goat's-beard	*Tragopogon dubius Scop.*	-	-	-	-	-	-	X		X	Invasive
Common Salsify	*Tragopogon porrifolius L.*	-	-	-	-	-	-	X	X	X	Introduced
Goat's-beard	*Tragopogon pratensis*	-	-	-	-	-	-		X	X	
Rabbit-foot Clover	*Trifolium arvense L.*	-	-	-	-	-	-	X		X	Introduced
Hop-clover	*Trifolium aureum*	-	-	-	-	-	-		X	X	
Small Clover	*Trifolium dubium Sibth.*	-	-	-	-	-	-	X		X	Introduced
Red Clover	*Trifolium pratense L.*	Least Concern	-	-	-	-	-	X	X	X	Introduced
White Clover	*Trifolium repens L.*	Least Concern	-	-	-	-	-	X	X	X	Introduced
Nodding Trillium	*Trillium cernuum L.*	-	-	-	Vulnerable	-	-	X			Native
Red Trillium	*Trillium erectum L.*	-	-	-	Vulnerable	-	-	X			Native
Bent Trillium	*Trillium flexipes Raf.*	-	-	-	Endangered	-	-	X			Native
White Trillium	*Trillium grandiflorum (Michaux) Salisb.*	-	-	-	Vulnerable	-	-	X			Native
Horse-gentian	*Triosteum aurantiacum E. Bickn.*	-	-	-	-	-	-	X			Native
Tinker's Weed	*Triosteum perfoliatum L.*	-	-	-	-	-	-	X			Native
Eastern Hemlock	*Tsuga canadensis (L.) Carriere*	Near Threatened	-	-	-	-	-	X	X		Native
Coltsfoot	*Tussilago farfara L.*	-	-	-	-	-	-	X	X	X	Invasive
Narrow-leaved Cattail	*Typha angustifolia L.*	-	-	-	-	-	-	X	X		
Common Cattail	*Typha latifolia L.*	-	-	-	-	-	-	X	X		Native
American Elm	*Ulmus americana L.*	-	-	-	-	-	-	X	X		Native
Siberian Elm	*Ulmus pumila L.*	-	-	-	-	-	-	X		X	Introduced
Slippery Elm	*Ulmus rubra Muhl.*	-	-	-	-	-	-	X			Native
Rock Elm	*Ulmus thomasii Sarg.*	-	-	-	Threatened	-	-	X			Native
Large-flowered Bellwort	*Uvularia grandiflora Smith*	-	-	-	-	-	-	X			Native
Perfoliate Bellwort	*Uvularia perfoliata L.*	-	-	-	-	-	-	X			Native
Merrybells	*Uvularia sessilifolia L.*	-	-	-	-	-	-	X			Native
Lowbush Blueberry	*Vaccinium angustifolium Aiton*	-	-	-	-	-	-	X			Native
Highbush Blueberry	*Vaccinium corymbosum L.*	-	-	-	-	-	-	X			Native
Dryland Blueberry	*Vaccinium pallidum Aiton*	-	-	-	-	-	-	X			Native
Deerberry	*Vaccinium stamineum L.*	-	-	-	-	Threatened	Threatened	X			Native
Tape-grass	*Vallisneria americana Michaux*	-	-	-	-	-	-	X			Native

Moth Mullein	*Verbascum blattaria L.*	-	-	-	-	-	-	X		X	Introduced
Common Mullein	*Verbascum thapsus L.*	-	-	-	-	-	-	X	X	X	Invasive
Blue Vervain	*Verbena hastata L.*	-	-	-	-	-	-	X			Native
White Vervain	*Verbena urticifolia L.*	-	-	-	-	-	-	X			Native
Corn Speedwell	*Veronica arvensis L.*	-	-	-	-	-	-	X		X	Introduced
Common Speedwell	*Veronica officinalis L.*	-	-	-	-	-	-	X	X	X	Introduced
Purslane Speedwell	*Veronica peregrina L. subsp. peregrina*	-	-	-	-	-	-	X		X	Introduced
Speedwell	*Veronica polita Fries*	-	-	-	-	-	-	X		X	Introduced
Thyme-leaved Speedwell	*Veronica serpyllifolia L. subsp. serpyllifolia*	-	-	-	-	-	-	X	X	X	Introduced
Maple-leaved Viburnum	*Viburnum acerifolium L.*	-	-	-	-	-	-	X	X		Native
Wayfaring Tree	*Viburnum lantana L.*	-	-	-	-	-	-	X	X	X	Introduced
Nannyberry	*Viburnum lentago L.*	-	-	-	-	-	-	X			Native
Snowball-tree	*Viburnum opulus L. var. americanum Ait.*	-	-	-	-	-	-	X			Native
European Highbush-cranberry	*Viburnum opulus L. var. opulus*	-	-	-	-	-	-	X		X	Invasive
Downy Arrow-wood	*Viburnum rafinesquianum Schultes*	-	-	-	-	-	-	X			Native
Vetch	*Vicia americana Muhlenb. ex Willd.*	-	-	-	-	-	-	X			Native
Carolina Vetch	*Vicia caroliniana Walt.*	-	-	-	-	-	-	X			Native
Cow Vetch	*Vicia cracca*	-	-	-	-	-	-		X	X	
Common Vetch	*Vicia sativa L. subsp. nigra (L.) Ehrh.*	-	-	-	-	-	-	X		X	Introduced
Common Periwinkle	*Vinca minor L.*	-	-	-	-	-	-	X	X	X	Invasive
Sweet White Violet	*Viola blanda Willd.*	-	-	-	-	-	-	X			Native
Canada Violet	*Viola canadensis L.*	-	-	-	-	-	-	X			Native
Dog Violet	*Viola conspersa Reichenb.*	-	-	-	-	-	-	X			Native
Wood Violet	*Viola palmata L.*	-	-	-	-	-	-	X			Native
Yellow Violet	*Viola pubescens Aiton*	-	-	-	-	-	-	X			Native
Long-spurred Violet	*Viola rostrata Pursh*	-	-	-	-	-	-	X			Native
Round-leaved Violet	*Viola rotundifolia Michaux*	-	-	-	-	-	-	X			Native
Common Blue Violet	*Viola sororia Willd.*	-	-	-	-	-	-	X	X		Native
Summer Grape	*Vitis aestivalis Michaux var. aestivalis*	-	-	-	-	-	-	X			Native
Fox Grape	*Vitis labrusca L.*	-	-	-	-	-	-	X		X	Native/Introduced
Riverbank Grape	*Vitis riparia Michaux*	-	-	-	-	-	-	X	X		Native
Six-weeks Fescue	*Vulpia octoflora (Walter) Rydb. var. glauca*	Least Concern	-	-	-	-	-	X			Native
Barren Strawberry	*Waldsteinia fragarioides (Michaux) Tratt.*	-	-	-	-	-	-	X			Native
Chinese Wisteria	*Wisteria sinensis*	-	-	-	-	-	-		X	X	
Cocklebur	*Xanthium strumarium L.*	-	-	-	-	-	-	X		X	Native/Introduced
Prickly-ash	*Zanthoxylum americanum Miller*	-	-	-	-	-	-	X			Native
White Camass	*Zigadenus elegans Pursh subsp. glaucus (Nutt.) Hulten*	-	-	-	-	-	-	X			Native

Sources of Status

IUCN Red List - "International Union for the Conservation of Nature, Red List of Threatened Species" (http://www.iucnredlist.org/)

CITES Appendix - "Convention on the International Trade in Endangered Species of Wild Flora and Fauna" (http://www.cites.org/)

US (Endangered Species Act) - "U.S. Fish and Wildlife Service, Endangered Species" (http://www.fws.gov/ENDANGERED/species/us-species.html)

New York State (Natural Heritage Program) - New York Rare Plant Status Lists, 2010, Edited by Stephen M. Young and Troy W. Weldy (http://www.dec.ny.gov/docs/fish_marine_pdf/2010rareplantstatus.pdf)

Canada (Species at Risk Act) - "Species at Risk Public Registry" (http://www.sararegistry.gc.ca/sar/index/default_e.cfm)

Ontario (Endangered Species Act) - "Species at Risk in Ontario (SARO) List" (http://www.mnr.gov.on.ca/en/Business/Species/2ColumnSubPage/MNR_SAR_CSSR_SARO_LST_EN.html)

Sources of Records

A - Oldham, M. J. (2007). Vascular plants of the Niagara River, Ontario. Draft. Report for the Niagara Parks Commission. Unpublished manuscript. (Canada Records)

B - Environmental Design & Research, Landscape Architecture, Planning, Environmental Services, Engineering and Surveying, P.C. (EDR). (2010). Ecological Inventory of the Niagara River Gorge and Rim - Draft. Report for Wild Ones: Native Plants, Natural Landscapes. (U.S. Records)

Additional Notes

Introduced species are a species living outside their native distributional range, which have arrived there by human activity, either deliberate or accidental. Identified in: Oldham, M. J. (2007). Vascular plants of the Niagara River, Ontario. Draft. Report for the Niagara Parks Commission. Unpublished manuscript.

[20]

[20] Botanicals table created as part of the Niagara River Corridor Ramsar Site nomination package, 2016.

Species Listed as Extirpated, Threatened, Endangered or of Special Concern

The U.S. Fish and Wildlife Service and NYS's Department of Environmental Conservation both identify species that are under threat of extinction as a means to combat these trends and support sustainable numbers. The official Federal designations include "Endangered Species" and "Threatened Species", but there are also species that are watched who are proposed for the lists or candidates. In these cases they're labeled "Proposed Endangered" or "Candidate". The NYSDEC designations also include those species identified by the state as Endangered and Threatened, but also list Species of Special Concern. In 2015, NYSDEC conducted a very thorough inventory of species distribution, population trends and habitat needs. Based off this extensive dataset, they developed three additional designations for species in decline.[21] These classifications are defined below:

Extinct - Species is no longer living or existing.

Extirpated - Species is not extinct, but no longer occurring in a wild state within New York, or no longer exhibiting patterns of use traditional for that species in New York (e.g. historical breeders no longer breeding here).

Endangered - Any native species in imminent danger of extirpation or extinction.

Threatened - Any native species likely to become an endangered species within the foreseeable future.

Special Concern - Any native species for which a welfare concern or risk of endangerment has been documented in New York State.

Species of Greatest Conservation Need with High Priority (SGCN*) - The status of these species is known and conservation action is needed in the next ten years. These species are experiencing a population decline, or have identified threats that may put them in jeopardy, and are in need of timely management intervention or they are likely to reach critical population levels in New York.

Species of Greatest Conservation Need (SGCN) - The status of these species is known and conservation action is needed. These species are experiencing some level of population decline, have identified threats that may put them in jeopardy, and need conservation actions to maintain stable population levels or sustain recovery.[22]

[21] All species lists have been fully updated as of June 2017 to reflect species distribution for all of the 18 sub-watersheds (seven new ones) and include SGCN/SPCN status, which has strong biological relevance for informing regional policy. Asterisks (*) indicate priority status for SGCN, both in this list and throughout species tables.
[22] http://www.dec.ny.gov/docs/wildlife_pdf/sgnc2015list.pdf

Species of Potential Conservation Need (SPCN)[23] - A species whose status is poorly known, but there is an identified threat to the species, or features of its life history that make it particularly vulnerable to threats. The species may be declining, or begin to experience declines within the next ten years, and studies are needed to determine their actual status.

Extirpated Species

The 2005 NYSDEC list for Species of Greatest Conservation Need (SGCN) included seven species that were confirmed extirpated from the Niagara River/ Lake Erie Watershed (highlighted in Table 5.3), and 31 species believed to be extirpated. Table 5.3 outlines the SGCN list and also incorporates information on those species that have been documented in the watershed from 1990-2005. However, this table warrants re-evaluation, as it may be inaccurate. For example, the extirpation of mayflies may no longer be the case.

The various species charts included in this chapter outline whether or not a species is listed as Threatened, Endangered or of Special Concern (federally or state classified). According to these species lists, there is currently only one species federally designated as Endangered and none listed as federally Threatened. State designations of Endangered and Threatened Species found in the watershed, includes 15 and 18 species, respectively. For Species of Special Concern (state designation), there are 21 species listed, 16 of which are birds. In fact, bird species hold the most designations according to these classifications, indicating they are the most threatened species type in the watershed.

[23] http://www.dec.ny.gov/docs/wildlife_pdf/spnc2015list.pdf

Table 5.3: Species that Historically Occurred in the Niagara River/Lake Erie Watershed Believed to be Extirpated

Taxa Group	Species name	Latin Name	Documented within the last 15 Years
Freshwater fish	Atlantic Salmon	Salmo salar	
Freshwater fish	Blackchin Shiner	Notropis heterodon	X
Freshwater fish	Deepwater Sculpin	Myoxocephalus thompsoni	
Freshwater fish	Lake Chubsucker	Erimyzon sucetta	X
Freshwater fish	Sauger	Stizostedion canadense	X
Freshwater fish	Shortjaw Cisco	Coregonus zenithicus	
Freshwater fish	Silver Chub	Macrhybopsis storeriana	
Freshwater fish	Spoonhead Sculpin	Cottus ricei	
Mollusk	Black Sandshell	Ligumia recta	X
Mollusk	Buffalo Pebble Snail	Gillia altilis	
Mollusk	Campeloma Spire Snail	Cincinnatia cincinnatiensis	
Mollusk	Eastern Pondmussel	Ligumia nasuta	X
Mollusk	Fawnsfoot	Truncilla donaciformis	
Mollusk	Globe Siltsnail	Birgella subglobosus	
Mollusk	Gravel Pyrg	Pyrgulopsis letsoni	
Mollusk	Lance Aplexa	Aplexa elongata	
Mollusk	Mapleleaf	Quadrula quadrula	
Mollusk	Mucket	Actinonaias ligamentina	
Mollusk	Pimpleback	Quadrula pustulosa	
Mollusk	Pocketbook	Lampsilis ovata	X
Mollusk	Salamander Mussel	Simpsonaias ambigua	
Mollusk	Snuffbox	Epioblasma triquetra	X
Mollusk	Spindle Lymnaea	Acella haldemani	
Mollusk	Watercress Snail	Fontigens nickliniana	
Mollusk	Yellow Sandshell	Lampsilis teres	
Insect	Mocha Emerald	Somatochlora linearis	
Insect	American Burying Beetle	Nicrophorus americanus	
Insect	Borer Moth		
Insect	Culvers Root Borer	Papaipema sciata	
Insect	Mayfly		
Insect	Midland Clubtail	Gomphus fraternus	
Mammal	Eastern Cougar	Felis concolor cougar	
Mammal	Gray Wolf	Canis lupus	
Mammal	Silver-haired Bat	Lasionycteris noctivagans	
Mammal	Least Shrew	Cryptotis parva	
Mammal	Least Weasel	Mustela nivalis	
Herpetofauna	Timber Rattlesnake	Crotalus horridus	
Bird	Loggerhead Shrike	Lanius ludovicianus	X

*Table adapted from the Comprehensive Wildlife Conservation Strategy for New York , Lake Erie Table 11. SGNC that historically occrured in Lake Erie Basin, but are now believed to be extirpated from the Basin.
Species documentation Resources (See Bibliography).

Invasive Species

There are hundreds of thousands of non-native plants, animals, and insects thriving within the Niagara River/Lake Erie Watershed; many of which are now considered naturalized to our climate and fit well within our ecosystem, supporting their new environment. However, there are occurrences where these non-native species become nuisances, thriving beyond a natural balance and disrupting the natural food chain and ecosystem. An unchecked nuisance species can displace native and naturalized species and their supporting role in the health of the watershed. When a species begins to cause significant harm which leads to major economic impacts, it transitions from being defined as a non-indigenous nuisance to an invasive species.[24]

The descriptions of invasive species that follow include only those that are widely recognized as invasive species within New York State and also pose the greatest threat to the Niagara River/Lake Erie Watershed. Each of the species included in this list have already been found within the watershed, or pose an immediate threat to establish within the watershed in the near future and are being monitored for detection.

1. Zebra Mussels (Mollusk)

The zebra mussel (*Dreissena polymorpha*) is a small shellfish named for the striped pattern of its shell. Native to the freshwater lakes in the Caspian Sea region of Asia, zebra mussels were transported to the Great Lakes in ballast water from a transoceanic vessel. Since they were first discovered in 1988 in Lake St. Clair they have spread to all the Great Lakes and waterways in multiple states, as well as Ontario and Quebec, and to southeast and western portions of the United States.

Zebra mussels characteristically colonize hard surfaces and rocky substrates in high densities with as many as tens of thousands of individuals living in one square yard. They have been known to attach to stone, wood, concrete, iron, steel, aluminum, plastic, fiberglass, PVC, crayfish and even other mussels. Their rapid reproduction rate, negative impacts on aquatic ecology, and limited amount of predators has led NYS to designate these mussels as an Aquatic Species of Concern.

The impact of these dreissenids appears to be beneficial to many lay people because their filter feeding behavior increases water clarity. However, their negative impacts far outweigh their water clarifying benefits. These mussels are known to smother out native mussel species and their massive population in the Great Lakes reduces the amount of phytoplankton available for other organisms, thus changing the ecological structure of the lakes. Zebra mussels are also considered to contribute to harmful algae blooms. As excessive filter feeders, the mussels dramatically reduce

[24] Based on NYS Environmental Conservation Law § 9-7105 (10).

beneficial green algae and aid *Microcystis* spp. (toxic blue-green algae), as it's the only bacterium they will not eat. Their tremendous filter feeding accumulates contaminants in their tissues at greater levels than other mussels as well, further contributing to bio-accumulation in wildlife and humans. Zebra mussels also cause tremendous economic impacts beyond those to the ecosystem. By clogging intake pipes for public drinking supplies, power plants, as well as boat engine cooling systems, the mussels are extremely costly for communities, business and industry.

2. Quagga Mussels (Mollusk)

The quagga mussel (*Dreissena bugensis*) is a small freshwater bivalve mollusk native to the Ukraine. Quagga mussels took longer than zebra mussels to establish in the Great Lakes through similar transport mechanisms in ballast water, but once founded their numbers exploded. Presently, quagga mussels make up 98% of the whole mollusk population in the Great Lakes. Quagga mussels remove substantial amounts of phytoplankton and suspended particulate from the water, reducing the food supply for zooplankton and forage fishes.

Figure 5.12: Zebra Mussel vs. Quagga Mussel

Quagga mussels out compete zebra mussels in several ways. Although quagga and zebra mussels have the same biological characteristics that allow them to establish and spread to watersheds across the United States, quagga mussels have an advantage in that they can colonize soft substrates as well as hard substrates. They are also better able to flourish in the low-food conditions that zebra mussels create, allowing them to colonize less productive waters in much greater numbers. Quagga mussels can be found everywhere zebra mussels are, but because they can also settle on soft substrate they are colonizing places like the bottom of Lake Erie, where the silty bottom provides a perfect habitat. For these reasons, it is likely quagga mussels will take over areas where zebra mussels are already established to become the dominant dreissenid in the Great Lakes. This trend is already being observed in the lower Great Lakes.[25]

[25] https://nas.er.usgs.gov/queries/FactSheet.aspx?speciesID=95

Similar to zebra mussels, quagga mussels clog intake pipes and cause damage to boats, power plants and harbors. As aggressive invaders, they too are destroying native mussel populations. Quagga mussels are also extremely effective in filter feeders. During their filtering process, pollutants are rejected, or spit out, leading to higher concentrations of pollutants in lake-bottom sediments. Unfortunately, quagga mussels also avoid filtering out toxic blue-green alga *Microcystis*, which provides this alga with fewer competitors for nutrients and supports their return as toxic algal blooms.

3. Round Goby (Fish)

The round goby (*Neogobius melanostomus*) is a non-native fish originating from central Eurasia. They were first detected in the St. Clair River in 1990 after being introduced via ballast water of transoceanic vessels. A rapid range expansion of the round goby has occurred throughout the Great Lakes since its initial introduction. Currently the round goby is considered established in several locations of the Niagara River/ Lake Erie Watershed.

This small fish has several traits which have allowed the populations to grow, including aggressive behavior, avid feeding behavior, and ability to feed in complete darkness. They can survive in degraded water conditions, spawn more frequently over a longer period than most native fish, reproduce rapidly, and guard their nests from predators.

Figure 5.13: Round Goby Fish (USGS)

As an aggressive competitor for food and habitat, especially spawning sites, the round goby is linked to declines in native fish populations (i.e. mottled sculpin, logperch, and darters). Round goby also feed on the eggs and fry of lake trout, posing environmental and ecological threats to these native fish populations. Although round goby usually prefer near shore habitats of rock, sand, cobble, gravel and submerged aquatic vegetation, they have been found invading offshore reefs where they are prey for sport fish like burbot, lake trout, and lake whitefish (Figure 5.5). This poses a health risk to both sport fish and humans, because gobies ingest toxic substances through the consumption of large quantities of zebra and quagga mussels. Additionally, round gobies have been identified as a potential vector for viral hemorrhagic septicemia virus (VHSV), which has decimated native fish populations of muskellunge, smallmouth bass, freshwater drum among others.

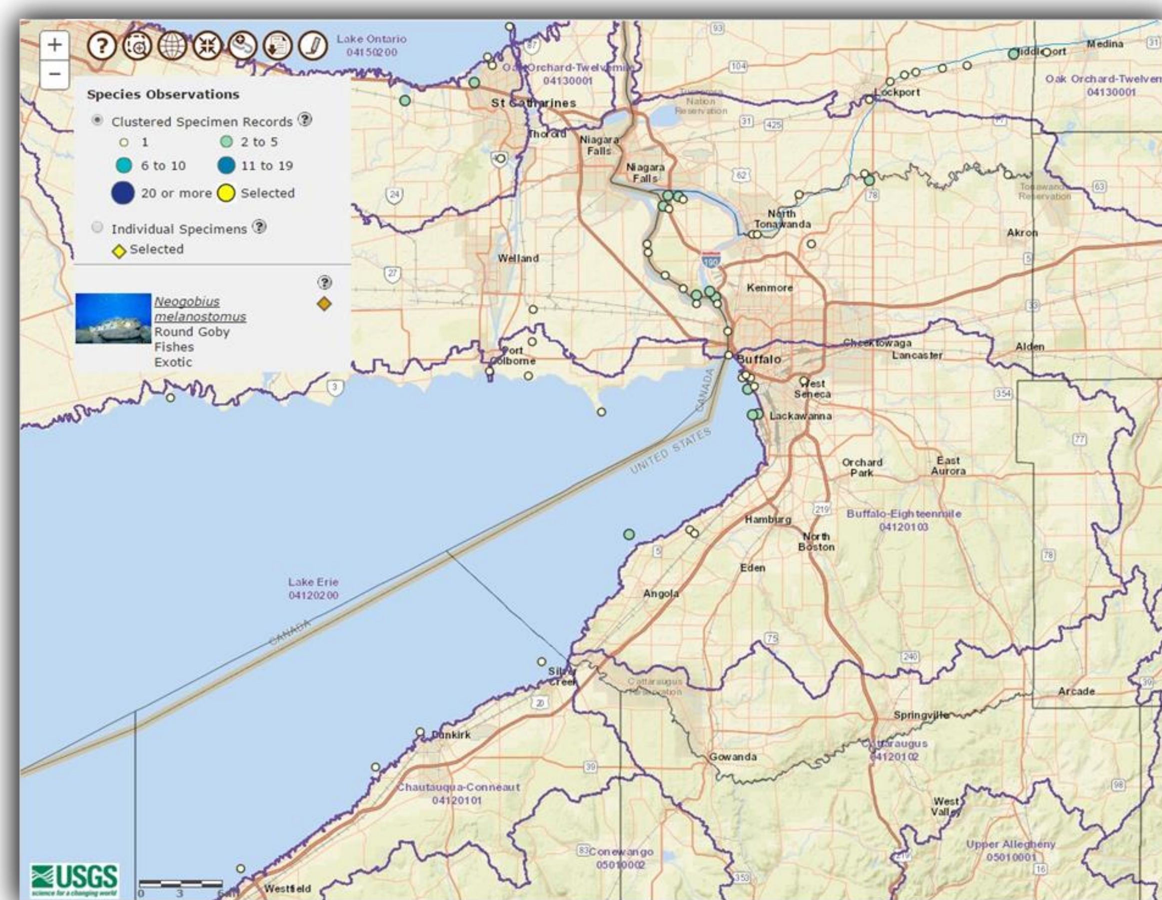


Figure 5.14: Round Goby Sightings in the Niagara River/Lake Erie Watershed
Source: (USGS Interactive Online Point Mapping)

4. Rudd (Fish)

Rudd (*Scardinius erythrophthalmus)* are an invasive fish species in the minnow family, although they reach lengths larger than what is typically considered a minnow in their adult stage, about 15 inches in length. Ruddpresence has been a combination of intentional and accidental introduction. Historically, in the late 1800s, they were likely brought to North America because they were a prized fish in Europe. More recently, in the 1980s, they were intentionally bred in bait shops and sold. Currently, their release as a bait fish is likely accidental and due to mislabeling. Rudd bears an extremely close resemblance to a native minnow species, the golden shiner. To the untrained eye, these fishes are indistinguishable, especially when they are only a few inches in length. The widespread distribution of rudd is yet another reason why the dumping of baitfish poses serious threats to watersheds. Currently they are established in the Niagara River/Lake Erie Watershed.

Figure 5.15: Rudd vs. Golden Shiner

This invasive fish can lead to several problems in its non-native range. First, it is an omnivorous fish which consumes both insects and plants. This flexible diet makes it unlikely for the fish to become food-limited throughout the year, and gives it a competitive advantage over fish which are strictly herbivorous or carnivorous. Their preferred plant source is submerged macrophytes and they avoid nuisance plants such as algae. They are capable of depleting native vegetation, decrease water quality conditions in plant beds, both directly through uprooting and sediment disturbance, and indirectly through excretion of partially digested plant matter. Also, rudd are capable of hybridizing with the golden shiner.

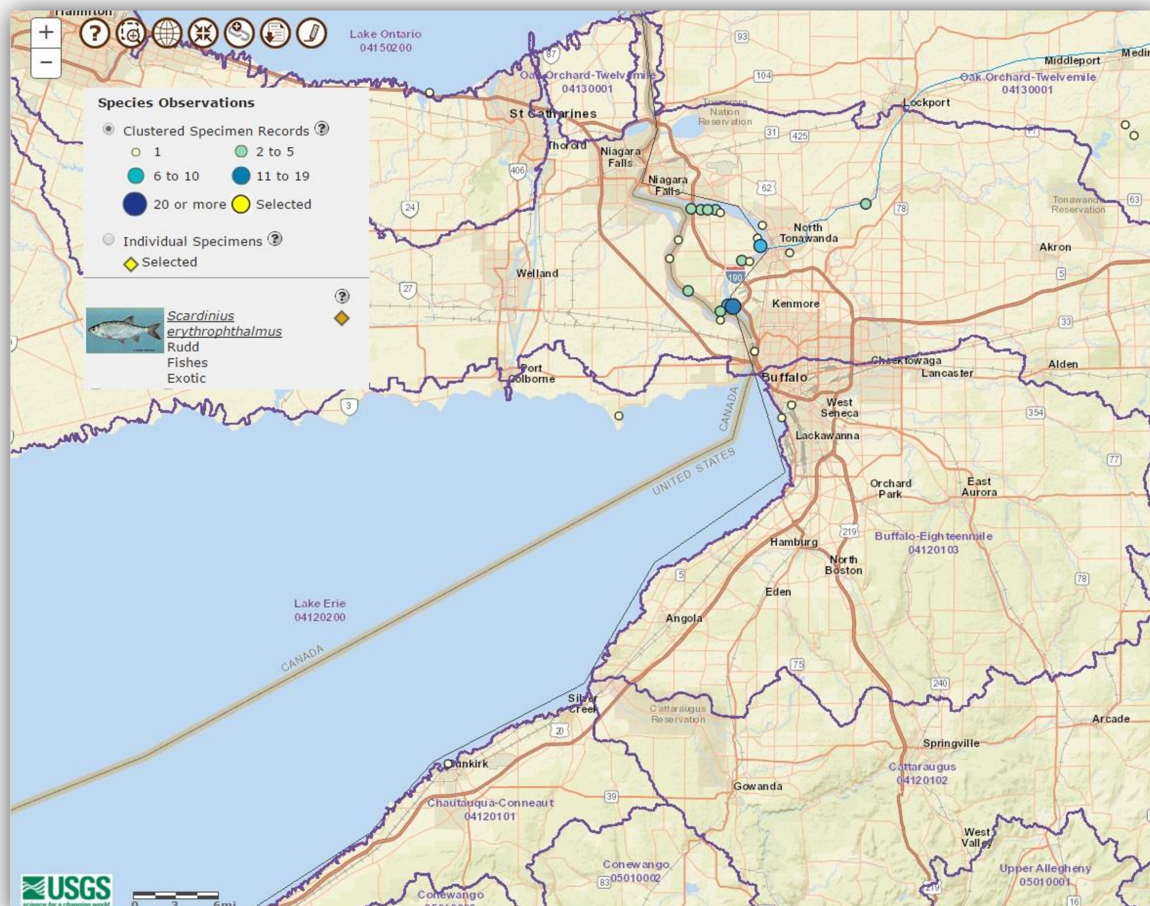


Figure 5.16: Rudd Sightings in the Niagara River/Lake Erie Watershed

This has potential to deplete the genetic integrity of golden shiners, and could disrupt the reproductive fitness and spawning behaviors.

A promising field of study is contaminant levels in rudd, which tend to be lower than other sportfish such as freshwater drum and bass, because of their herbivorous diet.[26] There is potential for a rudd fishery in the Niagara River, because they are a relatively clean source of fish protein. This would benefit both the aquatic ecosystem and humans.

5. Asian Carp (Fish)

Black, bighead, grass, and silver carp are the four species of Asian carp that were purposely introduced to ponds in Arkansas to control weeds (Figure 5.7). Since their escape, significant ecological and economic impacts have been documented in the Mississippi River system. Although they are not currently in the Great Lakes basin, these species are an imminent threat and are migrating toward Lake Michigan through the Illinois River and the Chicago Sanitary and Ship Canal. Recent discovery of the carp's environmental DNA sparked controversy regarding their status in Lake Erie. Some suspect that their populations could start growing to a notable number in the next few years.

The Asian carp diet overlaps with several native species, making them strong ecological competitors with the potential to displace and consume native populations of fishes, plants, mollusks, and other invertebrates. Rapid growth, nonselective feeding, consumption of vast quantities of food, prolific reproduction, and climate tolerance are all characteristics that will allow Asian carp to outcompete native species and potentially devastate the Great Lakes ecosystem.

Figure 5.17 Asian Carp Species

Source: Tip of the Mitt Watershed Council

[26] Kapucinsky, K.L., Farrell, J.M., Paterson, G., Wilkinson, M.A., Skinner, L.C., Richter, W., & A.J. Gudlewski. 2014. Low concentrations of contaminants in an invasive cyprinid, the rudd, in a Great Lakes Area of Concern. Bulletin of Environmental Contamination and Toxicology. 93:567–573.

Presently the Army Corp of Engineers is employing various tools to prevent Asian Carp species from entering the Great Lakes, including an electrical dispersal barrier system in the Chicago Sanitary and Ship Canal. However, in the event of a power outage, this would not be an effective barrier. There is also some preliminary research being conducted by the Corps on the efficacy of the electric barrier on juvenile fish, which are not shocked as easily as fish ≥100 mm, particularly when barges are moving through the barrier and affecting stream flow dynamics. Additionally, there are other pathways connecting the Mississippi river basin with the Great Lakes watershed. For example, in the event of a flood Asian carp could potentially make their way into the Great Lakes basin, in the same manner they escaped from Arkansas ponds.

6. Eurasian Ruffe (Fish)

Eurasian ruffe (*Gymnocephalus cernua*) are a small spiny perch capable of explosive population growth. Although they have been present in the upper Great Lakes since the 1980s, they have not yet established in Lake Erie. They were introduced to Lake Superior through the ballast water of a transoceanic vessel and have since spread throughout the southwestern and northern regions of Lake Superior, and in Lake Huron at the mouth of Thunder Bay River.

Figure 5.18: Ruffe (Wikipedia)

Ruffe are competitors with native fish for food and habitat. They outcompete other species in newly invaded areas due to their high reproductive rate (females can lay between 45,000 and 90,000 eggs per year) and feeding efficiency across a wide range of environmental conditions. Like many invasive species, they may not be recognized as prey in their newly invaded habitats, and their physical spines throughout their body may discourage potential predators. While ruffe are not currently in either the Niagara River or Lake Erie, GARP[27] modeling predicts ruffe will find suitable habitat almost everywhere in all five Great Lakes, and are considered a potential threat to Lake Erie.

[27] Genetic Algorithm for Rule-set Production (GARP) is a type of power of prediction analysis.

7. Spiny Waterflea (Crustacean)

The spiny water flea (*Bythotrephes longimanus*) is a small carnivorous crustacean with a long, barbed spiny tail native to the Caspian Sea. This zooplankton was first found in Lake Huron in 1984. Spiny water fleas have been found in all five great lakes, as well as inland rivers and creeks. They are a nuisance to anglers because gear can get tangled in large masses of *Bythotrephes,* forming a gelatinous intertwined mess that is difficult to remove.

Although they themselves are zooplankton, spiny water fleas compete directly with other native planktivorous fishes for smaller zooplankton, such as *Daphnia* spp. Spiny water fleas are capable of booming in populations under the right conditions, and their selective predation and depletion of *Daphnia* can disrupt the food web in nursery habitats for larval fish. They can also cause a change in behavior of *Daphnia* which are trying to escape predation. Many fish such as perch, shiners and walleye, consume spiny water fleas as juveniles and adults. However, most fish in their larval stage cannot eat spiny water fleas because of their large spine. *Bythotrephes* and *Daphnia* can reproduce both sexually and asexually a very complex reproductive strategy called parthenogenesis), and have an entirely female population.[28]

8. Hemlock Wooly Adelgid (Insect)

Hemlock wooly adelgid (*Adelges tsugae*), or HWA, is an invasive aphid originally from Asia. It was first found in the US in 1951, but has since spread northward, currently predicted to be dispersing at rates of 20-30 km/year. Just like *Bythotrephes* and *Daphnia*, it can reproduce both sexually and asexually, and has an entirely female population. In its introduced range, they are unable to complete the sexual reproduction phase, and produce two generations a year. Unlike most insects, they are dormant in summer months rather than winter. HWA encapsulates itself in a protective wooly substance and are generally less than one mm in length. They suck the plant tissue from the needles of hemlock, and the tree almost always dies within four to five years of infestation. Foresters are in the trial stages of using biological control methods, a beetle from HWA's native range, as a means of control. Pesticides and/or dormant oil can also be used to suppress infestations.[29]

HWA is a particularly troubling invasive species, because many of the ecoregion zones in the Niagara River/Lake Erie Watershed are comprised of Eastern hemlock forests. Once lost, it would take many decades to replace the climax forests. Furthermore, during that time period, large sections of streams would lose their shade cover; water temperatures will warm and certain streams may lose important coldwater fish such as brook trout. The loss of shaded understory will affect many other animals and plants adapted to those conditions. This widespread loss of mature

[28]. https://nas.er.usgs.gov/queries/factsheet.aspx?SpeciesID=162
[29] http://www.dec.ny.gov/docs/lands_forests_pdf/hwafactsheet.pdf

trees will also alter carbon cycling, because it takes many years to sequester the amount of carbon stored in climax forests, reducing regional climate resiliency.[30]

9. Emerald Ash Borer (Insect)

The emerald ash borer (*Agrilus planipennis*) is an exotic beetle native to Asia. It was first discovered in southeastern Michigan in 2002 and most likely arrived in the United States on wood packing material transported from Asia. The emerald ash borer is threatening native North American Ash trees, which currently make up around 20% of the watershed's tree population.[31] While adult beetles eat ash foliage and only cause minimal damage, the real harm comes from larvae that tunnel under bark and disrupts the tree's systems that transport food and water, eventually starving the tree and killing it.

Figure 5.19: Emerald Ash Borer (Trees Atlanta)

The NYSDEC has found emerald ash borers in all counties of the Niagara River/Lake Erie Watershed as of May 2017.[32] The entire watershed is currently quarantined.

Invasive Plant Species

The NYSDEC has identified over 60 Invasive Plant Species in the New York State Prohibited and Regulated Invasive Plants List.[33] The following are those species that pose the most significant threat to the health of the Niagara River/Lake Erie Watershed.

10. Eurasian Water-milfoil (Aquatic Plant)

Eurasian watermilfoil (*Myriophyllum spicatum*) is a submersed rooted aquatic weed native to Eurasia. It was introduced accidentally in the 1940's and has spread through the United States by boats and waterbirds. Eurasian water-milfoil forms thick, underwater strands of tangled stems and vast mats of vegetation at the water's surface which interferes with recreational activities such as boating, swimming, and fishing. The floating canopy also crowds out native plants.

[30] https://www.na.fs.fed.us/spfo/pubs/pest_al/hemlock/hwa05.htm
[31] https://www.wgrz.com/article/sports/outdoors/death-knell-for-ash-trees/71-587539056
[32] http://www.dec.ny.gov/docs/lands_forests_pdf/eabquarmaps.pdf
[33] September 10, 2014

Figure 5.20: Eurasian Milfoil Infestation

It can reproduce through stem fragmentation and underground runners, which means a single segment of stem and leaves can take root and form a new colony (i.e. fragments clinging to boats and trailers can spread from lake to lake). Clearing weed beds for beaches, docks, landings, etc. creates thousands of new stem fragments and therefore thousands of possibilities for new colonies to form. Fortunately, water-milfoil has difficulty becoming established in lakes with healthy populations of native plants. In some lakes water-milfoil appears to coexist with native flora and has little impact on fish and other aquatic animals.

Currently, water-milfoil is mostly found within the northern portions of the Niagara River/ Lake Erie Watershed, in the northern and southern locations of Attica Reservoir/Crow Creek. There have been much fewer milfoil observations (<5) in Cattaraugus, Chautauqua-Conneaut, and Buffalo-Eighteenmile sub-basins, although the adjacent Chautauqua Lake sub-basin has considerably more water-milfoil observations, which pose a threat to spreading into the Niagara River/Lake Erie Watershed.[34]

11. Curly Leaf Pondweed (Aquatic Plant)

Curly-leaf pondweed (*Potamogeton crispus*) is a submersed aquatic plant which grows in 3-10 feet of water and has a heavy presence in the Niagara River/ Lake Erie Watershed. Curly-leaf pondweed forms dense mats that interfere with water activities and displaces native plants. It is able to re-establish a colony from any remaining roots after being removed from an area. When curly-leaf dies in large numbers during mid-summer, rafts of dying plants pile up along shorelines and are often followed by an increase in phosphorus and harmful algal blooms.

Figure 5.21: Curly Leaf Pondweed

[34] http://login.imapinvasives.org/nyimi/map/#

12. Frogbit (Aquatic Plant)

Frogbit (*Hydrocharis morsus-ranae)* is a small, floating plant resembling a water lily. Native to Europe and parts of Asia, frogbit was introduced to Canada in the 1930's. They have since spread to Eastern Canada and the Northeastern US, particularly around the Great Lakes. Frogbit is fast growing, and interestingly it spreads rapidly by horizontal stems, called stolons, instead of through roots. In winter, it creates dormant buds called turionds, which rest on the bottom then rise again to the surface in the spring. Frogbit colonizes waterways and forms dense masses of vegetation on the surface, threatening biodiversity. In its native areas, this plant is rarely dominant. Once this plant establishes a population, it spreads very quickly. It first appears at boat launches and reservoirs, and should be treated as soon as it is confirmed. Currently, frogbit is absent from Buffalo-Eighteenmile, Cattaraugus, and Chautauqua-Conneaut sub-basins, although there have been a handful of isolated reports of it in the Niagara sub-basin (WNY PRISM iMap Database, accessed spring 2017). Andrea Locke (WNY PRISM: Great Lakes Center) predicts frogbit will further spread in the Niagara River/Lake Erie Watershed, because of its highly invasive nature.

13. Water Chestnut (Plant)

Water chestnut (*Trapa natans*) is an invasive plant found in freshwater lakes and ponds, and slow-moving streams and rivers. It was introduced to New York State in the 1800's and is a major nuisance for the state. In the Niagara River/Lake Erie Watershed, water chestnut has been found in Tonawanda Creek/Erie Canal where removal activities (hand pulling) take place every few years. It has also been found in Chautauqua and Cattaraugus counties in adjacent watersheds, which poses a danger to the southern portions of the Watershed.

Figure 5.22: Water Chestnut pull event in Tonawanda Creek

Water chestnut is an annual and dies back at the end of each growing season. However, its seeds, which sink down into waterway sediments can live for up to 12 years. Each plant produces approximately 20 seeds annually. Seeds are primarily distributed through moving waters and water fowl. Hand pulling, herbicides, and mechanical harvesters are an effective tool to address water chestnut, but removal strategies need to be employed for over 10 years to ensure eradication.

Infestations of water chestnut form impenetrable floating mats of vegetation, creating hazards for boaters and other water recreation. The density of the mats can severely limit light penetration into the water and reduce or eliminate the growth of native aquatic vegetation. Upon seasonal die-off water chestnut also reduces levels of oxygen in the water, possibly contributing to fish kills. Because of its invasiveness and the severity of its impacts, the species has been listed under the federal regulations that prohibit the interstate sale and transport of noxious plants.[35]

14. Hydrilla (Plant)

Water thyme (*Hydrilla verticillata*, hereafter *Hydrilla)* is considered one of the worst aquatic invasive species in the world. To achieve such notoriety, *Hydrilla* has several features that make it difficult to eradicate. *Hydrilla* grows quickly, sometimes up to an inch a day and can regenerate new plants from broken off fragments, which makes it very easy to spread. The plant survives winter with its tubers and prefers deeper darker locations than other aquatic plants growing 20-30ft long stems. This allows it to establish and then spread along the surface waters, eventually overshadowing shallower waters with its aggressive growth. Similar to water chestnut, *Hydrilla* grows at such a density that it blocks out sunlight and outcompetes all other native plant species. The very thick mats of plant matter eventually settle to the bottom and decompose which can severely reduce dissolved oxygen and suffocate macroinvertebrates on the sediment. In some cases infrastructure has been affected, such as water intakes and power generation facilities.

First established in Florida in the 1950's the plant has spread considerably across the southern US and been found in a select few locations in New York State. The plant prefers freshwater lakes, ponds, rivers, impoundments, and canals. *Hydrilla* was first documented in 2012 in the Niagara River/ Lake Erie Watershed, specifically the Erie Canal section of Tonawanda Creek. The U.S. Army Corp of Engineers and other project partners undertook aggressive action and targeted the invasive species in a demonstration project from 2014-2018 by applying the herbicides endothall (Aquathol K™) and chelated copper (Komeen Crystal™) during the summer months. *Hydrilla* is still present in the canal and continued monitoring and maintenance treatment will be needed.[36]

[35] O'Neill, Jr., Charles R. Feb 2006. Water Chestnut (*Trapa natans*) in the Northeast, NYSG Invasive Species Factsheet Series 06-1

[36] http://hydrillacollaborative.com/Content/Files/Final%20TC%202018%20Post-Treatment%20Assessment%20Report%20(REDUCED).pdf

15. Mugwort (Plant)

Mugwort (*Artemisia vulgaris*) is an aromatic plant native to Eurasia. Like most of the other invasive plant species discussed in this section, mugwort develops into thick stands that can spread quickly, thus outcompeting native species for resources. It is also considered allelopathic, meaning it releases biochemicals that inhibit the growth, germination, or reproduction of other plants nearby. They are currently present in Monroe, Erie, and Cattaraugus counties within Western New York. Ecologist David Spiering (Buffalo Museum of Science) contests that mugwort is the most common non-grass herbaceous species found in post-industrial sites in Erie County and likely inhibiting the succession of these sites to forested communities.

16. Japanese Knotweed (Plant)

Native to eastern Asia, Japanese knotweed (*Fallopia japonica*) was introduced to the US as an ornamental plant in the late 1800's and has since been planted for erosion control and landscape screening. They can be found across the United States, but are most prevalent on the east coast.

Figure 5.23: Young Japanese Knotweed

Japanese knotweed pushes out native plant species with the formation of thick, dense colonies, reducing diversity and impacting wildlife habitat. Japanese knotweed is also considered to be allelopathic. It poses significant threat to riparian lands where it can survive flooding events and rapidly colonize scoured shores and islands. Its established populations are persistent, able to resist cutting by vigorously re-sprouting by the roots. The invasive root system and strong growth can damage concrete foundations, buildings, flood defenses, toads, paving, retaining walls and architectural sites. This plant spreads through its rhizomes, meaning fragments can be easily dispersed by moving soil or being transported downstream during storm events to form new colonies.

Unfortunately, Japanese knotweed is highly prevalent in the Niagara River/Lake Erie Watershed and efforts to remove its colonies have proven difficult for non-professionals. There are no estimates on how much land is inhabited by Japanese Knotweed at this time, though it does appear to be extremely widespread. It mostly inhabits roadside ditches, recently disturbed soil, and riparian lands.

17. Non-Native Cattails (Plant)

There are two species of non-native cattails in North America, *Typha angustifolia* and *Typha glauca.* They were introduced with European settlers around 1920 and occur in aquatic wetland areas. Although both species can be found, *T. angustifolia* is more prevalent in the Niagara River/ Lake Erie watershed. Additionally, a hybrid of the two species has been confirmed in the watershed.[37]

T. angustifolia invades and displaces native wetland and emergent species by forming dense, monospecific stands that cause the loss of biodiversity in wetlands. They additionally clog drainageways (stormwater infrastructure). Non-native and hybrid cattail pose a potential threat to the ecosystem. Wetlands taken over by these varieties have less biodiversity and lower habitat and wildlife value.

Figure 5.24: Flowering Giant Hogweed (NYSDEC)

18. Giant Hogweed (Plant)

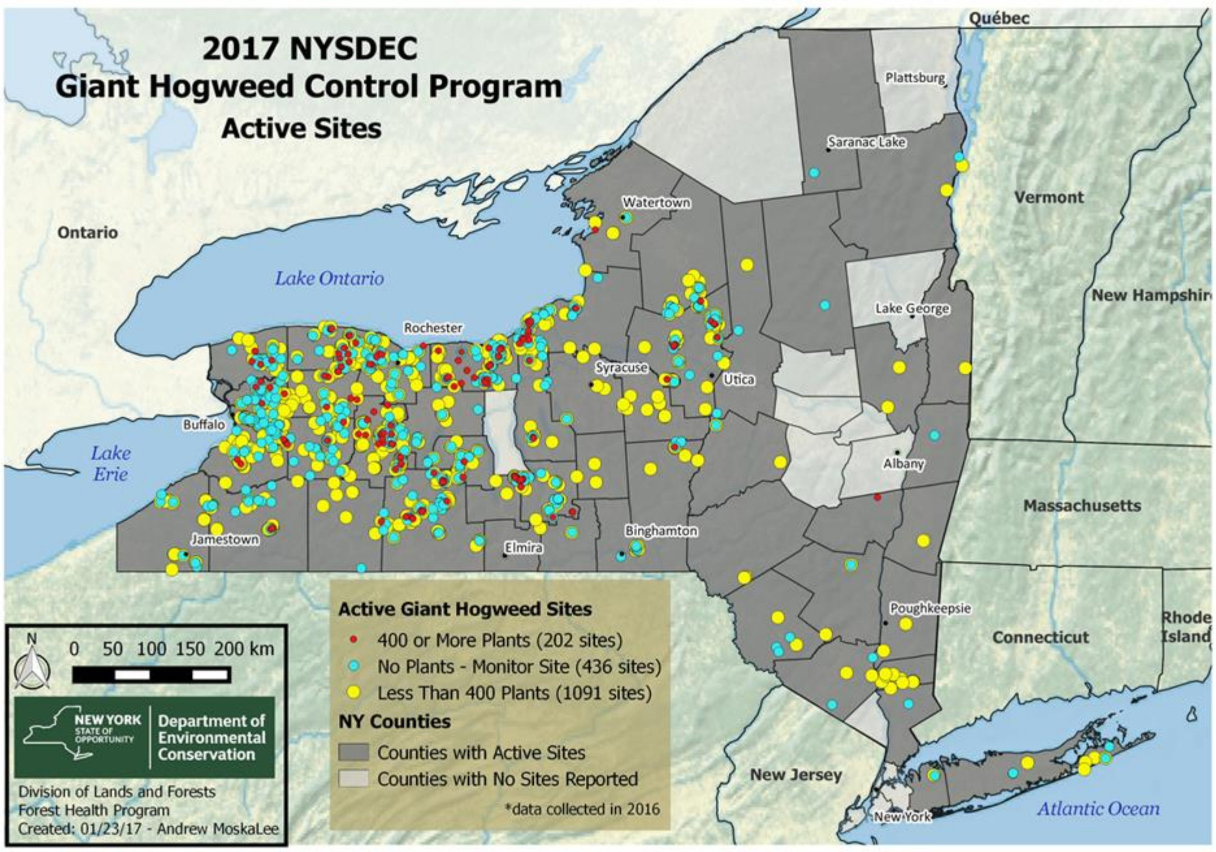
Giant hogweed (*Heracleum mantegazzianum*) is a federally listed noxious weed due to its toxic sap, which in combination with moisture and light can cause severe skin and eye irritation, painful blistering, permanent scarring and blindness.[38] Giant hogweed is native to the Caucasus Mountain region between the Black and Caspian seas and was brought to the US as an ornamental garden plant around 1917.

Tremendous, tight growth patterns, large leaf area, and prolific seed production are all characteristics which allow giant hogweed to outcompete and replace native vegetation. It prefers rich soils in disturbed areas and now grows along streams and rivers and in fields, forest, yards and roadsides. The plant's toxicity creates bare soils beneath them, contributing to shoreline soil erosion through the loss of riparian plants along slopes and stream banks.

[37] https://www.invasive.org/browse/subinfo.cfm?sub=12262
[38] http://www.dec.ny.gov/animals/39809.html

Giant hogweed is quite prolific in Western New York and the Niagara River/Lake Erie Watershed (Figure 5.25).

Figure 5.25: Giant Hogweed in New York State 2017 (NYSDEC)



19. Common Reed (Plant)

The common reed (*Phragmites australis*), also known as *Phragmites*, was introduced to North America by ballast water in the early 1800s. It has since spread to almost every state with the exception of Alaska and Hawaii. An extremely versatile plant, the common reed occurs in disturbed to pristine wet areas including tidal and non-tidal wetlands, brackish and freshwater marshes, riverbanks, shores of lakes and ponds and roadsides and ditches. Disturbances by boat or fish facilitate the spread of this invasive species.

Phragmites forms dense, monotypic stands that consume available growing space, pushing out native species. *Phragmites* is also considered to be allelopathic. Dense beds of *Phragmites* reduce and degrade wetland wildlife habitat, alter wetland hydrology, and increase the potential for fire. Common reed can be found throughout the Niagara River/ Lake Erie Watershed. Because of its prevalence, *Phragmites* is one of the biggest threats to native communities and water quality in wetland ecosystems.

20. Purple Loostrife (Plant)

Purple loosestrife (*Lythrum salicaria*) is a wetland plant from Europe and Asia. It was introduced and distributed as an ornamental plant, and soon began growing wild along roads, canals and drainage ditches. Like most invasive plants, purple loosestrife thrives on disturbed, moist soils and often invades after some construction activity. Wetland birds carry seeds from gardens and nurseries into wetlands, lakes, and rivers. Once in aquatic systems, moving water and animals easily spread seeds. According to the Ecological Inventory of the Niagara River Gorge and Rim (2010)[39] and New York State Invasive Species Information (2015),[40] Purple loosestrife is already present in the Watershed.

Figure 5.26: Purple Loosestrife colony (Wikimedia)

Purple loosestrife forms dense, impenetrable stands that are unsuitable as cover, food, or nesting sites for a wide range of native wetland animals, thus putting many rare and endangered animals at risk. This species is incredibly resilient to removal. A lack of effective predators has contributed to purple loosestrife's expansion across North America. As a result, several European insects that only attack purple loosestrife are being considered as a possible long-term biological control in North America.

Watershed Ecological Conditions

The *Niagara River Habitat Conservation Strategy* was completed by Buffalo Niagara Riverkeeper in the northern portion of the Niagara River/Lake Erie Watershed for 11 of the 18 sub-watersheds in 2014. The Strategy focuses on the Niagara River Watershed's biological and ecological function with the aim to reset the region's environmental health trajectory away from "poor" and towards "good". Watershed and sub-watershed level habitat-based assessments from the Strategy have been incorporated here, as well as the primary findings, while the "best-bet" conservation opportunities

[39] http://niagara.nypa.gov/RelicensingGreenwayFunds/EcologicalGreenway/NGR_AppendixB.pdf
[40] http://nyis.info/invasive_species/purple-loosestrife/

and action strategies have been incorporated into the overall sub-watershed priorities found in Chapter 8.

One component of the Strategy was to utilize a model called the Active River Area (ARA). Nature Conservancy describes the ARA as: "a conservation framework that provides a conceptual and spatially explicit basis for the assessment, protection, management, and restoration of freshwater and riparian ecosystems. The ARA framework is based upon dominant processes and disturbance regimes to identify areas within which important physical and ecological processes of the river or stream occur. The framework identifies five key subcomponents of the active river area: 1) material contribution zones, 2) meander belts, 3) riparian wetlands, 4) floodplains, and 5) terraces. These areas are defined by the major physical and ecological processes associated and explained in the context of the continuum from the upper, mid and lower watershed in the ARA framework paper. The framework provides a spatially explicit manner for accommodating the natural ranges of variability to system hydrology, sediment transport, processing and transport of organic materials, and key biotic interactions."[41]

Niagara River Watershed Assessment

The Strategy conducted a viability assessment on the Niagara River Watershed based on biodiversity features, such as open water aquatic habitat; wetlands; woodlands; grasslands; and natural areas; as well as selected indicators of these features, such as Biological Assessment Profiles; wetland classification and protections; riparian forest tracts; and contiguous natural areas in excess 150 acres.[42]The evaluations and rankings used in the report reflect The Nature Conservancy's Conservation Action Planning (CAP) model and findings from current research on watershed and ecological health. Key terms and the ranking scale of the viability assessment are provided below:

Assessing Viability of Biodiversity Features

Key Terms:

- **Size:** Abundance of a biodiversity feature or of a species population size.
- **Condition:** Measures of biological composition, structure and biotic integrity. For example, presence of representative or historic native communities or at-risk species.
- **Landscape context:** The environmental and ecological processes that maintain a biodiversity feature and keep it functional. For example, connectivity between natural areas keeps them functional as wildlife corridors.

[41] https://www.conservationgateway.org/ConservationByGeography/NorthAmerica/UnitedStates/edc/Documents/ED_freshwater_ARA_NE2008.pdf

[42] This is not a comprehensive list of all of the indicators. See the Niagara River Habitat Strategy report for more detailed information. https://bnwaterkeeper.org/projects/habitat/habitat/habitatstrategy/

Ranking Scale:

- **VERY GOOD** - Ecologically desirable status; requires little intervention for maintenance.
- **GOOD** - Indicator within acceptable range of variation; some intervention required for maintenance.
- **FAIR** - Outside acceptable range of variation; requires human intervention.
- **POOR** - Restoration increasingly difficult; may result in extirpation of target.

Niagara River Watershed Baseline Data	
Total size:	903,305 acres
Total waterways:	3,193 miles
Active River Area:	413,541 acres
ARA Wetlands:	52,979 acres or 12.8%
ARA Woodlands:	115,503 acres or 28.2%
ARA Grass/Shrublands:	10,253 acres or 2.5%
ARA and continuous Natural Areas:	349,664 acres or 60% of study area (580,167 acres)
ARA and continuous tracts >150 acres:	291,622 acres or 83%

The following summary offers an overall assessment of health or viability of each biodiversity feature within the Niagara River Watershed. See Table 2.1.

Open Water Aquatic Habitat: POOR - GOOD

- Benthic community health: (2010 RIBS sampling av. plus NHP-TNC Predicted BAP scores) Map 2.2
- Percent of impervious land cover: Map 2.3
- Bed and bank assessments (by sub-watershed only)
- Barriers to migratory fish movement (by sub-watershed only, see Section 4.4)
- Presence of listed plant and animal species
- Nested features: Populations of lake sturgeon, native trout, listed mussel species are stable to increasing

Wetlands: FAIR

- Percent of NYSDEC-regulated compared to total NYSDEC and NWI mapped wetlands: Map 2.4
- Presence of Class 1 wetlands
- Population of listed marsh birds are stable to increasing

Woodlands: FAIR - GOOD

- Acreage (percent) of woodlands in the ARA: Map 2.5
- Number of core forests in unbroken blocks, >500 acres, and >100m from roads
- Amount of functional riparian forest habitat >50 acres and >100m width from stream edge
- Population of listed forest birds are stable to increasing

Grass/Shrublands: POOR

- Percent of acreages in tracts >10 acres: Map 2.6

- Population of listed grassland birds are stable to increasing

Natural Areas in and continuous with the ARA: FAIR

- Percent of ARA and continuous study area
- Number of tracts >150 acres: Map 2.7
- Amount/percent of semi-protected natural area
- Presence of listed bird species requiring large mixed natural areas are stable to increasing

Niagara River Habitat Conservation Strategy Table 2.1 Niagara River Watershed

- **Bold** = Current condition
- Listed plant and animal species are identified in technical report
- For unranked indicators, see sub-watershed descriptions

FEATURE	ATTRIBUTE	INDICATOR	POOR	FAIR	GOOD	V. GOOD	OTHER
Open Water Aquatic Habitat	Condition	Actual & predicted BAP scores (by % of stream)	0-2.5	2.5-5.0 **5%**	5.0-7.5 **90%**	7.5-10 **5%**	
	Condition	% impervious surface	>20%	10-20%	5-10% **9%**	<5%	
	Condition	Bed/ bank assessments (HMA/SVAP scores)	<60	60-69	70-79	>80	By sub-watershed only
	Landscape Context	Known barriers to migratory fish species					By sub-watershed only
	Listed mussel species	Populations are stable to increasing	X				Of 27 species 17 are believed to be regionally extirpated
	Native trout	Populations are stable to increasing		X			Stable
	Lake sturgeon	Populations are stable to increasing			X		Increasing
Wetlands	Condition	NYSDEC compared to total mapped (NYSDEC, NWI)	<25%	25-37% **33%**	38-50%	>50%	33%
	Condition	Number of Class 1 wetlands					59
	Listed bird species	Populations are stable to increasing	X				Of 8 listed species 5 are decreasing
Woodlands	Condition	Riparian forest tracts: >50 acres & >100m wide, spanning a waterway					354 tracts
	Condition	Core forest: unbroken blocks >500 acres and >100m from a road					110 tracts
	Listed bird species	Populations are stable to increasing		X			Of 13 listed species 3 are decreasing
Grass/ Shrubland	Condition	% of acres in tracts >10 acres	11%				11%
	Listed bird species	Populations are stable to increasing	X				Of 12 listed species 7 are decreasing

FEATURE	ATTRIBUTE	INDICATOR	POOR	FAIR	GOOD	V. GOOD	OTHER
Natural Areas	Size	% of study area (ARA and continuous) with natural cover		<60%	>60% **60%**		349,664a or 60%
	Condition	% of above that is semi-protected	<25%	<50% **27%**	>50%	>75%	27%
		# of tracts >150 acres					324
	Listed bird species	Populations are stable to increasing	X				Of 15 listed species 10 are decreasing

Threats Identification

According to the Strategy, identification of critical threats is an important step in the CAP process that helps to address the factors that most affect the future viability of biodiversity features. The CAP process generally ranks threats in terms of scope, severity, and irreversibility. Those threats that receive the highest ranks are referred to as critical threats and are factored into conservation strategy priorities.

From the Strategy process, a preliminary list of threats was developed from local, regional and Great Lakes studies, and from State assessments like the Natural Heritage Program and the Comprehensive Wildlife Conservation Strategy. The Strategy's list was fine-tuned through public workshops and meetings with local experts, resulting in the top threats for each biodiversity feature within each sub-watershed, which were then evaluated in terms of mitigation feasibility. The results of this threat-identification process are outlined below.

Critical Threats in the Niagara River Watershed

Top-ranked threats to **aquatic habitat** across all sub-watersheds are runoff, erosion and lack of riparian buffers. Runoff from farms, roads and development contribute to eroding stream banks, and increase siltation and pollutant loads—especially where natural vegetated buffers are not present to stabilize banks and filter the runoff.

For **wetlands**, invasive species are a major threat, with roadside management considered a major component, including soil disturbance, spreading of seeds and propagules, and ditching.

For **all terrestrial features**, especially woodlands and wetlands, top-ranked threats are lack of long-term protection and fragmentation from roads, utility corridors and railroad Right of Ways (ROWs).

In the major **upland sub-watersheds** where most large publicly-owned forests and parks are found, lack of ecological management plans is a top-ranked threat.

For **grasslands/shrublands**, loss of acreage and mowing regimes on farm fields and on public lands are ranked highest for their impacts on grassland breeding birds.

Climate change is a threat with widespread scope and severity that is already observable in the watershed. Climate change affects natural cycles including fish spawning and migration, increased damages to property and ecosystems related to more severe storms and temperature changes, and increasing numbers of invasive plant and animal species as their ranges shift northward. Many of the indicators chosen for habitat viability—such as the minimum size for core forests or riparian forest tracts—are directly related to climate change scenarios for the region.

Niagara River Watershed Conservation Objectives

The viability and critical threats analyses of the Niagara River Habitat Conversation Strategy led to an initial identification of conservation objectives for the eleven sub-watersheds within the Niagara River Watershed.

Conservation Objectives

Aquatic habitat:

- Increase stream buffers, especially where connectivity to active floodplains, riparian wetlands or other habitats is enhanced, or where problems with runoff and/or erosion are known to exist.
- Reduce impervious surface—especially in sub-watersheds where impervious surface is >25%.
- Protect and replicate high quality stream segments.
- Reduce stream barriers in areas of known or probable interference with aquatic life.

Wetlands:

- Protect critical wetlands (e.g., bogs, fens, mineral spring wetlands, wetlands hydraulically connected to aquifers, floodplain wetlands, wetlands supporting listed species, etc.).
- Increase the amount of state-regulated wetlands to >50% of total mapped wetlands.
- Conserve, reclaim wetlands/grasslands in quarry siting and reclamation plans.

Woodlands:

- Increase the amount of protected, functional, riparian forest, especially in headwater streams.
- Conserve & increase number and quality of core forest tracts (>500 acres >100m from roads).

Grasslands:

- Increase acreages and habitat values for grassland breeding birds.

Natural Areas:
- Increase protected coverage to >50% of existing natural areas in and continuous with ARA.

Species /communities:
- Conserve and restore habitats supporting New York State-listed fish and wildlife species.

Stewardship:
- Build partnerships with and between municipalities to connect and increase ecological values of coastal zones, stream corridors and other shared habitat features through BMPs and ecology-based planning and zoning regulations.
- Increase conservation of habitat and ecological services at the landscape level to increase habitat viability and resilience to climate change stressors.

Sub-watershed Evaluations

The same evaluation process was applied to the 11 Sub-watersheds which corresponded to the Strategy, beginning with a biodiversity assessment and then a review of the same critical threats of the full watershed. An initial set of conservation objectives for each sub-watershed was also identified by the Strategy. The full sub-watershed assessments from the Niagara River Habitat Conservation Strategy are provided on the following pages.

Since Phase 1, seven additional sub-watersheds have been incorporated into this report (Big Sister, Cattaraugus, Cattaraugus Headwaters, Walnut, Canadaway, Chautauqua and Sixmile). At this time, we do not have the same Conservation Action Planning (CAP) model ranking scores. However, a biodiversity assessment and summary is provided for the additional sub-watersheds. Updating the model to reflect all 18 sub-watersheds may be an important strategy for a more integrated watershed-wide management plan in the near future.

Eighteenmile Creek Sub-watershed

Eighteenmile Creek is a large, meandering stream whose upland forests and spring-fed headwater tributaries are part of a functional landscape providing natural overhanging cover, material contribution and good water quality to the system. Mid-reaches of both the main stream and principal tributary, South Branch, flow through steep-sided, undeveloped, wooded gorges with 70-150 foot high shale cliffs, cold springs and seeps, and talus communities of probable biodiversity significance. The lower half-mile is low gradient, 75-100 feet wide, with a broad floodplain, including potential patches of clayplain forest and/or limestone woodland with abundant swamp white oak.

The Eighteenmile Creek Active River Area has a high percentage of woodland cover (48%) and natural area cover (60%) of the described sub-watersheds. In its mid reaches Eighteenmile Creek has tributary gorges to Lake Erie. The Nature Conservancy ranked Eighteenmile Gorge highest as a functional landscape based on natural land cover within the gorge, relative lack of dams and diversions, large roadless blocks, and good water quality.[43] The gorge has been designated a "significant fish and wildlife area" by the NYS Coastal Management Program, a "critical environmental area" by the Town of Hamburg, and a "Conservation Park" by Erie County.

Not surprisingly, given the amount and quality of riparian forest, canopy cover and the relatively low overall impervious surface, Eighteenmile Creek also has the highest amount of predicted non-impaired aquatic habitat in the Niagara River Watershed. Stream channels are mainly bedrock with cobble, gravel, sand and silt. Listed species include the northern pygmy clubtail dragonfly (in the headwaters); queen snake and freshwater drum in the lower creek near Lake Erie. From the Eighteenmile Gorge at the fork of the main and south branches downstream to the mouth, the creek has extensive public fishing access areas, known for its steelhead and smallmouth bass runs in the spring.

Conservation potential is high in this sub-watershed. Less than 20% of the riparian forest is protected. The top ranking matrix forest, Fowlerville Forest is entirely privately owned. Three upland county forests, totaling over 600 acres are not explicitly managed for ecological values. Undeveloped county parks, including Eighteenmile Gorge and the 90-acre Shale Creek natural area adjacent to Chestnut Ridge County Park contain fragile areas that will benefit from trail re-routing or other public access management strategies.

Municipalities: Towns of Hamburg, Eden, Evans, North Collins, Orchard Park, Boston, Colden, and Concord; Village of Hamburg

Total waterways: 274 miles including South Branch, Newman Creek, and Hampton Brook
Total sub-watershed: 76,843 acres

Biodiversity features by percent of ARA[44] land cover:

- ARA: 18,547 acres or 24% of sub-watershed
- Wetlands (NOAA): 1,596 acres or 9%
- Woodlands: 8,922 acres or 48%
- Grass/Shrublands: 629 acres or 3%
- Natural Areas (% of ARA and continuous land that is natural): 37,245 acres or 84% of study area

Viability assessment: (amount, condition, connectivity) Table 3.1

- Aquatic habitat: **GOOD**
- Wetlands: **FAIR**

[43] Hunt D.M., Edinger G.J., Schmid J.J., Evans D.J., Novak G., Olivero A.E., & S.M. Young 2002. Lake Erie Gorges Biodiversity Inventory and Landscape Integrity Analysis. New York Natural Heritage Program, Albany, NY.
[44] Denotes geographical Active River Area

- Woodlands: GOOD
- Grass/Shrublands: POOR
- Natural areas: FAIR – GOOD

Threats:

- Aquatic habitat: Erosion/sedimentation (lack of riparian buffers); runoff; fish barriers
- Wetlands: Loss of acreage; invasive species (road management practices)
- Woodlands: Lack of ecological management plans; lack of protection
- Grasslands: Management practices on agricultural and public lands
- Natural areas: Lack of protection; fragmentation (utility, roads, rail)

Conservation Strategies:

- Assess state, county, municipal and other public lands and management plans for opportunities to increase ecological function and biodiversity values
- Identify large and/or connecting headwater forest tracts for acquisition or easements
- Promote natural buffers for erosion control for high quality aquatic habitats like South Branch
- Partner with municipality, Natural Resource Conservation Service (NRCS), and/or angler groups to remove/remediate barriers to flow and fish movement

Niagara River Habitat Conservation Strategy Table 3.1 Eighteenmile Creek

- **Bold** = Current condition
- Listed plant and animal species are identified in technical report
- For unranked indicators, see sub-watershed descriptions

FEATURE	ATTRIBUTE	INDICATOR	POOR	FAIR	GOOD	V. GOOD	OTHER
Open Water Aquatic Habitat	Condition	Actual & predicted BAP scores (by % of stream)	0-2.5	2.5-5.0 **1%**	5.0-7.5 **89%**	7.5-10 **10%**	
	Condition	% impervious surface	>20%	10-20%	5-10%	<5% **3.5%**	
	Condition	Bed/ bank assessments (HMA/SVAP scores)	<60 **51**	60-69	70-79 **75,77**	>80	
	Landscape Context	Known barriers to migratory fish species					**Y**
Nested Feature	Migratory Fish	Reproducing trout or sturgeon populations					**Y – trout spp**
Wetlands	Condition	NYSDEC compared to total mapped (NYSDEC, NWI)	<25%	25-37% **26%**	38-50%	>50%	**704a / 2,754a**
	Condition	Number of Class 1s					**1**

FEATURE	ATTRIBUTE	INDICATOR	POOR	FAIR	GOOD	V. GOOD	OTHER
Woodlands	Condition	Functional riparian forest: >50 acres and >100m wide					**28 tracts (20,531a)**
	Condition	Core forest: unbroken blocks >500 acres, >100m from road					**15 tracts (12,270a)**
Grass/Shrublands	Condition	% of acreage in tracts >10 acres	11.4%				**11.4%**
Natural Areas	Size	% of study area (ARA and cont.) that is natural cover		<60%	>60% **84%**		**84%**
	Condition	% semi-protected	<25% **17%**	<50%	>50%		**17%**
	Condition	Number of tracts >150 acres					**31 tracts**

Buffalo River Sub-watershed

The Buffalo River sub-watershed varies across ecoregions—from high quality upland forests and streams down to the urban-industrial corridor and AOC section approaching Lake Erie. Headwaters include the East and West Branches of Cazenovia Creek, which rise in the Towns of Sardinia and Concord respectively, and flow northwest to join in the Village of East Aurora. This sub-watershed has 31 tracts of riparian forest greater than 50 acres in size and at least 100 meters in width from water's edge, and 49 tracts of unbroken core forest greater than 500 acres. The cool, well-oxygenated Buffalo River headwaters support trout and other aquatic communities of statewide significance,[45] however they have many barriers limiting fish passage.

The industrialized lower six miles of the Buffalo River was designated a Great Lakes AOC in 1987, primarily due to contaminated sediments from the steel and chemical industries that once lined the river. Most of these sediments have been removed. However, while the shoreline transitions away from industrial uses, the lower river itself remains a federally-designated navigation channel and is subject to dredging to maintain a depth of 22 feet. Today, although 48 fish species are found in the river system, including 6 listed species, the dredged zone is likely a low oxygen barrier to walleye and other species attempting to migrate upstream to spawn. The sub-watershed as a whole is 11.9% impervious surface or "fair" for aquatic habitat with most of that occurring in the lake plain. Wetlands protection is relatively high at 41% and includes six listed marsh bird species.

[45] Hunt D.M., Edinger G.J., Schmid J.J., Evans D.J., Novak G., Olivero A.E., & S.M. Young 2002. Lake Erie Gorges Biodiversity Inventory and Landscape Integrity Analysis. New York Natural Heritage Program, Albany, NY.

This sub-watershed also includes about four miles of Lake Erie shoreline and a few semi-protected habitats inside the harbor break walls such as Times Beach, Bell Slip and Tifft Nature Preserve with its remnant of what was once one of the most extensive and productive coastal marshes on Lake Erie. These areas still play an important role in the life cycles of many resident and migratory fish and bird species, including lake sturgeon, and nesting colonies of terns and gulls. Several conservation strategies already exist for these habitats through the Buffalo and Niagara River RAPs, the Niagara River Globally Important Bird Area, and Great Lakes Fishery Commission fish community objectives.

In terms of acreage, the greatest habitat conservation opportunities in this sub-watershed lie in the publicly-owned or otherwise protected upland landscapes, including several Erie County forests, the botanically-rich Protection Bog, eight NYSDEC Class 1 wetlands, and recreational lands such as parks and ski resorts which have potential to enhance ecological values while still accommodating recreational uses. Two large grassland areas—the state-owned Knox Farm and Erie County owned Sprague Brook Park—are good candidates for management plans and practices in support of grassland breeding birds.

Municipalities: City of Buffalo; Villages of East Aurora and Sloan; Towns of West Seneca, Elma, Aurora, Colden, Holland, Concord, Cheektowaga, Boston, Wales and Sardinia

Total waterways including Buffalo River, Cazenovia Creek: 312 miles
Total sub-watershed: 105,392 acres

Biodiversity features by percent of ARA land cover:
- ARA: 23,838 acres or 23% of sub-watershed
- Wetlands (NOAA): 2,036 acres or 8.61%
- Woodlands: 9,130 acres or 39%
- Grass/Shrublands: 770 acres or 3%
- Natural Areas
  (% of ARA and continuous natural tracts):
  52,468 acres or 82% of study area

Viability assessment: (amount, condition, connectivity) Table 3.2
- Aquatic habitat: FAIR – **GOOD**
- Wetlands: FAIR – **GOOD**
- Woodlands: **GOOD**
- Grasslands: **POOR**
- Natural Areas: **FAIR** – **GOOD**

Threats:
- Aquatic: Lack of riparian buffers; barriers to fish movement; channelization (lower river)
- Wetlands: Loss of acreage; highway department practices (spreading invasives/ditching)
- Woodlands: Lack of ecological management plans; lack of protection (land clearing)
- Grasslands: Mowing (agricultural practices); management practices on public lands
- Natural areas: Lack of protection; Fragmentation/Loss of connectivity

Conservation strategies:

- Assess public lands and management plans for opportunities to increase ecological values
- Partner with municipalities, Trout Unlimited (TU), NRCS to remove/remediate barriers to flow and fish movement
- Grasslands/wetlands: Assess large tracts for habitat values and opportunities for conservation of at-risk species
- Lower river and lakeshore: support ongoing shoreline, channel and floodplain conservation efforts

Niagara River Habitat Conservation Strategy Table 3.2 Buffalo River

- **Bold** = Current condition
- Listed plant and animal species are identified in technical report
- For unranked indicators, see sub-watershed descriptions

FEATURE	ATTRIBUTE	INDICATOR	POOR	FAIR	GOOD	V. GOOD	OTHER
Open Water Aquatic Habitat	Condition	Actual & predicted BAP scores (by % of stream)	0-2.5	2.5-5.0	5.0-7.5	7.5-10	
	Condition	% impervious surface	>25%	10-20% **11.9%**	5-10%	<5%	**11.9%**
	Condition	Bed/ bank assessments (HMA/SVAP scores)	<60 **56, 57**	60-69	70-79	>80 **85**	
	Landscape Context	Known barriers to migratory fish species					**Y**
Nested Feature	Migratory Fish	Reproducing trout or sturgeon populations					**Y**
Wetlands	Condition	NYSDEC compared to total mapped (NYSDEC, NWI)	<25%	25-37%	38-50% **41%**	>50%	**1,443a /3,524a**
	Condition	Number of Class 1s					**8**
Woodlands	Condition	Functional riparian forest: >50 acres and >100m wide					**31 tracts 38,622 acres**
	Condition	Core forest: unbroken blocks >250 acres, >100m from road					**24 >250a (8,468a) 25 >500a (22,662a)**
Grass/Shrublands	Condition	% of acreage in tracts >10 acres	**8.12%**	<50%	>50%		**8.12%**
Natural Areas	Size	% of study area in & cont. w/ ARA that is natural		<60%	>60% **82%**	82%	**82%**
	Condition	% semi-protected	**<25%**	<50%	>50%		**10%**

FEATURE	ATTRIBUTE	INDICATOR	POOR	FAIR	GOOD	V. GOOD	OTHER
	Condition	Number of tracts >150 acres					**20 tracts**

Buffalo Creek Sub-watershed

Buffalo Creek has many miles of high quality trout streams within the headwaters. Six NYSDEC Class 1 wetlands occur in the source areas; several are hydraulically connected to the underlying aquifer and support heritage strains of brook trout. Queen snake and two listed species of freshwater mussel, fragile papershell and slippershell, are found in mid-reaches, plus several pocketbook mussel were observed there in 2013, although they are listed as locally extirpated.[46]

Upland and mid-reaches have significant tracts of natural land, including three county forests plus the 384-acre Beaver Meadow Audubon Center and the 789-acre Hunter's Creek County Park. Almost 80% of the ARA and adjacent land is capable of supporting at least eight listed bird species, which require large, mixed-cover natural areas to survive and breed. However, only 16% of this land is semi-protected, therefore the natural area may potentially decline without additional protection status

The sub-watershed includes 44 tracts of riparian forest, 39 tracts of core forest larger than 500 acres, and six reported species of listed woodland birds, plus several others observed but not yet documented in the state records. Wetlands are also an important feature in this sub-watershed which includes three rare wetland communities as well as the kettle pond wetlands of Beaver Meadow and the County-owned Protection Bog, subject of several botanical studies.

Given the sprawl that has taken place in the lower Buffalo Creek basin, and the growing awareness of the municipalities and local groups of the value in their natural assets, this sub-watershed offers good opportunity for partnerships in stream corridor, floodplain and farmland conservation.

Municipalities: Towns of West Seneca, Elma, Marilla, Bennington, Aurora, Wales, Sheldon, Holland, Java, Sardinia, and Arcade

Total waterways: Hunters Creek and Pond Brook tributaries: 354 stream miles
Total sub-watershed: 93,165 acres

Biodiversity features by percent of ARA land cover:

- ARA: 22,944 acres or 5.5% of sub-watershed
- Wetlands (NOAA): 2,329 acres or 10%
- Woodlands: 9,168 acres or 40%

[46] http://www.dec.ny.gov/animals/30483.html

- Grass/Shrublands: 868 acres or 4%
- Natural Areas (% of ARA and continuous tracts in natural cover): 38,894 acres or 79% of study area

Viability assessment: (amount, condition, connectivity) Table 3.3

- Aquatic habitat: **GOOD**
- Wetlands: **GOOD**
- Woodlands: **GOOD**
- Grass/Shrublands: **POOR**
- Natural areas: FAIR – **GOOD**

Threats:

- Aquatic: Lack of riparian buffers/erosion; barriers to fish movement; loss of headwater spring connectivity and quality
- Wetlands: Loss of acreage; highway department practices (spreading/ditching)
- Woodlands: Lack of ecological management plans; lack of protection
- Grasslands: Mowing (agricultural practices); management practices on public lands
- Natural Areas: Lack of protection; fragmentation (utility, roads, rail)

Conservation strategies

- Aquatic: Identify opportunities to build on mid and upper watershed town partnerships for stream corridor, floodplain and farmland conservation (Elma, W. Seneca, Marilla, etc.)
- Aquatic: This is a priority sub-watershed for work with NYSDEC, TU and other partners on improving trout habitat including barrier remediation (upper tributaries)
- Wetlands: Identify areas where headwater spring and wetlands protection is most critical and feasible (e.g. Beaver Meadow, Protection Bog)
- Forests: Identify conservation opportunities on county forest and park land
- Parks: Identify practices to conserve ecological values in county and town parks

Niagara River Habitat Conservation Strategy Table 3.3 Buffalo Creek

- **Bold** = Current condition
- Listed plant and animal species are identified in technical report
- For unranked indicators, see sub-watershed descriptions

FEATURE	ATTRIBUTE	INDICATOR	POOR	FAIR	GOOD	V. GOOD	OTHER
Open Water Aquatic Habitat	Condition	Actual & predicted BAP scores (by % of stream)	0-2.5	2.5-5.0 **5%**	5.0-7.5 **92%**	7.5-10 **3%**	
	Condition	% impervious surface	>20%	10-20%	5-10% **3.8%**	<5%	**3.8%**
	Condition	Bed/ bank assessments (HMA/SVAP scores)	<60 **47**	60-69 **67, 6.13**	70-79 **74, 70**	>80	

FEATURE	ATTRIBUTE	INDICATOR	POOR	FAIR	GOOD	V. GOOD	OTHER
	Landscape Context	Known barriers to native migratory fish species					**Y – trout**
Nested Feature	Migratory Fish	Reproducing trout or sturgeon populations					**# & status**
Wetlands	Condition	NYSDEC compared to total mapped (NYSDEC, NWI)	<25%	25-37% **34%**	38-50%	>50%	**1,240a / 3,683a**
	Condition	Number of Class 1s					**7**
Woodlands	Condition	Riparian forest tracts: >50 acres and >100m wide, spanning a waterway					**44 tracts (24,373 a)**
	Condition	Core forest: unbroken blocks >500 acres, >100m from road					**12 tracts (10,455a)**
Grass/Shrublands	Condition	% of acreage in tracts >10 acres	**8.63%**	<50%	>50%		**8.63%**
Natural Areas	Size	% of study area in & cont. w/ ARA that is natural		<60%	>60% **79%**		**79%**
	Condition	% semi-protected	<25% **16%**	<50%	>50%		**16%**
	Condition	Number of tracts >150 acres					**39 tracts**

Cayuga Creek Sub-watershed

Cayuga Creek has just under half of its land area in the Cattaraugus Hills ecoregion (48%). The remaining Erie/Ontario Lake Plain and Lowlands are comparatively developed. Predicted BAP scores are correspondingly lower, with 17% of the stream miles considered "moderately impacted." Silt, sedimentation and high water temperatures related to stream bank erosion, storm runoff and lack of canopy are suspected of stressing fisheries in segments of Cayuga Creek in Cheektowaga.

The 1993 Buffalo River RAP baseline habitat study recommended using the creek upstream from its confluence with Buffalo Creek to the county-owned Overflow Retention Facility (ORF) as an AOC reference area for aquatic habitat restoration, as this stretch appears to be the least manipulated of the three lower tributaries. Stream bank cover, natural shoreline, boulders, pools, riffles and snags provide conditions suitable for many native fish. Four listed fish species: northern brook lamprey, Iowa darter, bigeye chub, longear sunfish; and four listed mussel species are reported.

Little Buffalo Creek, Cayuga Creek's main tributary, contains many reaches of adequate aquatic habitat, which would be improved if homeowners maintained or restored vegetated buffers along the banks. Dams, including one at Como Lake and another a mile upstream on Little Buffalo Creek, may impede movement and reproduction of native aquatic species as well as steelhead stocked in Cayuga Creek below the dam and brown trout stocked in Little Buffalo Creek above the dam.

Invasive species like Japanese knotweed are pervasive along lower Cayuga Creek. Of the 4,779 acres of mapped wetlands, only 1,082 or 23% are regulated by the NYSDEC. One listed marsh bird species, one listed wetland plant, and three listed grassland bird species are recorded. The 280-acre Reinstein Woods State Nature Preserve contains a unique 80-acre forest of old growth cherry, sugar maple and beech.

The Town of Cheektowaga has designated its freshwater wetlands, Cayuga Creek and its 100-year floodplain, Reinstein Woods Preserve and its surrounding 400-foot buffer, and Stiglemeier Town Park as Critical Environmental Areas (CEAs), providing greater protection against development incursions. Aside from these CEAs and Como Lake County Park, natural areas in the Cayuga Creek ARA are mainly privately owned, with only 12% semi-protected. A conservation overlay district along Cayuga and Little Buffalo Creek could help set up a review process to encourage best management practices designed to reverse degradation trends and benefit habitat and stream function over time.

Municipalities: Towns of Cheektowaga, Lancaster, Alden, Elma, Marilla, Bennington, Darien, Sheldon; Villages of Lancaster and Depew
Total waterways including Little Buffalo, Slate Bottom, Plum Bottom Creeks: 356 stream miles
Total sub-watershed: 81,385 acres

Biodiversity features by percent of ARA land cover:

- ARA: 33,037 acres or 41% of sub-watershed
- Wetlands (NOAA): 2,545 acres or 8%
- Woodlands: 12,247 acres or 37%
- Grass/Shrublands: 1,128 acres or 3%
- Natural Areas (% of ARA and continuous with natural land cover): 32,758 acres or 66% of study area

Viability assessment: (amount, condition, connectivity) Table 3.4

- Aquatic habitat: **FAIR** – **GOOD**
- Wetlands: **FAIR**
- Woodlands: **FAIR** - **GOOD**
- Grass/Shrublands: **POOR**
- Natural areas: **POOR** – **FAIR**

Threats:

- Aquatic: Lack of buffers; runoff: agricultural and residential; barriers to fish movement

- Wetlands: Loss of acreage; invasive species (road management practices)
- Woodlands: Lack of protection; lack of ecological management plans
- Grass/Shrublands: Management practices on agricultural and public lands
- Natural areas: Lack of protection; fragmentation

Conservation strategies:

- Policy: Pursue stream corridor conservation planning with neighboring municipalities
- Remove or modify known barriers to fish spawning
- Use "Very Good" micro-scale reference sites for restoration, including: Cayuga upstream from confluence w/ Buffalo Creek to ORF, Little Buffalo Creek segments, and Reinstein Woods.

Niagara River Habitat Conservation Strategy Table 3.4: Cayuga Creek

- **Bold** = Current condition
- Listed plant and animal species are identified in technical report
- For unranked indicators, see sub-watershed descriptions

FEATURE	ATTRIBUTE	INDICATOR	POOR	FAIR	GOOD	V. GOOD	OTHER
Open Water Aquatic Habitat	Condition	Actual & predicted BAP scores (by % of stream)	0-2.5	2.5-5.0 **17%**	5.0-7.5 **73%**	7.5-10 **11%**	
	Condition	% impervious surface	>20%	10-20%	5-10% **6.4%**	<5%	**6.4%**
	Condition	Bed/ bank assessments (HMA/SVAP scores)	<60 **42**	60-69	70-79 **76**	>80 **85**	
	Landscape Context	Known barriers to migratory fish species					**Y**
Nested Feature	Migratory Fish	Reproducing trout or sturgeon populations					**Y (but not listed)**
Wetlands	Condition	NYSDEC compared to total mapped (NYSDEC, NWI)	<25% **23%**	25-37%	38-50%	>50%	**1,082a / 4,779a**
	Condition	Number of Class 1s					**6**
Woodlands	Condition	Riparian forest tracts: >50 acres and >100m wide, spanning a waterway					**42 (20,756 a)**
	Condition	Core forest: unbroken blocks >500 acres, >100m from road					**10 tracts (6,570a)**
Grass/Shrublands	Condition	% of acreage in tracts >10 acres	**11.2%**	<50%	>50%		**11.2%**

FEATURE	ATTRIBUTE	INDICATOR	POOR	FAIR	GOOD	V. GOOD	OTHER
Natural Areas	Size	% study area in natural cover		<60%	>60% **65.8%**		**65.8%**
	Condition	% semi-protected	**<25%**	<50%	>50%		**12%**
	Condition	Number of tracts >150 acres					**35 tracts**

Upper Tonawanda Creek Sub-watershed

The Upper Tonawanda sub-watershed is almost equally divided between the Cattaraugus Hills and Ontario Lowlands ecoregions (57% and 42%, respectively). From its source in the Towns of Wethersfield and Java, the creek flows north through the Towns of Alexander and Batavia where the terrain levels out and the active floodplain broadens. The main branch, Little Tonawanda Creek, joins Tonawanda in the Town of Batavia. At the City of Batavia, the Onondaga Escarpment blocks further flow north and the creek turns west towards the Niagara River. The confluence with another tributary, Bowen Creek, marks the northwestern boundary of the Upper Tonawanda Creek sub-watershed.

Aquatic habitat, based on the actual and predicted health of the benthic macroinvertebrate community, is slightly impacted to non-impacted in the upland reaches of Tonawanda Creek and its tributaries. Two listed species of freshwater mussels are recorded, including one in Little Tonawanda. Naturalized trout species are found in the cool waters upstream from Route 20A, although barriers like stranded culverts interfere with some trout movement. Overall, good quality aquatic habitat is supported by the fact that only about 3.3% of the basin has impervious land cover. Most of that occurs around the City of Batavia, where the benthic community is moderately impacted. Downstream from Batavia, Tonawanda Creek and its tributaries are mainly warm water streams due to urban runoff and lack of buffering.

The 4,442 acres (110 tracts) of NYSDEC-regulated wetlands represent about half the potential for wetland conservation. Wetlands are at the source of many small tributary headwaters, and are a major land cover in the Towns of Alexander and Batavia. NHP identifies three significant wetland communities including red maple-tamarack and hemlock-hardwood peat swamps and a rich sloping fen. Nine of the NYSDEC wetlands are Class 1s, including one on the highest hill in Wyoming County connected to a glacial aquifer that is the source of Tonawanda, Cayuga, and Buffalo Creeks.

Almost 30,000 acres of riparian and continuous woodlands larger than 50 acres indicate good potential for conserving stream buffers and habitat. The Natural Heritage Program (NHP) notes a functional floodplain forest at the headwaters of Little Tonawanda. Carlton Hill is a good example of a large natural upland area that provides critical cover, filtration and material contribution to first and second order streams. The Faun Lake area, official source of Tonawanda Creek, is another. Implementation of headwater stream stewardship principles (Meyer, 2003) could improve ecological values at these sites and throughout the watershed.

Municipalities: Towns of Batavia, Stafford, Alexander, Bethany, Bennington, Attica, Middlebury, Sheldon, Orangeville, Java, Warsaw, Darien, and Wethersfield; City of Batavia; Villages of Attica and Alexander

Total waterways including Tannery, Stony Brooks; Little Tonawanda, Crow, Bowen Creeks: 589 miles
Total sub-watershed: 127,308 acres

Biodiversity features by percent of ARA cover:

- Active River Area: 41,994 acres or 33% of sub-watershed
- Wetlands (NOAA): 4,813 acres or 12%
- Woodlands: 12,820 acres or 31%
- ARA Grass/Shrublands: 2,141 acres or 5%
- ARA and continuous Natural areas: 50, 723 acres or 70% of study area

Viability assessment: (amount, condition, connectivity) Table 3.6

- Aquatic habitat: **GOOD**
- Wetlands: **GOOD**
- Woodlands: **GOOD**
- Grass/Shrublands: **POOR**
- Natural Areas: **FAIR-GOOD**

Threats:

- Aquatic: Lack of riparian buffers; agricultural runoff; barriers to fish movement
- Wetlands: Loss of acreage; road management practices
- Woodlands: Lack of protection; lack of ecological management plans (invasives; overbrowsing)
- Grasslands: Management practices on agricultural and public lands
- Natural areas: Lack of protection; fragmentation (roads, utility corridors)

Conservation strategies:

- Assess opportunities for headwater stewardship within and across sub-watersheds
- Aquatic: Analyze highest BAP score sites for reference conditions to conserve/replicate
- Remediate culverts impeding trout movement
- Wetlands: Assess potential impacts and reclamation strategies for stone, sand and gravel quarries
- Woodlands: Identify opportunities to conserve/restore riparian buffers based on critical areas of need
- Natural Areas: Identify best bet opportunities (size, ownership) to acquire easements on active floodplains (Alexander)

Niagara River Habitat Conservation Strategy Table 3.5: Upper Tonawanda

- **Bold** = Current condition
- Listed plant and animal species are identified in technical report
- For unranked indicators, see sub-watershed descriptions

FEATURE	ATTRIBUTE	INDICATOR	POOR	FAIR	GOOD	V. GOOD	OTHER
Open Water Aquatic Habitat	Condition	Actual & predicted BAP scores (by % of stream)	0-2.5	2.5-5.0 **4%**	5.0-7.5 **92%**	7.5-10 **4%**	
	Condition	% impervious surface	>20%	10-20%	5-10%	<5% **3.3%**	**3.3%**
	Condition	Bed/ bank assessments (HMA/SVAP scores)	<60	60-69	70-79 **79**	>80	
	Landscape Context	Known barriers to migratory fish species					**Y**
Nested Feature	Migratory Fish	Reproducing trout or sturgeon populations					**Y – trout spp.**
Wetlands	Condition	NYSDEC compared to total mapped (NYSDEC, NWI)	<25%	25-37%	38-50% **47%**	>50%	**4,742a / 10,094a**
	Condition	Number of Class 1s					**9**
Woodlands	Condition	Riparian forest tracts: >50 acres and >100m wide, spanning a waterway					**66 tracts (29,763a)**
	Condition	Core forest: unbroken blocks >500 acres, >100m from road					**13 tracts (9,061a)**
Grass/Shrublands	Condition	% of acreage in tracts >10 acres	**16.9%**	<50%	>50%		**16.9%**
Natural Areas	Size	% of study area in & cont. w/ ARA that is natural		<60%	>60% **70%**		**70%**
	Condition	% semi-protected	<25%	**<50%**	>50%		**27%**
	Condition	Number of tracts >150 acres					**57 tracts**

Middle Tonawanda Creek Sub-watershed

From the City of Batavia to the Village of Pendleton, Middle Tonawanda Creek includes parts of seven towns and the Tonawanda Seneca territory. Its northern border is formed by the Niagara

Escarpment and its southern, in part, by the Onondaga Escarpment which the creek crosses at Indian Falls. In the 20-mile stretch from Indian Falls downstream to the Village of Pendleton, where the creek meets the Barge Canal, Tonawanda Creek's broad floodplain and many wetlands are a remnant of glacial Lake Tonawanda. New York's Freshwater Blueprint program recognizes this wetland-floodplain complex as "a critical area for floodplain protection and restoration" based on the presence of a large active floodplain adjacent to core patches of wetland, grassland and forest. These patches include parts of the 20,000-acre Alabama Swamp including the State Tonawanda Wildlife Management Area.

The Middle Tonawanda sub-watershed has approximately twice as much wetland (20% of the ARA land cover) as all the other sub-watersheds in the watershed except Murder Creek. Of the federally mapped and state regulated wetland acreage, 56% is State regulated, including 24 large (>100 acre) tracts and four Class 1 wetlands.

According to a 1998 survey, Middle Tonawanda's freshwater mussel population is regionally significant with 19 species recorded below Indian Falls,[47] including several NYS-listed species. Other protected aquatic species here include redfin shiner, black redhorse, and longear sunfish. However, in terms of aquatic habitat, Middle Tonawanda Creek is nearing the threshold of impaired uses. These impairments are caused by a variety of threats including increasing pollution from agricultural and residential runoff and lack of buffering.[48] The amount of stream predicted to be moderately impaired is about the same as the amount slightly impaired, based on these NYSDEC RIBS benthic macroinvertebrate profiles. Freshwater mussels such as those in the Unionidae family may be most affected of macroinvertebrates due to their very specific dispersal strategy. They attach onto fish in a larval parasitic life stage (glochidium stage), then detach from the fish, attach to substrate and enter the juvenile life stage. Certain mussels have high host-specificity, and can live up to 40 years. However, dams and flow alterations may prevent movement of the host fish and consequently, native mussel dispersion. Therefore, the presence of an adult mussel does not necessarily indicate reproducing populations; particularly if fish passageways have been blocked in recent years.

At least five listed grassland bird species breed in the area, though grassland cover is less than 1%. Large natural areas of mixed native vegetation support species like Northern Harrier, Short-eared Owl and Henslow's Sparrow. Patches of lupine support three state-protected butterfly species in this area.

Conservation opportunities in this sub-watershed include in-filling, connecting and protecting unique riparian natural feature complexes such as the thousand-acre Tonawanda wetland-

[47] Marangelo, P.J. and D.L. Strayer. 2000. The freshwater mussels of the Tonawanda Creek basin in western New York. Walkerana, 11(25): 97-106.
[48] New York State Department of Environmental Conservation (NYSDEC), New York State's Waterbody Inventory and Priority Waterbodies List (WI/PWL) Basin Report, 2010

floodplain complex and unique features like the Onondaga Escarpment, with its rare limestone-loving plants.

Municipalities/Governments: Tonawanda Seneca Nation, Towns of Lockport, Royalton, Alabama, Clarence, Newstead, Pembroke, Shelby and Batavia

Total waterways including principal tributaries Mud and Beeman Creek: 331 miles
Total sub-watershed: 79,116 acres

Biodiversity features by percent of ARA cover:

- ARA: 60,859 acres or 80% of sub-watershed
- Wetlands (NOAA): 11,978 acres or 20%
- Woodlands: 14,781 acres or 24%
- Grass/Shrublands: 762 acres or 1%
- Natural areas (ARA and continuous): 30,609 acres or 49% of study area

Viability assessment

- Aquatic habitat: **FAIR-GOOD**
- Wetlands: **GOOD**
- Grass/Shrublands: **POOR**
- Woodlands: **FAIR**
- Natural Areas: **GOOD**

Threats

- Aquatic: Lack of riparian buffer, runoff
- Wetlands: Loss of acreage; highway department practices (spreading invasives, ditching)
- Woodlands: Fragmentation, lack of protection (invasive species, overbrowsing)
- Grasslands: Management practices on agricultural and public lands
- Natural areas: Fragmentation, loss of acreage

Conservation Strategies

- Aquatic: Identify good reference areas for benthic/mussel habitat conservation and restoration
- Identify acquisition, easement, and/or best management opportunities for stream buffering
- Grasslands: Identify priority tracts for conservation within Tonawanda Creek floodplain complex
- Woodlands: Identify opportunities to conserve and connect Onondaga Escarpment parcels

Niagara River Habitat Conservation Strategy Table 3.6: Middle Tonawanda

- **Bold** = Current condition
- Listed plant and animal species are identified in technical report
- For unranked indicators, see sub-watershed descriptions

FEATURE	ATTRIBUTE	INDICATOR	POOR	FAIR	GOOD	V. GOOD	OTHER
Open Water Aquatic Habitat	Condition	Actual & predicted BAP scores (by % of stream)	0-2.5	2.5-5.0 **51%**	5.0-7.5 **49%**	7.5-10	
	"	% impervious surface	>20%	10-20%	5-10%	<5% **3.4%**	**3.4%**
	"	Bed/ bank assessments (HMA/SVAP scores)	<60	60-69 **63**	70-79	>80 **80**	
	Landscape Context	Known barriers to migratory fish species					**Y**
Nested Feature	Migratory Fish	Reproducing trout or sturgeon populations					**N**
Wetlands	Condition	NYSDEC compared to total mapped (NYSDEC, NWI)	<25%	25-37%	38-50%	>50% 56%	**8,455a / 15,595a**
	"	Number of Class 1s					**4**
Woodlands	Condition	Riparian forest tracts: >50a and >100m wide, spanning a waterway					**31 tracts (14,490a)**
	"	Core forest: unbroken blocks >500 acres, >100m from road					**9 tracts (6,170a)**
Grass/Shrublands	Condition	% of acreage in tracts >10a	**1.4%**	<50%	>50%		**1.4%**
Natural Areas	Size	% of study area in & cont. w/ ARA that is natural		<60% **49%**	>60%		**49%**
	Condition	% semi-protected	<25%	<50%	**>50%**		**59%**
		Number of tracts >150a					**26 tracts**

Lower Tonawanda Creek Sub-watershed

From the Village of Pendleton to its mouth on the Niagara River, the last 11.6 miles of Tonawanda Creek is channelized and dredged to a width of 75 feet and a depth of 12 feet to accommodate the Erie Canal. From April through November, a lock diverts Lower Tonawanda Creek to flow backward approximately 19 miles northeast through the canal to Lockport. The Erie Canal channelization and flow reversal regime limits habitat connectivity between the Niagara River and Tonawanda Creek, its main tributary, and has likely impaired aquatic biodiversity in both systems. Flow reversals also affect water temperatures and may be responsible for periodic fish die-offs in the creek.

Biological and channel assessments show Lower Tonawanda tributaries to be moderately impaired, with lack of stream cover, lack of water clarity, and lack of aquatic vegetation affecting many segments of Ransom, Bull, and Gott Creeks. The lack of mussel species below Pendleton is likely an impact of the Erie Canal. Upstream from Pendleton, Lower Tonawanda Creek is similar to Middle Tonawanda Creek in that both receive high (non-impacted) BAP scores, and include many listed aquatic species including redfin shiner, black redhorse, and eight species of native mussels. Most notably, however, this is the only waterway in New York that hosts self-sustaining populations of the NYS threatened longear sunfish, in the stretch just before the Erie Canal.[49]

The NYSDEC regulates about 5,000 acres of wetlands or 37% of the state regulated and federally mapped wetlands in the Lower Tonawanda ARA. These 51 tracts include eight Class 1 wetlands including three near the source of Ransom Creek that are hydraulically connected to the Onondaga Aquifer, a high quality limestone aquifer whose northern border is the Onondaga Escarpment. Several crushed stone quarries along the escarpment have historically influenced water well yields as have surface water channelizations that rerouted streams away from aquifer recharge areas.[50] Listed species associated with this escarpment-aquifer-wetland habitat include Pied-billed Grebe, Sedge Wren, Upland Sandpiper and Swamp Lousewort.

Conservation opportunities include outreach and education on mitigating the habitat impacts of the Erie Canal including native buffers and shallow water habitat improvements; working with willing quarry owners on habitat-enhancing design and implementation for quarry reclamations; and working with towns and land conservancies to target high quality riparian parcels for protection or acquisition.

Municipalities: Towns of Cambria, Lockport, Wheatfield, Pendleton, Clarence, Amherst, Lancaster, and Newstead, City of North Tonawanda and Lockport.

Total waterways including Bull and Sawyer Creeks, Erie Canal, Black, Gott, and Ransom Creeks: 217 miles
Total sub-watershed: 78,802 acres

Biodiversity features by percent of ARA land cover:

- Active River Area: 62,938 acres or 79% of sub-watershed
- Wetlands (NOAA): 7,698 acres or 12%

Woodlands: 15,092a or 23.9%

- Grass/Shrublands: 1,142 acres or 2%
- Natural areas (% of ARA and continuous that has natural cover): 23,932 acres or 41% of study area

[49] NYSDEC Fish Atlas Maps of New York
[50] Staubitz, W.W. and Miller, T.S., 1987, Geology and hydrology of the Onondaga aquifer in eastern Erie County, New York, with emphasis on ground-water-level declines since 1982: U.S. Geological Survey Water-Resources Investigations Report 86-4317, p.44

Viability assessment: (amount, condition, connectivity) Table 3.7

- Aquatic habitat: **FAIR**
- Wetlands: **FAIR**-**GOOD**
- Grass/Shrublands: **POOR**
- Woodlands: **FAIR**
- Natural Areas: **FAIR**

Threats:

- Aquatic: Lack of riparian buffers; runoff; channelization (invasives)
- Wetlands: Loss of acreage; Highway department practices; hydrologic alterations
- Woodland: Lack of protection; fragmentation
- Grasslands: Management on public lands; invasive species (loss of native vegetation)
- Natural areas: Fragmentation; invasive species

Conservation strategies:

- Aquatic: Identify best public land opportunities (Canal Corps; T's of Amherst & Pendleton) for naturalizing/buffering shoreline or increasing wetland values between Veterans Park & Pendleton.
- Wetlands/grasslands/groundwater: Assess Tillman Swamp as a reference area for wetland habitat
- Natural Areas: Assess conservation easement opportunities with interested private owners.

Niagara River Habitat Conservation Strategy Table 3.7: Lower Tonawanda

- **Bold** = Current condition
- Listed plant and animal species are identified in technical report
- For unranked indicators, see sub-watershed descriptions

FEATURE	ATTRIBUTE	INDICATOR	POOR	FAIR	GOOD	V. GOOD	OTHER
Open Water Aquatic Habitat	Condition	Actual & predicted BAP scores (by % of stream)	0-2.5	2.5-5.0 **77%**	5.0-7.5 **23%**	7.5-10	
	Condition	% impervious surface	>20%	10-20%	5-10% **8.4%**	<5%	**8.4%**
	Condition	Bed/ bank assessments (HMA/SVAP scores)	<60	60-69	70-79	>80	**N/A**
	Landscape Context	Known barriers to migratory fish species					**Y**
Nested Feature	Migratory Fish	Reproducing trout or sturgeon populations					**N**

FEATURE	ATTRIBUTE	INDICATOR	POOR	FAIR	GOOD	V. GOOD	OTHER
Wetlands	Condition	NYSDEC compared to total mapped (NYSDEC, NWI)	<25%	25-37%	38-50% **37%**	>50%	**4,688a / 12,683 a**
	Condition	Number of Class 1s					**8**
Woodlands	Condition	Riparian forest tracts: >50 acres and >100m wide, spanning a waterway					**24 tracts (8,274a)**
	Condition	Core forest: unbroken blocks >500 acres, >100m from road					**2 tracts (1,134a)**
Grass/Shrublands	Condition	% of acreage in tracts >10 acres	<25% **20%**	<50%	>50%		**20%**
Natural Areas	Size	% of study area in & cont. w/ ARA that is natural		<60% **41%**	>60%		**41%**
	Condition	% semi-protected	<25%	<50% **44%**	>50%		**44%**
	Condition	Number of tracts >150 acres					**36 tracts**

Murder Creek Sub-watershed

Murder Creek is the major tributary to Middle Tonawanda Creek, with its mouth about two miles downstream from the western boundary of Tonawanda Seneca territory. The two sub-watersheds share many characteristics. In both, over half of the Active River Area has natural land cover evenly divided between forest and wetland. A major difference is in the amount of natural area that is protected. Only 29% of the Murder Creek ARA and continuous natural area is protected, compared with 63% of the Middle Tonawanda ARA. Murder Creek has fewer state-protected wetlands, no wildlife management areas, and only one major habitat preserve, Counterfeiter's Ledge on the Onondaga Escarpment.

NYSDEC RIBS assessments find Murder Creek's aquatic habitat to be moderately impacted, with urban and industrial contaminants found in the reach between Corfu and Akron. However, predicted BAP scores for most of the creek and its main tributary, Ledge Creek, are good, or slightly impacted. As a C(t) classified stream with a Class 1 wetland at its source, Ledge Creek may be a priority for aquatic habitat conservation. Only three recent records of living native mussel species occur in the sub-watershed, including one at Ledge Creek.[51]

[51] Marangelo, P. J. and D. L. Strayer, *The Freshwater Mussels of the Tonawanda Creek Basin in Western New York,* Walkerana, 2000, 11(25): 97-106.

Of the federally mapped and state-regulated wetland acreage, 50% is state-protected, with three tracts greater than 500 acres. The NHP lists no protected wetlands species. The Spring Marsh created wetlands complex along Ledge Creek at Koepsel Road was field assessed and rejected as a possible reference area for wetlands habitat restoration. A Class 1 wetland (AT-4) at the headwaters of Murder Creek in the Town of Bennington partially supplies the Attica Reservoir, a public drinking water supply.

Historic (NHP) woodland communities and plants are associated with the Onondaga Escarpment and provide some good connectivity along the Pembroke Creek tributary, with opportunity to link core forest areas. Non-native invasive species, illegal dumping and ATV use negatively impact the potential habitat value of these corridors.

Municipalities: Tonawanda Seneca Nation; Towns of Newstead, Pembroke, Darien, Alexander, Batavia, Bennington; Villages of Akron and Corfu.

Total waterways: including principal tributaries Ledge Creek, Pembroke, Darien: 222 miles
Total sub-watershed: 46,686 acres

Biodiversity features by percent of ARA land cover:

- ARA: 27,533 acres or 59% of sub-watershed
- Wetlands (NOAA): 6,794 acres or 25%
- Woodlands: 7,190 acres or 26%
- Grass/Shrublands: 446 acres or 2%
- Natural areas: 14,431 acres or 53% of ARA
- ARA and continuous Natural areas: 19,586 acres or 60% of study area

Viability assessment: (amount, condition, connectivity) Table 3.8

- Aquatic habitat: **GOOD**
- Wetlands: **GOOD**
- Woodlands: **FAIR** – **GOOD**
- Grass/Shrublands: **POOR**
- Natural Areas: FAIR - **GOOD**

Threats:

- Aquatic: Lack of riparian buffers; runoff (from agriculture, urban, roads); failing septic systems
- Wetlands: Loss of acreage; highway department practices (spreading invasive species)
- Woodlands: Fragmentation; land clearing
- Grasslands: Agricultural practices; unprotected status
- Natural areas: Fragmentation; loss of acreage/ lack of protection

Conservation Strategies:

- Protect and connect wooded uplands and wetlands along Onondaga Escarpment
- Assess created Spring Marsh as a gravel pit reclamation reference area, as recommended in the Akron/Newstead Comprehensive Plan

- Aquatic: Assess tributary along Dodgeson Rd for confined animal feelot operation (CAFO) impacts and remediation opportunities
- Work with highway departments to reduce invasives spreading
- Woodlands: Identify opportunities to connect large riparian woodland tracts in Pembroke and Newstead

Niagara River Habitat Conservation Strategy Table 3.8: Murder Creek

- **Bold** = Current condition
- Listed plant and animal species are identified in technical report
- For unranked indicators, see sub-watershed descriptions

FEATURE	ATTRIBUTE	INDICATOR	POOR	FAIR	GOOD	V. GOOD	OTHER
Open Water Aquatic Habitat	Condition	Actual & predicted BAP scores (by % of stream)	0-2.5	2.5-5.0 **19%**	5.0-7.5 **81%**	7.5-10	
	Condition	% impervious surface	>20%	10-20%	5-10%	<5% **3.3%**	**3.3%**
	Condition	Bed/ bank assessments (HMA/SVAP scores)	<60	60-69	70-79 **73**	>80	
	Landscape Context	Known barriers to migratory fish species					**N**
Nested Feature	Migratory Fish	Reproducing trout or sturgeon populations					**N**
Wetlands	Condition	NYSDEC compared to total mapped (NYSDEC, NWI)	<25%	25-37%	38-50% **50%**	>50%	**4,671a / 9,413a**
	Condition	Number of Class 1s					**2**
Woodlands	Condition	Riparian forest tracts: >50 acres and >100m wide, spanning a waterway					**25 tracts (11,631a)**
	Condition	Core forest: unbroken blocks >500 acres, >100m from road					**6 tracts (4,758a)**
Grass/Shrublands	Condition	% of acreage in tracts >10 acres	<25% **5.2%**	<50%	>50%		
Natural Areas	Size	% of study area that is natural		<60%	>60%		**60%**
	Condition	% of natural areas that is semi-protected	<25%	<50% **29%**	>50%		**29%**
	Condition	Number of tracts >150 acres					**19 tracts**

Ellicott Creek Sub-watershed

Ellicott Creek flows northwest from headwater wetlands in the Town of Darien (southwest corner of Genesee County) to the City of Tonawanda where it joins Tonawanda Creek about a half mile above its mouth at the Niagara River. While the upper reaches (upstream of Transit Rd.) are less developed; the lower reaches flow through the residentially and commercially developed Towns of Lancaster, Amherst and Tonawanda. Overall the sub-watershed is 14.7% impervious. Aquatic biological assessment profiles follow this pattern: slightly impacted in the upper watershed; moderately impacted downstream in Lancaster and Amherst. Variables like agricultural activity upstream, and groundwater discharge downstream affect these conditions.

In the 1930s lower Ellicott was widened and a dam was built at Island Park 2.4 miles upstream of the United States Geological Survey gage near the Village of Williamsville to control flooding. Regulation occurs today by the seasonal manipulation of that dam and also by intermittent pumping from stone quarries into the stream. In 1965, Erie County completed construction of a 1.5 mile long diversion channel between Rt. 990 and Niagara Falls Blvd. to control flooding in the Town of Amherst. This also affects stream and riparian habitat quality.

The Onondaga Escarpment and Aquifer are major features across the sub-watershed (as in the Lower Tonawanda and Murder Creek sub-watersheds), along with many associated active and abandoned stone quarries. The Onondaga Aquifer discharges to and is recharged by many of the wetlands along this northern edge, including five Class 1 wetlands in the Towns of Clarence, Lancaster, Newstead and Alden (LA-14 is in the Ellicott sub-watershed). Springs, swallets and sinks are important connecting features that should be protected by setbacks and buffers.

Grasslands associated with the 1,800-acre Darien Lakes State Park and its grassland breeding bird species are another feature with potential opportunities for conservation. Working with the Darien Lake Park rangers to incorporate mowing regimes that are less harmful to nesting grassland birds would be an important first step.

Municipalities: Towns of Tonawanda, Amherst, Lancaster, Newstead, Alden, Bennington, Cheektowaga, Clarence, and Darien; Cities of Tonawanda and Buffalo; Villages of Williamsville and Alden

Total waterways: 244 miles including Elevenmile, Crooked, Spring/Peck and Dorsch Creeks
Total sub-watershed: 76,843 acres

Biodiversity features by percent of ARA land cover

- ARA: 44,699 acres or 58% of sub-watershed
- Wetlands (NOAA): 6,729 acres or 15%
- Woodlands: 10,146 acres or 23%
- Grass/Shrublands: 769 acres or 2%

- Natural areas: 17,645 acres or 40%
- ARA and continuous Natural areas: 25,679 acres or 49% of study area

Viability assessment: (amount, condition, connectivity) Table 3.9

- Aquatic habitat: **FAIR**
- Wetlands: **GOOD**
- Woodlands: **FAIR**
- Grass/Shrublands: **FAIR**
- Natural Areas: **FAIR**

Threats:

- Aquatic: Channelization; lack of riparian vegetation; runoff
- Wetlands: Loss of acreage; invasives
- Woodlands: Lack of protection; fragmentation
- Grasslands: Lack of protection; mowing-planting regimes on public lands (e.g. Darien Lakes SP)
- Natural areas: Lack of protection; invasive species; fragmentation

Conservation Strategies:

- Aquatic: Assess the Doersch Creek area of the Onondaga Escarpment and Aquifer for threats to significant areas of surface and groundwater recharge (sinks, swallets, springs) and conservation options (Recommend to include in the Town of Alden Proposed Aquifer Overlay District)
- Grassland: Darien Lakes State Park. Assess for grassland breeding bird habitat opportunities
- Assess the Town of Amherst's Nature View Park for habitat and functional values including stormwater retention benefits provided to neighboring property owners

Niagara River Habitat Conservation Strategy Table 3.9: Ellicott Creek

- **Bold** = Current condition
- Listed plant and animal species are identified in technical report
- For unranked indicators, see sub-watershed descriptions

FEATURE	ATTRIBUTE	INDICATOR	POOR	FAIR	GOOD	V. GOOD	OTHER
Open Water Aquatic Habitat	Condition	Actual & predicted BAP scores (by % of stream)	0-2.5	2.5-5.0 **30%**	5.0-7.5 **69%**	7.5-10	
	Condition	% impervious surface	>20%	10-20% **14.7%**	5-10%	<5%	**14.7%**
	Condition	Bed/ bank assessments (HMA/SVAP scores)	<60	60-69 **66**	70-79	>80	

FEATURE	ATTRIBUTE	INDICATOR	POOR	FAIR	GOOD	V. GOOD	OTHER
	Landscape Context	Known barriers to migratory fish species					**N**
Nested Feature	Migratory Fish	Reproducing trout or sturgeon populations					**N**
Wetlands	Condition	NYSDEC compared to total mapped (NYSDEC, NWI)	<25%	25-37% **35%**	38-50%	>50%	**3,714a / 10,774a**
	Condition	Number of Class 1s					**4**
Woodlands	Condition	Riparian forest tracts: >50 acres and >100m wide,spanning a waterway					**26 tracts (14,363a)**
	Condition	Core forest: unbroken blocks >500 acres, >100m from road					**6 tracts (4,758a)**
Grass/Shrublands	Condition	% of acreage in tracts >10 acres	**15%**	<50%	>50%		**15%**
Natural Areas	Size	% of study area in & cont. w/ ARA that is natural		<60% **49%**	>60%		**49%**
	Condition	% semi-protected	<25%	<50% **41%**	>50%	>75%	**41%**
	Condition	Number of tracts >150 acres					**29 tracts**

Smokes Creek Sub-watershed

Smokes Creek rises in the Town of Orchard Park and flows northwest for 15 miles to its mouth on Lake Erie. Its one principal tributary, South Branch, is 12 miles long. The creek is named after "Old Smoke," a Seneca leader whose son traditionally carried the fire—the "smoking brand"—from the Haudenosaunee or Iroquois Confederacy Council fire at Onondaga to the Seneca Nation council fire in Western New York. Old Smoke lived near this creek in his later years and was buried here.

Smokes Creek is a tributary to a NYS DOS "significant coastal habitat"—the 500-acre shallow water Smokes Creek Shoals—a spawning grounds for important Lake Erie fish species like walleye and smallmouth bass. However, over the past decades, Smokes Creek itself was severely degraded by cyanide and other toxic waste from the Bethlehem Steel plant and inadequately treated sewage effluent. The creek's habitat value was further impaired by complete buffer removal and channelization of the last mile of the creek. The NYSDEC 2010 RIBS data at three of four sites sampled shows aquatic life to be moderately impacted by elevated nutrient and silt/sediment loads, sludge banks, and other pollutants associated with urban runoff and other nonpoint source inputs. Hydrologic modification for flood control and a high density of roads and culverts are also a concern. The US Army Corp of Engineers is considering a plan to restore ecology and natural flows to areas along the main stem and South Branch (2014).

This sub-watershed includes several small direct tributaries to Lake Erie, all unnamed except for Rush Creek, within a mile of Smokes Creek on the south. The coastal area here includes an NHP-listed remnant Great Lakes dune system, with a wide sand beach and a strip of wooded dunes partially protected by Woodlawn Beach State Park and used by colonial nesting gulls and terns. Another of the unnamed Lake Erie tributaries supports a high predicted number (5-7) of native mussel species.[52] With the major industrial use gone, this once significant Lake Erie coastal area—associated with three state-listed mussel species and three listed fish species, including lake sturgeon—needs to be assessed for any opportunity to improve its viability and connectivity for these important remaining Great Lakes species.

Two Hamburg municipal parks are part of larger (200-500 acre) woodland communities, including a high quality hardwood swamp in the headwater areas. These parks and adjacent natural areas offer many potential opportunities to improve ecological function and habitat in and along Smokes Creek.

Municipalities: Towns of Hamburg, Orchard Park, Aurora, and West Seneca. City of Lackawanna. Villages of Blasdell and Orchard Park

Total waterways: 109 miles including principal tributaries Rush Creek, South Branch
Total sub-watershed: 39,527 acres

Biodiversity Features by percent of ARA cover

- ARA: 15,680 acres or 40% of sub-watershed
- Wetlands (NOAA): 1,306 acres or 8%
- ARA Woodlands: 4,563 acres or 29%
- ARA Grass/Shrublands: 462 acres or 3%
- ARA and continuous Natural areas: 11,654 acres or 56% of study area

Viability assessment: (amount, condition, connectivity) Table 3.10

- Aquatic habitat: **FAIR**
- Wetlands: **FAIR**
- Woodlands: **FAIR**
- Grasslands: **POOR**
- Natural Areas: **POOR**

Threats:

[52] White, E.L., J.J. Schmid, T.G. Howard, M.D. Schlesinger, and A.L. Feldmann. *New York State freshwater conservation blueprint project, phases I and II: Freshwater systems, species, and viability metrics. New York Natural Heritage Program*, The Nature Conservancy. Albany, NY. 85 pp. plus appendix, 2011.

- Aquatic habitat: Lack of riparian buffer; channelization (culverts)
- Wetlands: Loss of acreage; road management practices
- Woodlands: Lack of protection; lack of ecological management plans
- Grasslands: Invasive species; management on public lands
- Natural Areas: Lack of protection; fragmentation

Conservation strategies:

- Identify forest, wetland and/or aquatic habitat values and needs in county owned parcels around California Rd. Recreation Area (Brush Mountain Park) and Lakeview Rd. Recreation Area
- Identify any opportunities to mitigate flood control channelization with shoreline softening
- Investigate lakeshore/tributary restoration opportunities including mussel habitat protection

Niagara River Habitat Conservation Strategy Table 3.10: Smokes Creek

- **Bold** = Current condition
- Listed plant and animal species are identified in technical report
- For unranked indicators, see sub-watershed descriptions

FEATURE	ATTRIBUTE	INDICATOR	POOR	FAIR	GOOD	V. GOOD	OTHER
Open Water Aquatic Habitat	Condition	Actual & predicted BAP scores (by % of stream)	0-2.5	2.5-5.0 **23%**	5.0-7.5 **77%**	7.5-10	
	Condition	% impervious surface	>20%	10-20% **18.3%**	5-10%	<5%	**18.3%**
	Condition	Bed/ bank assessments (HMA/SVAP scores)	<60	60-69 **60**	70-79	>80	
	Landscape Context	Known barriers to migratory fish species					**Y**
Nested Feature	Migratory Fish	Reproducing trout or sturgeon populations					**Unknown**
Wetlands	Condition	NYSDEC compared to total mapped (NYSDEC, NWI)	<25%	25-37% **30%**	38-50%	>50%	**724a / 2,452a**
	Condition	Number of Class 1s					**1**
Woodlands	Condition	Riparian forest tracts: >50 acres and >100m wide, spanning a waterway					**22 tracts (3,912a)**
	Condition	Core forest: unbroken blocks >500 acres, >100m from road					**1 tract (543a)**

FEATURE	ATTRIBUTE	INDICATOR	POOR	FAIR	GOOD	V. GOOD	OTHER
Grass/Shrublands	Condition	% of acreage in tracts >10 acres	**8%**	<50%	>50%		**8%**
Natural Areas	Size	% of study area in & cont. w/ ARA that is natural		<60% **56%**	>60%		11,654a or **56%**
	Condition	% semi-protected	<25% **21%**	<50%	>50%		**21%**
	Condition	Number of tracts >150 acres					**15 tracts**

Niagara River Sub-watershed

Biodiversity features and conservation opportunities in the Niagara River sub-watershed vary according to three major geographies: the Upper River including the stream drainages above Niagara Falls; the Lower River, including the Niagara Gorge; and the natural (unpopulated) islands. Niagara Falls was the historic natural barrier between the four Upper Great Lakes and the Lower Lake Ontario-St. Lawrence River system. Fish species like Atlantic salmon and American eel migrated to and from the Atlantic Ocean as far as the lower river, but no further. Canals like the Erie Canal changed all of that, and yet even today the assemblages and even genotypes of some Upper River-Lake Erie aquatic species differ from those in the Lower River-Lake Ontario system.

Direct drainage to the Upper River includes the lower Buffalo River, Scajaquada Creek, Twomile Creek, Tonawanda Creek, Cayuga Creek, and Gill Creek tributaries. Shoreline and riparian areas have been highly modified by navigational dredging, diversions (Ontario and New York power plants and the Erie Canal), industrialization, landfills, and waste discharges. The land disturbance and contamination caused by this history led to significant loss and degradation of habitat. Based on existing and predicted BAP scores, 88% of the stream miles are moderately impacted for aquatic life, and lower Scajaquada Creek is "precluded" for aquatic life. In the lower Niagara River, below the falls, the one major tributary, Fish Creek, was channelized to accommodate the NYPA power reservoir, and much of the Greenway area is highly modified by power plant infrastructure.

Island habitat has been decreased by quarrying (Strawberry), infilling of channels (Rattlesnake), removal (Bird) and park development (Three Sisters). Restoration efforts are underway to restore components of these historic island complexes but much work is needed to ensure long-term protection and management practices are in place and practical.

Despite this history, the Niagara River sub-watershed is the most biodiverse of all the tributary sub-watersheds in its watershed, in part because of its key role in the migratory cycles of so many Great Lakes and global species. Globally significant numbers of Bonaparte's Gull, Common

Tern and Lesser Scaup overwinter here. The islands and shoreline areas support breeding colonies of black-crowned night heron, great egret and great blue heron, as well as nesting osprey, bald eagle and peregrine falcon. Lake sturgeon are found in increasing numbers in both the upper and lower river, likely representing two different genetic variants from Lake Erie and Lake Ontario. Keystone species like the emerald shiner support many of these resident and migratory species. The Niagara Gorge, once considered one of the most botanically diverse places in North America, still supports many rare plants and communities.

There are several major existing proposals to protect these features, including designation of the Niagara Gorge as a bi-national park or biosphere reserve; removal of redundant roads like the Robert Moses Parkway to restore a natural condition to the gorge rim; and protection of the islands and shallow water habitats with no or low-wake zones and other measures limiting human disturbance. The eight state parks and many municipal parks along the river, along with the Niagara River Greenway initiative offer opportunities to coordinate restoration work.

Scajaquada Creek is one of the greatest restoration priorities within the urbanized Greenway corridor of this sub-watershed. Listed as either “impaired” or “precluded” for aquatic life and buried for much of its journey to the Niagara River, the creek’s water quality is degraded due to point and non-point source pollution. Most notably, urban storm and waste water inputs from both the upper and lower portions of the sub-watershed result in frequent sewage overflows, intense sediment loads and decreased aquatic habitat availability. Both human and wildlife are threatened by exposure to these impaired conditions. Yet, springs and seeps within the entirety of the creek provide a portion of the stream’s baseflow with high-quality water inputs and offer opportunities for restoration where documented problems can be addressed.

Other strategies involve reconnecting the river with its tributaries through strategic barrier removal (where barriers limit the capacity of fish or mussels to reproduce), restoring (or mimicking) natural flows, and compensating for the loss of wetland and shallow water habitat. These will be further explored in the Niagara River Greenway Habitat Conservation Strategy, a companion planning effort currently underway.

Municipalities: Towns of Porter, Lewiston, Niagara, Grand Island, Wheatfield, Tonawanda, Cheektowaga, Lancaster; Cities of Buffalo, Niagara Falls, North Tonawanda, Cambria, and Tonawanda; Villages of Youngstown, Kenmore, Depew, and Lewiston. Tuscarora Indian Reservation

Total waterways: Including Fish Creek, Gill Creek, Cayuga Creek, Bergholtz Creek, Black Creek, Two Mile Creek, Scajaquada Creek, and Grand Island creeks: 185 miles
Total sub-watershed: 98,211 acres

Biodiversity features by percent of ARA land cover:

- ARA: 62,452 acres or 64% of sub-watershed

- Wetlands (NOAA): 5,149 acres or 8%
- Woodlands: 12,442 acres or 20%
- Grass/Shrublands: 1,136 acres or 2%
- ARA and Continuous Natural areas: 22,179 acres or 34% of study area

Viability assessment: (amount, condition, connectivity) Table 3.11

- Aquatic habitat: **POOR-FAIR**
- Wetlands: **FAIR**
- Woodlands: **FAIR**
- Grass/Shrublands: **POOR**
- Natural areas: **FAIR**

Threats:

- Aquatic: Channelization; flow alterations/water level fluctuations; hazardous waste (sediments, landfills, discharges); fish barriers; invasives
- Wetlands: Loss of acreage; invasive species; water level fluctuations
- Woodlands: Lack of ecological management plans; lack of protection
- Grasslands: Management practices on public lands; invasive species
- Natural areas: Lack of protection; fragmentation

Conservation strategies:

- Assess shorelines for softening and buffering opportunities
- Include living shoreline Best Management Practices in waterfront regulations and policies
- Prioritize and remediate barriers to migratory fish use of tributaries
- Investigate water level fluctuation influence on reproduction of fish, mussel and shore birds
- Assess identified high quality woodland parcels for conservation easements or acquisition
- Develop and implement ecology-based management plans for public lands including NY State parks, WMAs, Class 1 wetlands, and Niagara River islands

Niagara River Habitat Conservation Strategy Table 3.11: Niagara River

- **Bold** = Current condition
- Listed plant and animal species are identified in technical report
- For unranked indicators, see sub-watershed descriptions

FEATURE	ATTRIBUTE	INDICATOR	POOR	FAIR	GOOD	V. GOOD	OTHER
Open Water Aquatic Habitat	Condition	Actual & predicted BAP scores (by % of stream)	0-2.5	2.5-5.0 **88%**	5.0-7.5 **12%**	7.5-10	
	Condition	% impervious surface	>20% **23.3%**	10-20%	5-10%	<5%	**23.3%**

FEATURE	ATTRIBUTE	INDICATOR	POOR	FAIR	GOOD	V. GOOD	OTHER
	Condition	Bed/ bank assessments (HMA/SVAP scores)	<60	60-69	70-79	>80	**See Greenway**
	Landscape Context	Known barriers to migratory fish species					**Y**
	Species	Presence of listed fish or mussel species					**9 birds; 2 bird communities; 6 fish; 10 mussels**
Nested Feature	Migratory Fish	Reproducing trout or sturgeon populations					**Y**
Wetlands	Condition	NYSDEC compared to total mapped (NYSDEC, NWI)	<25% **24.7%**	25-37%	38-50%	>50%	**3,166a / 12,722a**
	Condition	Number of Class 1s					**10**
Woodlands	Condition	Riparian forest tracts: >50 acres and >100m wide, spanning waterways					**15 tracts (9,249a)**
	Condition	Core forest: unbroken blocks >250 acres, >100m from road					**7 tracts (5,342a)**
Grass/Shrublands	Condition	% of acreage in tracts >10 acres	<25% **14%**	<50%	>50%		**14%**
Natural Areas	Size	% of study area in & cont. w/ ARA that is natural		<60% **34%**	>60%		**34%**
	Condition	% semi-protected	<25%	<50% **35%**	>50%		**35%**
	Condition	Number of tracts >150 acres					**17 tracts**

<u>Big Sister Creek Sub-Watershed</u>

The headwaters of the Big Sister sub-watershed begin in Collins, North Collins, Cattaraugus Indian Reservation and Eden, and then drain into Lake Erie. This is the southwestern most sub-watershed within the Buffalo-Eighteenmile sub-basin. Notable recreational areas along Lake Erie's coast are Evangola State Park, Bennett Beach, and Sturgeon Point. There are two largely intact forests: Franklin Gulf County Park (North Collins) and also in Cattaraugus Indian Reservation. The remainder of the land is dominated by a mix of suburban municipalities, agricultural farms, with evenly distributed wetland patches of sized 50-150 acres.

The Big Sister Creek sub-watershed is within the Erie/Ontario Lake Plain and Cattaraugus Hills ecoregions. The Erie Lake Plain ecoregion consists of beach dunes with various grass species, and soils containing limestone and shale that allow for agricultural success. This ecoregion is susceptible to lake effect weather conditions. The Cattaraugus Hills region has broad, low hills with deeply cut streams in shale bedrock. The region is described by the NYSDEC as moderately covered by forest, which is mostly comprised of beech-maple mesic (and American chestnuts historically), shale cliffs, and a talus community. However these forests are fragmented by both agricultural and suburban areas; headwaters have marshland with inadequate forest buffer zones.[53] Many of the municipalities in this sub-watershed are on septic systems, some of which are known, suspected, or considered possible to be failing, and contributing to poor water quality.[54]

The Lake Erie waterfront in this sub-watershed is impaired due to PCBs and pathogens. Lower stems of Little Sister Creek and Muddy Creek are both listed as impaired for pathogens, and Little Sister is also impaired due to nutrients and dissolved oxygen. Big Sister Creek, Delaware Creek, and upper Muddy Creek have minor impacts, while only Rythus Creek has no known impacts.[55] NYSDEC RIBS assessments in this sub-watershed are consistent with poor aquatic habitat and water quality. In lower Little Sister Creek, the macroinvertebrate community was dominated by midges and scuds which are tolerant for low dissolved oxygen and poor water quality. Big Sister and Delaware Creeks macroinvertebrate communities were more diverse, however many nutrient tolerant species were present.[56]

Historically, Big Sister Creek has been highly impacted by sewage input. A stream survey conducted in 1973 (Puleo et al. 1974) found low dissolved oxygen, pollution tolerant macroinvertebrate communities, and noted that the area noticeably smelled of sewage. Currently, this is still observed in most tributaries in this sub-watershed as indicated through macroinvertebrate community distribution.[57] In 2010, sewage and nutrient input were still cited a major impairment of Big Sister Creek despite SPDES compliance.[58]

A key area for conservation is Evangola State Park, which provides critical habitat for many migratory species including monarch butterflies, bats, and numerous bird species. In 2011, a survey conducted by US Fish and Wildlife Service found Evangola State Park to have the highest bird count, and second highest bat count of all the coastal sites surveyed spanning each of the Great Lakes (USFWS 2012). This park is also known to host Bald Eagles, and protection of this stopover point is essential for the migratory biotic community. The Lake Erie portion of this sub-watershed also hosts important fishes including lake sturgeon, lake trout, walleye, yellow perch, channel catfish and smallmouth bass. Established non-native species that are of recreational importance are steelhead, brown trout and Chinook salmon.

Municipalities: Villages of North Collins, Angola, and Farnham. Towns of Brant, Eden, Evans, Collins, and North Collins. Cattaraugus Indian Reservation.

[53] New York State Department of Environmental Conservation (NYSDEC*), Species of Greatest Conservation Need*, *Comprehensive Wildlife Conservation Strategy for New York*, Lake Erie Table 11, pp. 233 – 279, 2005.
[54] https://www.dec.ny.gov/docs/water_pdf/winiagbigsister.pdf
[55] Ibid
[56] New York State Department of Environmental Conservation (NYSDEC*), Rotating Integrated Basin Studies Water Quality Assessment Program New York Statewide Waters Monitoring Program. Niagara River Lake Erie Drainage Basin: Sampling years 2005 – 2006*. 2011
[57] Ibid
[58] https://www.dec.ny.gov/docs/water_pdf/winiagbigsister.pdf

Total waterways: 186.65 miles including principal tributaries Big Sister Creek, Little Sister Creek, Delaware Creek, Muddy Creek.
Total sub-watershed: 62,363 acres

Threats:

- Aquatic: nonpoint nutrient runoff (agricultural), storm runoff, sewage input, pathogens,
- Wetlands: Inadequate buffers and/or fragmentation, suburban development
- Woodlands: Inadequate forest buffers, the largest intact forest (Franklin Gulf) is surrounded by agriculture
- Grasslands: Invasive species in grassy dunes along Lake Erie coasts, mowing regimes on farmland impact grassland-dependent bird nests
- Natural areas: Fragmentation of natural areas

Conservation Strategies:

- Increase stream buffers to reduce pathogen and nutrient inputs.
- Protection of Rhythus, Big Sister, Delaware and upper Muddy Creek, which have no known or minor impacts.
- Conserve, protect and regulate the well-distributed wetlands. Prevent degradation of largest wetland areas.
- Protect intact forests and increase forest acreage where possible.
- Partnerships with Seneca Nation of Indians and NYSDEC to enhance key conservation areas, such as natural areas within Cattaraugus Indian Reservation and Evangola State Park.
- Work with landowners to improve septic systems, increase riparian zones between cropland and streams, and implement mowing regimes that reduce harm to grassland dependent species (block mowing method outwards from the center as opposed to strip mowing).

<u>Cattaraugus Creek Sub-Watershed</u>

The Cattaraugus Creek sub-watershed, along with the Headwaters Cattaraugus Creek sub-watershed make up their own sub-basin, which drains into Lake Erie. The far reaches of this sub-watershed begin in Concord, Springville, Ashford, East Otto, and Mansfield. The midreaches flow through several towns in Erie and Cattaraugus Counties—mostly agricultural villages. In the lowest reaches it passes through Cattaraugus Indian Reservation and Hanover before draining into Lake Erie. There is adequate forest coverage in this sub-watershed, including parks and multiple use areas such as Zoar Valley, Cattaraugus State Forest, Deer Lick Nature Sanctuary, East Otto State Forest, and Dobbins Memorial State Forest. The Nature Conservancy, North Collins, Cattaraugus Indian Reservation and NYSDEC are all stakeholders in the forested areas with high conservation potential. There are also three designated wildlife preserves in this watershed operated by Nature Sanctuary Society of Western New York, which does not permit public access. These preserves host many unique plants ranging from sphagnum moss and orchids in a bog preserve, to protected floodplains with native wildflowers.

This sub-watershed encompasses six ecoregions before draining into Lake Erie: the Unglaciated High Allegheny Plateau, Glaciated Allegheny Hills, Low Allegheny Plateau, Cattaraugus Hills, Low Lime Drift Plain, and Erie/Ontario Lake Plain. As such, there is a variety of soil types, forest communities and climate patterns throughout this sub-watershed. Some parts of this sub-watershed are covered with broad sloping hills, open lands with rich soils, while other sections have steep shale cliffs and stony, nutrient-poor soils with hemlock-beech forests.

The main stem of Cattaraugus Creek is relatively long, about 50 miles. Most of the wetlands are in the northern extent of this sub-watershed with a large cluster in Otto and East Otto south of Cattaraugus Creek. The poorest water quality occurs at the end of the watershed, due to agricultural runoff accumulation (NYSDEC 2005). The lower stem of Cattaraugus Creek, Rainbow, Timber, and Clear Lakes are known to have minor impacts. One of greatest concern in this region is siltation, excess nutrients and low dissolved oxygen caused by agricultural runoff and erosion. Stream bank erosion naturally occurs in this region, but can be exacerbated by additional erosion as a consequence of poor agricultural practices. The remaining tributaries in this watershed have no known impacts affecting biological communities, as observed through macroinvertebrate testing. However, nutrient loading is evident from agricultural nonpoint sources and should be monitored, so that it does not continue to increase. Failed septic systems in the region are an identified cause for increased nutrients and decreased dissolved oxygen.[59]

Cattaraugus Creek is an important migratory body of water for salmonids and protection of this cold water fishery should be a priority. However, dating to at least 1970 there have been concerns about adequate dissolved oxygen from sewage input negatively affecting native brook trout (Barry and Kaczaja 1970). The NYSDEC RIBS assessments suggest that although healthy, pollution-sensitive macroinvertebrate communities are supported in all sampled streams, siltation and excess nutrients are present in most, if not all streams.[60]

Notable wildlife found in Zoar Valley forest includes Bald Eagles, red-spotted newt, and ruffed grouse, among others. NYSDEC is working with partners to re-establish American chestnuts in this forest, a tree which was nearly wiped out from blight.[61] Many other rare and/or slow-growing woodland plants thrive in the forests of Zoar Valley. Important cold water fisheries in the tributaries and Lake Erie are lake sturgeon, lake trout, brook trout, naturalized steelhead, brown trout, and Chinook salmon (NYSDEC 2006). However, Cattaraugus Creek also provides habitat for very large populations of sea lamprey in Lake Erie, with costly lampricide treatments necessary every three to five years. Important warm water fisheries in the Lake Erie waters and lower stem of Cattaraugus Creek are smallmouth bass, walleye and yellow perch.

This watershed is in fairly good condition; however, it should be protected from any further degradation. The most imminent threat is agricultural runoff in the watershed. Also, it is adjacent to the West Valley Demonstration Project, located in the Cattaraugus Headwaters sub-watershed, which is a storage area for hazardous radioactive waste. Although the hazardous waste is currently being stored in

[59] https://www.dec.ny.gov/docs/water_pdf/winiagcattrgslow.pdf

[60] New York State Department of Environmental Conservation (NYSDEC*), Rotating Integrated Basin Studies Water Quality Assessment Program New York Statewide Waters Monitoring Program. Niagara River Lake Erie Drainage Basin: Sampling years 2005 – 2006*. 2011

[61] New York State Department of Environmental Conservation (NYSDEC), *Zoar Valley Multiple Use Area.* 2017. http://www.dec.ny.gov/lands/36931.html

solid form, it cannot be disregarded as a potential threat to the biotic community should the storage facility be compromised.

Municipalities: Villages of Springville, Cattaraugus and Gowanda. Towns of Ashford, Concord, Ellicottville, Mansfield, East Otto, Otto, New Albion, Persia, Dayton, Collins, North Collins, Perrysburg, Brant, and Hanover. Cattaraugus Indian Reservation.

Total waterways: 837 miles including principal tributaries Cattaraugus Creek, Connoisarauley Creek, Clear Creek.
Total sub-watershed: 197,539 acres

Threats:

- Aquatic: Siltation due to stream bank erosion, nonpoint sources of agricultural runoff and septic system failure, inadequate dissolved oxygen which is necessary for trout and salmons.
- Wetlands: Loss of acreage, invasive species.
- Woodlands: Invasive species, fragmentation.
- Grasslands: Invasive species in meadows and floodplains (Zoar Valley).
- Natural areas: Fragmentation of contiguous natural areas.

Conservation Strategies:

- Reduce agricultural runoff into waterways through increasing riparian forest buffers.
- Protect the several high quality stream segments in this watershed from further degradation.
- Maintain strong riparian forest buffers.
- Continued protection and conservation of critical wetlands, bogs and floodplains by Nature Sanctuary Society of WNY.
- Partnerships with the several agencies that are active stakeholders in the region.
- Working with homeowners to improve and maintain septic systems. Work with farmers to implement best land use practices and cattle guards to prevent livestock from eroding and degrading streams.

<u>Headwaters Cattaraugus Creek Sub-Watershed</u>

The Cattaraugus Headwaters sub-watershed, along with the lower Cattaraugus Creek sub-watershed, make up their own sub-basin which drains into Lake Erie. The headwaters begin in the rural towns of Java, Arcade, Wethersfield, Farmersville and Freedom. The midreaches pass through Sardinia, Delevan, Yorkshire, and Machias which contain both forests and farms. Finally this sub-watershed feeds into the Cattaraugus Creek sub-watershed near Springville and Ashford.

This sub-watershed encompasses three ecoregions: Cattaraugus Hills, Glaciated Low Allegheny Plateau, and Glaciated Allegheny Hills. Cattaraugus Hills, in the northern portion host the only wetlands in the sub-watershed. The steep shale banks of the Glaciated Allegheny Hills and Plateau regions do not support wetland systems; however, the Cattaraugus Hills ecoregion can potentially support wetland systems (in the northern extent of this sub-watershed). Two state forests, Farmersville and Bush Hill, as well as Erie County forests are within this sub-watershed.

This sub-watershed has some of the best intact forest coverage of all those described in this report. It has multiple community types, both climax and successional communities: beech-mesic, hemlock-northern hardwoods, maple-basswood and northern- southern hardwoods (NYSDEC 2005). However, in the furthest upland extent of this sub-watershed, near Freedom and Delevan, agricultural areas begin to dominate and fragment the forests. Work with landowners to restore riparian buffers in these key locations would mitigate agricultural runoff to the lower reaches.

Both perennial and intermittent streams feed the main stem of Cattaraugus Creek. The streams in this sub-watershed sustain many fishes indicative of adequate water quality, such as darters, sculpins, shiners, suckers and daces (NYSDEC 2006). Non-native rainbow and brown trout have been established since the early 1900s due to early stocking (NYSDEC 2006). Fourteen tributaries in this sub-watershed support brook trout. Of these, Spring Brook has the greatest ability to sustain wild populations of brook trout, although lack of shade canopy as the stream meanders through a golf course is warming the stream and threatens the coldwater fishery. Scoby Dam, a 40 foot former hydroelectric dam near Springville, separates the headwaters from lower reaches of Cattaraugus Creek and prevents migration and movement of native trout along this tributary. The dam is currently being assessed with plans to be lowered in the near future. Although this will help to restore connectivity, it will likely increase sedimentation in the initial stages, then be a potential pathway for invasive and non-natives species such as sea lamprey and steelhead. These impacts could strain wild native brook trout populations thriving upstream of the dam (NYSDEC 2006). Preventative weirs and fish ladders are planned to be installed to exclude sea lamprey, while allowing other fish to pass through. There will also be lamprey traps installed during their spawning migrations for individuals to be euthanized.

Although this is a healthy sub-watershed, certain risks have been identified which could compromise these headwaters. Any degradation experienced in the headwaters has the potential to further exacerbate the stressors and impacts apparent in the lower Cattaraugus Creek watershed. Within the Cattaraugus headwaters is the West Valley Demonstration Project, a 3,000 acre storage area of hazardous radioactive waste and facilities from a fuel rod reprocessing facility near the town of Ashford. The liquid high-level radioactive waste was solidified in the early 2000s and is currently stored in 275 stainless steel canisters, each of which contains an average of 36,640 curies. Also on site are two radioactive waste burial grounds made up of 20 acres of unlined, unengineered trenches containing an estimated 340,000 curies. The facility is within the Buttermilk Creek and Cattaraugus Creek floodplains, and should not be dismissed as a potential threat to this watershed and Lake Erie. Decision making for the future of this site (clean-up or long term stewardship) is still in the process of studying options and will not be made until 2020. Any decision will take decades, if not centuries to implement and maintain.

Municipalities: Villages of Arcade, Delevan, and Springville. Towns of Java, Wethersfield, Eagle, Arcade, Centerville, Freedom, Rushford, Farmersville, Machias, Yorkshire, Sardinia, Concord, Ashford, and Ellicottville.

Total waterways: 615.27 miles including principal tributaries Cattaraugus Creek, Clear Creek, Elton Creek, Stony Creek, Spring Brook.
Total sub-watershed: 160,667 acres

Threats:

- Aquatic: Invasive sea lamprey movement to headwaters, stream bank erosion
- Wetlands: Loss of acreage, invasive species
- Woodlands: Natural forests are surrounded by farmland.
- Grasslands: Invasive species in meadows and floodplains, mowing regimes on farmland impact grassland-dependent bird nests
- Natural areas: Nuclear and hazardous waste storage facility near floodplains and streams.

Conservation Strategies:

- Protection of wild brook trout populations in key tributaries.
- Early detection monitoring for invasive sea lamprey post-dam removal.
- Continued protection of forested areas, particularly stream riparian buffers.
- Work with NYSDEC and Erie County to increase acreage or quality of the state and county forests.
- Work with homeowners and farmers to implement BMPs, including strip barriers between croplands and forests, maintenance on septic systems, mowing strategies to protect grassland dependent species and excluding livestock from natural areas.
- Work with NYSERDA to ensure that West Valley Demonstration project hazardous waste storage tanks are adequately maintained.

Walnut Creek Sub-Watershed

The Walnut Creek sub-watershed is the northernmost of the Chautauqua/Erie sub-basin, and encompasses portions of the Erie/Ontario Plain and Low Lime Drift Plain ecoregions. The Erie Lake Plain ecoregion consists of beach dunes with various grass species, and nutrient rich soils containing limestone and shale that allow for agricultural success. This ecoregion is susceptible to lake effect weather conditions. The lower reaches of Walnut Creek have shale cliff and talus communities, with a narrow band of forest buffer surrounded by agricultural land. The headwaters, in the Low Lime Drift Plain are rockier and more protected with forest coverage (NYSDEC 2005), however the forests are fragmented by agricultural land throughout the entire area. These soils are poorly-drained and better suited for livestock than farming.

The headwaters of this sub-watershed begin in Villenova, Arkwright, and Perrysburg. Most of the sub-watershed is located in the town of Hanover, with some portions in Sheridan and Forestville as well. It eventually drains directly into Lake Erie at Silver Creek and Hanover. Most of the sub-watershed is within Chautauqua County, but there is a small portion in Cattaraugus County as well. Some segments of Wheeler Brook and Silver Creek tributaries have farmland right up to the stream, without any riparian buffer whatsoever. Suburban development from the village of Silver Creek expands right up to the Lake

Erie coastline. Working with landowners to address these issues would significantly improve water conditions in this watershed. There are no major county or state parks within this sub-watershed and the only notable wetlands are on the southernmost edge near Villenova.

Upper Silver Creek and Silver Creek Reservoir have no known impacts, as described by the NYSDEC to date. Halfway Brook, Walnut Creek and Lower Silver Creek have minor impacts to water quality.[62] Halfway Brook has shifted to a pollution tolerant community of macroinvertebrates, most likely as a response to lowered dissolved oxygen and increased organic loads from sewage input. Walnut Creek is reported to have poor dissolved oxygen, increased phosphorous and siltation, and possible thermal pollution. Logging activities have increased turbidity, sedimentation and siltation loads in lower Silver Creek. In 2012, NYSDEC initiated legal action against the Silver Creek wastewater treatment plant for violation of SPDES regulations. The plant was reportedly using clarifiers intended for secondary wastewater treatment and bypassing primary treatment steps, and releasing improperly treated waste.[63]

Silver Creek (CT) and Halfway Brook (CTS) are designated for fishing (C), and as important streams for trout habitat (T) and potentially trout spawning (S). These streams can support various species of trout, including naturalized ones such as steelhead and brown trout. Future protection and stocking may eventually support self-sustaining brook trout, a native species of interest. As with other sub-watersheds encompassing eastern Lake Erie, lake trout and lake sturgeon are important native species warranting protection and conservation. Lake trout cannot inhabit the shallower western and central basins of Lake Erie, thus their habitat in this lake is limited. Other notable warm water fishes in eastern Lake Erie are walleye, yellow perch, channel catfish and large and smallmouth bass. Important avian species such as Bald Eagles, waterfowl, gulls, and many other migratory birds utilize the Lake Erie coastline.

Municipalities: Villages of Forestville and Silver Creek. Towns of Arkwright, Sheridan, Perrysburg, Villenova, and Hanover.

Total waterways: 129.44 miles including principal tributaries Walnut Creek, Tupper Creek, Silver Creek and Wheeler Brook.
Total sub-watershed: 36,014 acres

Threats:

- Aquatic: Improper wastewater treatment methods and release of sewage (leading to pathogen loads and inadequate dissolved oxygen), siltation caused by logging practices, nutrient loading from agricultural runoff, potential thermal pollution sources.
- Wetlands: Lack of connectivity, lack of formal protection, invasive species.
- Woodlands: Loss of riparian woodlands, forests are extremely fragmented by suburban development and agriculture on all sides, lack of formal protection.

[62] https://www.dec.ny.gov/docs/water_pdf/winiagwalnutcr.pdf
[63] Ibid

- Grasslands: Invasive species in grass dunes along Erie coasts and houses replacing dune areas, mowing regimes on farmland impact grassland-dependent bird nests.
- Natural areas: No natural areas with formal protection or designation on state, county or municipality level.

Conservation Strategies:

- Restoration and reclamation of forested riparian buffers, particularly along Wheeler Brook, Silver Creek and Walnut Creek, where agriculture fields dominate.
- Development of formal protection status of natural areas, or watershed plan in this sub-watershed is essential.
- Protection of wetlands.
- Protection of streams described as having minor impacts and prevention of further degradation cause by agricultural runoff.
- Increase the acreage and quality of natural forests, reduce fragmentation.
- Consider partnering with the Chautauqua Lake & Watershed Management Alliance (and their affiliated members) to promote the Agricultural Environmental Management Program to promote best management practices with farmers (in partnership with the Soil and Water Conservation District).

Canadaway Creek Sub-Watershed

The Canadaway Creek sub-watershed is located within the Chautauqua/Erie sub-basin and is entirely in Chautauqua County. It begins in the towns of Charlotte and Arkwright, then flows through Pomfret Fredonia, Sheridan and Dunkirk. Erie/Ontario Lake Plain and Low Lime Drift Plain are the two ecoregions of this area. The Erie Lake Plain ecoregion consists of beach dunes with various grass species, and nutrient rich soils containing limestone and shale that allow for agricultural success. This ecoregion is susceptible to lake effect weather conditions. The Low Lime ecoregion is comprised of beech-maple forests and numerous depositional glacial landforms. Those soils are poorly-drained and better suited for livestock than farming. This sub-watershed has intact forest coverage in the furthest reaches; however the land closest to Lake Erie shores is almost entirely altered by the city of Dunkirk and/or agricultural lands.

Lake Erie waters and two tributaries (Crooked Brook and Scott Creek) are listed as impaired by the NYSDEC. Lake Erie is impaired due to the presence of PCBs in the sediments, fish consumption advisories, and pathogen and storm runoff in the waters. Hyde Creek, which flows through the city of Dunkirk, has been identified as a source of storm runoff transport into Lake Erie. The impaired streams have excessive nutrient inputs, although the source has not been confirmed. In Crooked Brook and Scott Creek, macroinvertebrate communities were moderately impacted, though Scott was nearly categorized as severely impacted. Pollution tolerant species are missing, with an overrepresentation of tolerant species. Dissolved oxygen levels were poor and nutrients were elevated. However, both of these tributaries are suspected to have other pollution sources, which are to date unidentified. Upper and lower Canadaway Creek are not impaired. Many other tributaries are listed as threatened, with unverified sources of pollution input. Siltation from logging and stream bank erosion, thermal pollution, inadequate sewage treatment from Dunkirk's WWTP, industrial and urban runoff from Dunkirk, and livestock runoff from agriculture are all suspected causes.[64]

Sheridan has the most emergent wetland and woodlands of all the municipalities, but they are fragmented by roads and development. In the southern reaches of this sub-watershed, in Arkwright, is the Canadaway Wildlife Management Area (owned by the NYSDEC) with a few small county forest parcels adjacent to it. Just south of this, in Charlotte is the Boutwell Hill State Forest, also owned by NYSDEC. These two areas are the largest core forest areas and likely have the highest conservation impact in the sub-watershed. The NYSDEC has recently prepared an in-depth management plan for these forests, which aims to increase habitat for species in decline, while also utilize the land for logging.[65]

Notable wildlife in the state forests include black bear, deer, Wild Turkey, Ruffed Grouse, American Woodcock[66], and multiple species of frogs, snakes and turtles. Multiple threatened, high priority, and species of concern are found in these woods as well, including many types of grassland and young forest dependent birds. For this reason, the NYSDEC currently manages abandoned pastures as grassland habitat, and is working to convert softwood plantations back to young forests in early succession stages to support several of these species. As with other sub-watersheds that encompass the eastern basin of Lake Erie, there are important warm and cold water fishes to protect including lake sturgeon, lake trout, walleye, channel catfish, large and smallmouth bass, and yellow perch. Recreational species that are not native, but have naturalized include brown trout, Chinook salmon, and steelhead.

Municipalities: Villages of Silver Creek and Fredonia. Towns of Sheridan, Hanover, Arkwright, Charlotte, Stockton, Pomfret, Dunkirk, and Portland. City of Dunkirk.

Total waterways: 187.33 miles including principal tributaries Canadaway Creek, Little Canadaway Creek, Scott Creek, Beaver Creek
Total sub-watershed: 64,521 acres

Threats:

- Aquatic: Urban runoff from city of Dunkirk,
- Wetlands: Fragmentation, invasive species
- Woodlands: Fragmentation from agriculture and urban sprawl
- Grasslands: Invasive species in grass dunes along Erie coasts, mowing regimes on farmland impact grassland-dependent bird nests
- Natural areas: Lack of protection, increasing urbanization and suburban sprawl

Conservation Strategies:

[64] https://www.dec.ny.gov/docs/water_pdf/winiagcanadaway.pdf
[65] New York State Department of Environmental Conservation (NYSDEC*), Habitat Management Plan for Canadaway Creek Wildlife Management Area*. 2017
[66] Audubon title case capitalization is used for bird species only

- Reduce impervious surface in the city of Dunkirk. Install green infrastructure, particularly along Hyde Creek where urban runoff is polluting Lake Erie.
- Increase forest areas and riparian zones where agricultural lands begin to dominate in lower reaches.
- Identify sources of pollution and degradation to threatened stream segments.
- Reduce siltation from poor logging practices by increasing buffer distance between logging fields and waterways. Install living shorelines along streams where riparian zones have been logged.
- Protection of wetlands in Sheridan from further fragmentation and/or invasive species.
- Partnerships with the Chautauqua Lake & Watershed Management Alliance (and their affiliated members) to promote BMPs among regional farmers (see Walnut Creek sub-watershed for further detail).

Chautauqua Creek Sub-Watershed

Chautauqua Creek is in the Chautauqua/Erie sub-basin, divided between the Erie/Ontario Plain and Low Lime Drift Plain ecoregions. The Erie Lake Plain ecoregion consists of beach dunes with various grass species, and soils containing limestone and shale that allow for agricultural success. This ecoregion is susceptible to lake effect conditions. The Low Lime ecoregion is comprised of beech-maple forests and numerous depositional glacial landforms. Those soils are poorly-drained and better suited for livestock than farming. Compared to the other sub-watersheds in the same ecoregion, Chautauqua Creek has better forest coverage, approximately 70%, with most of the agriculture occurring closest to Lake Erie (NYSDEC 2005). There are many small wetland patches interspersed throughout the watershed, but there are not any large connected wetland regions.

The headwaters of this sub-watershed begin in Westfield and Chautauqua and the lower reaches pass through Brocton and Portland, which drain to Lake Erie. It contains Chautauqua Gorge State Forest, which has steep shale banks on either side of Chautauqua Creek and bedrock creek bottom. This 538-acre forest has a popular swimming spot for tourists and day hikers. It borders private property, but the portion that belongs to the state is protected and fairly rustic. On the far southeastern edge of this sub-watershed is Mount Pleasant State Forest. Mount Pleasant State Forest is just over 1,500 acres in size and hosts many mammals and birds such as bear, deer, rabbit, Turkey and Ruffed Grouse. This forest is managed by the NYSDEC for logging and forestry practices.

Lake Erie State Park in Brocton is a large campground and park in this sub-watershed. As with other Lake Erie coastal areas, it is an important stopover point for many migratory birds, and species of interest such as the Bald Eagle. Important cold and warm water fishes to protect include lake sturgeon, lake trout, walleye, large and smallmouth bass, channel catfish and yellow perch. Recreational species throughout the watershed include naturalized populations of brown trout, Chinook salmon, and steelhead. Lake Erie State Park has some wetland habitat intact, which hosts herpetiles such as salamanders and frogs.

Currently, this sub-watershed is in good condition; all the stream segments in this watershed are listed as having no known impact, though some are considered threatened by the NYSDEC.[67] Several streams host healthy communities of macroinvertebrates, and Chautauqua Creek is listed as a suitable trout habitat stream. However, agricultural and non-point sources are suspected to be in the early stages of affecting waters, and protection is necessary to prevent degradation of this relatively healthy sub-watershed. Westfield WWTP has been required to address water treatment and overflow issues, and has rectified most of them to date. This watershed is adjacent to the Chautauqua Lake watershed, which has a very thorough water management plan in place by various watershed partners in that region. Collaboration with these conservation groups may play a future role in ensuring the protection of the Chautauqua Creek sub-watershed.

Municipalities: Villages of Brocton and Westfield. Towns of Pomfret, Portland, Chautauqua, Westfield, and Ripley.

Total waterways: 180.43 miles including principal tributaries Chautauqua Creek, Little Chautauqua Creek, Doty Creek, Spring Creek, Bournes Creek, Walker Creek, Corell Creek, and Slipper Rock Creek. Total sub-watershed: 51,243 acres

Threats:

- Aquatic: Agricultural non-point sources of nutrients and water pollution. Inadequate sewage treatment by Westfield WWTP.
- Wetlands: Fragmentation, invasive species.
- Woodlands: Loss of forests in lower reaches of watershed.
- Grasslands: Invasive species in grass dunes along Erie coasts, mowing regimes on farmland impact grassland-dependent bird nests
- Natural areas: Overuse or misuse in recreational areas (Chautauqua Gorge State Forest)

Conservation Strategies:

- Identification and resolution of non-point pollution threats to tributaries. Working with homeowners to encourage septic system routine maintenance.
- Protection of wetlands.
- Increase stream buffers in lower reaches of watershed.
- Partnerships with the Chautauqua Lake & Watershed Management Alliance (and their affiliated members) to promote BMPs among regional farmers (see Walnut Creek sub-watershed for further detail).
- Partnerships with the NYSDEC in state forests, which have high conservation value.

Six Mile Sub-Watershed

For the purpose of this report, only the portion of this sub-watershed within New York State boundaries is described. Pennsylvania municipalities and streams are not surveyed; however they are an integral

[67] https://www.dec.ny.gov/docs/water_pdf/winiagchautauqua.pdf

component of the sub-watershed health as well. On the New York side, this sub-watershed begins in the towns of Mina and Sherman. The bulk of the watershed is within the towns of Ripley and Westfield before the tributaries drain into Lake Erie.

The Six Mile sub-watershed is within the Chautauqua/Erie sub-basin and encompasses the Erie/Ontario Lake Plain and Low Lime Drift Plain ecoregions. The Erie Lake Plain ecoregion consists of beach dunes with various grass species, and soils containing limestone and shale that allow for agricultural success. This ecoregion is susceptible to lake effect weather conditions. The Low Lime ecoregion is comprised of beech-maple forests and numerous depositional glacial landforms. Those soils are poorly-drained and better suited for livestock than farming. The Lake Erie coastline, lower reaches and headwaters of this sub-watershed are dominated by agriculture. Twentymile Creek is well forested along its corridor; however it is surrounded by agriculture on either side. The nearest 2-3 miles to Lake Erie coasts in this watershed are nearly all agriculture.

There are no major parks in this sub-watershed on the NY side. However, there are five small parcels owned by the county, reserved for reforestation with minimal conservation value (NYPAD GIS Data Layer). There is one large (~100 acres) shrub wetland community intact; however it is bounded by the I-90 to the north and the 20 to the south. The remaining wetlands are patchy, interspersed and fragmented by farmland and roads (USFWS, National Wetland Inventory).

Lake Erie waters near Barcelona Harbor are impacted due PCB contaminated sediments and fish advisories. Twentymile Creek has very healthy macroinvertebrate communities (as of 2005 NYSDEC RIBS sampling efforts). Upper Belson Creek, Gage Gulf, and minor tributaries leading to Lake Erie, however are threatened and/or need continued monitoring to properly assess the health of the aquatic ecosystems. Pathogen inputs from poor agricultural practices are suspected impairments that may impact aquatic communities if these waterways are not protected from degradation.

As with other sub-watersheds that encompass the eastern basin of Lake Erie, there are important cold and warm water fishes to protect including lake sturgeon, lake trout, walleye, small and largemouth bass, channel catfish, and yellow perch. Recreational species of importance include naturalized populations of brown trout, Chinook salmon, and steelhead. Many migratory and resident avian species utilize the Erie coastlines, such as raptors including Bald Eagles, gulls, and various waterfowl.

Municipalities: Village of Westfield. Towns of Westfield, Sherman, Mina, and Ripley. This report does not include municipalities in the state of Pennsylvania.

Total waterways: 573.63 miles including principal tributaries Norge Creek, Freelings Creek, Twentymile Creek, Belson Creek, and Gage Gulf. This report does not include waterways in the state of Pennsylvania.

Total sub-watershed: 68 acres

Threats:

- Aquatic: agricultural runoff, pathogen input
- Wetlands: Lack of protection, invasive species, fragmentation

- Woodlands: Lack of protection, no significant core forests, all forests are bound by agriculture and suburban sprawl.
- Grasslands: Invasive species in grass dunes along Erie coasts, mowing regimes on farmland impact grassland-dependent bird nests
- Natural areas: There are no large protected natural areas or notable parks within this sub-watershed, fragmentation and suburban sprawl.

Conservation Strategies:

- Close monitoring and protection of streams with no known impact.
- Increase forest coverage and riparian zones to reduce pathogen and nutrient input. Forest riparian zones in the headwaters would be ideal.
- Working with the county to improve protected forest areas, and increase woodland acreage.
- Protection of wetlands.
- Partnerships with the Chautauqua Lake & Watershed Management Alliance (and their affiliated members) to promote BMPs among regional farmers (see Walnut Creek sub-watershed for further detail).
- The Jillson Road Farm (>100 acres) within this sub-watershed is under conservation easement with WNY Land Conservancy. Partnership with this farmer may lead to increased BMP and conservation implementation, as this farm is immediately adjacent to Freelings Creek, which feeds Lake Erie.

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Chapter 6: Assessment of Local Laws and Practices Affecting Water Quality

Local municipalities play a critical role in the stewardship of watersheds. Actions regulated at the municipal level in a home-rule state such as New York contribute greatly to the quality of local water resources. Through the development and enforcement of the municipalities' ordinances and practices for road de-icing, stormwater management, sediment and erosion control, development standards and other activities, watersheds and water quality may be protected and improved.

This chapter reviews the ability and capacity of local governments throughout the Niagara River/Lake Erie Watershed to control non-point source pollution by assessing their existing local laws and management practices.

Regional Niagara River/Lake Erie Watershed Management Plan Municipalities

Allegany County **2 Municipalities**

Towns of Centerville and Rushford

Cattaraugus County **15 Municipalities**

Towns of Ashford, Dayton, East Otto, Ellicottville, Farmersville, Freedom, Machias, Mansfield, New Albion, Otto, Perrysburg, Persia, Yorkshire

Villages of Cattaraugus and Delevan

Chautauqua County **19 Municipalities**

City of Dunkirk

Towns of Arkwright, Charlotte, Chautauqua, Dunkirk, Hanover, Mina, Pomfret, Portland, Ripley, Sheridan, Sherman, Stockton, Villenova, Westfield

Villages of Brocton, Fredonia, Silver Creek, and Westfield

Erie County **44 Municipalities**

Cities of Buffalo*, Lackawanna*, Tonawanda*

Towns of Alden*, Amherst*, Aurora*, Boston*, Brant, Cheektowaga*, Clarence*, Colden, Collins, Concord, Eden*, Elma*, Evans*, Grand Island*, Hamburg*, Holland, Lancaster*, Marilla, Newstead, North Collins, Orchard Park*, Sardinia, Tonawanda*, Wales, West Seneca*

Villages of Akron, Alden*, Angola*, Blasdell*, Depew*, East Aurora*, Farnham, Gowanda, Hamburg*, Kenmore*, Lancaster*, North Collins, Orchard Park*, Sloan*, Springville, Williamsville*

Genesee County **10 Municipalities**

City of Batavia

Towns of Alabama, Alexander, Batavia, Bethany, Darien, Pembroke, Stafford,

Villages of Alexander and Corfu

Niagara County **13 Municipalities**

Cities of Lockport*, Niagara Falls*, North Tonawanda*

Towns of Cambria*, Lewiston*, Lockport, Niagara*, Pendleton*, Porter*, Royalton, Wheatfield*

Villages of Lewiston* and Youngstown*

Orleans County **1 Municipality**

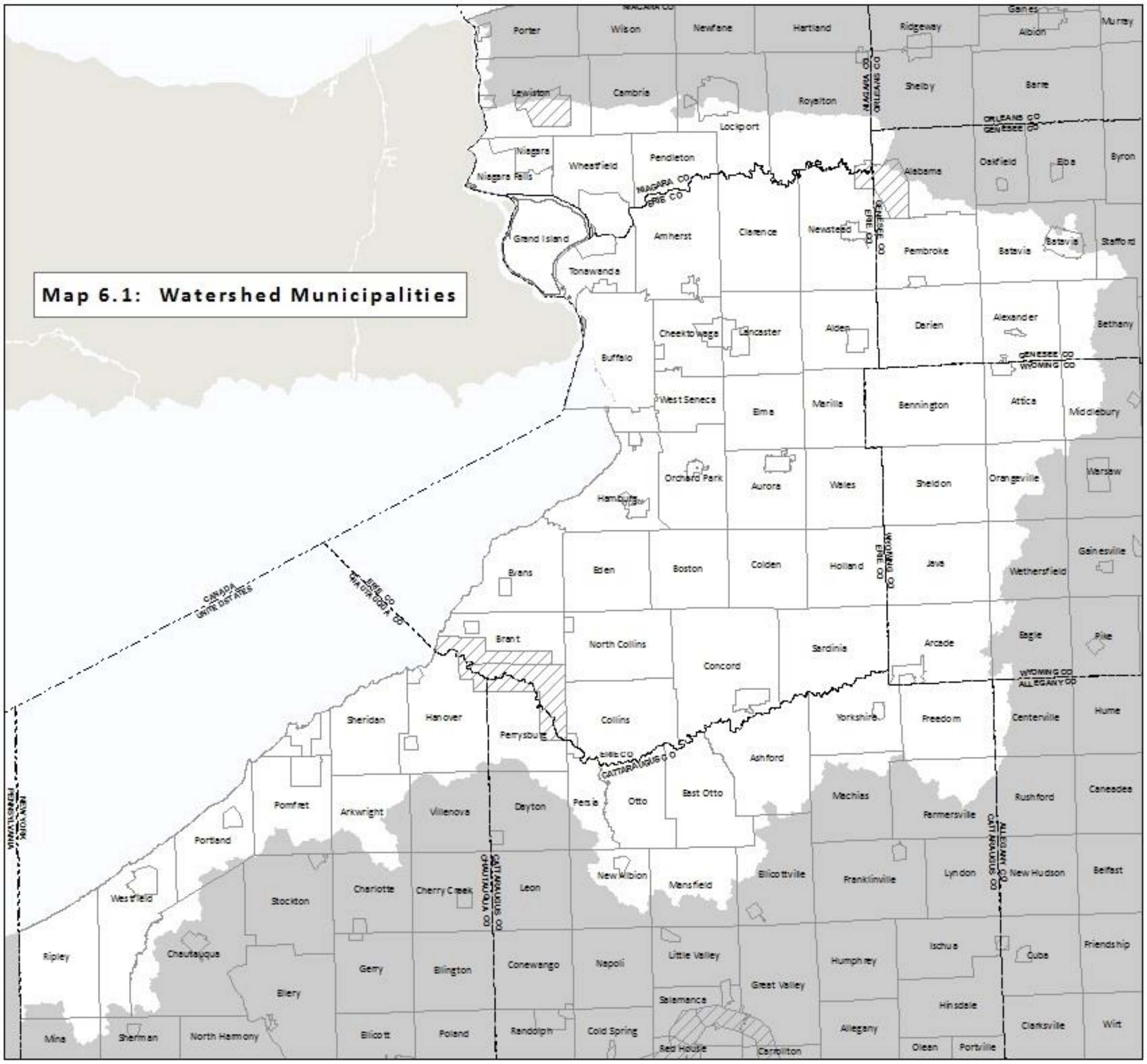
Town of Shelby

Wyoming County **12 Municipalities**

Towns of Arcade, Attica, Bennington, Eagle, Java, Middlebury, Orangeville, Sheldon, Warsaw, Wethersfield

Villages of Arcade and Attica

**Indicates municipalities that are MS4 communities located in Erie and Niagara Counties.*



Map 6.1: Watershed Municipalities

Assessment Methodology

Because of the sheer size of the watershed (2,381 square miles) and the number of municipalities it encompasses (116 total), the analysis of municipal efforts was broken into two levels. The first level is a general assessment of the use and status of common planning and development tools across the watershed as a whole. This initial review provides a collective snapshot of the level to which watershed municipalities plan and regulate land use and development; which can affect how our water resources are being maintained, protected, and restored.

The second level of review involved a much more in-depth assessment of local laws and zoning regulations, as well as any local departmental policies or practices (documented or un-documented), to gauge how municipalities are directly employing Best Management Practices (BMPs) for watershed protection. This in-depth assessment involved 18 municipalities spread across the watershed, which were chosen based on their location, development density, current trends or appropriate timing, and willingness to participate in the assessment.

Findings from both the general and in-depth assessments reveal opportunities to expand regulations, programs and practices for watershed protection at the local level. To further assist municipalities in improving their effectiveness, a series of resources are also outlined in this section of the plan, including information on BMPs, model zoning ordinances, and a summary of supporting programs and technical assistance provided by other organizations and agencies.

Municipal Role in Water Quality Control

While there is an increasing tendency to plan for and manage surface and ground waters on a regional basis, local governments with the power to regulate and oversee land development are essential players of these critical efforts. In New York State, local municipalities have significant land use powers[1] that can be used to address a wide variety of environmental issues. Comprehensive plans, land use and zoning tools such as site plan review, subdivision regulation, erosion and sediment control ordinances, and special use permits can be used separately or in combination to protect/conserve important water resources.

General Assessment of Local Planning & Development Tools

The following tables identify which communities in the watershed employ basic planning and zoning tools. Municipalities are not required to have such regulations in New York State and their existence for a specific community should not be assumed. In some cases even if such regulations do exist, they are not always up to date or as effective as they could be.

[1] New York is a Home Rule state. See NY MHR Law Articles 1- 6.

Table 6.1 Status of Municipal Planning & Zoning Tools for Erie County

Municipality	Type	Comp. Plan	Zoning	Sub-division	Site Plan Review	Municipality	Type	Comp. Plan	Zoning	Sub-division	Site Plan Review
Buffalo	City	Yes (2006)	Yes	Yes	Yes	North Collins	Town	Yes (1996)	Yes	Yes	Yes
Lackawanna	City	Yes (2001)	Yes	No	Yes	Orchard Park	Town	Yes (2007)	Yes	Yes	Yes
Tonawanda	City	Yes (2002)	Yes	Yes	Yes	Sardinia	Town	Yes (2003)	Yes	Yes	Yes
Alden	Town	Yes (2009)	Yes	Yes	Yes	Tonawanda	Town	Yes (2005)	Yes	Yes	Yes
Amherst	Town	Yes (2011)	Yes	Yes	Yes	Wales	Town	Yes (2002)	Yes	Yes	Yes
Aurora	Town	Yes (2012)	Yes	Yes	Yes	West Seneca	Town	Yes (2016)	Yes	Yes	Yes
Boston	Town	Yes (2002)	Yes	Yes	Yes	Akron**	Village	Yes (2001)	Yes	Yes	Yes
Brant	Town	Yes (2003)	Yes	Yes	Yes	Alden	Village	Yes (2009)	Yes	Yes	Yes
Cheektowaga	Town	Yes (2010)	Yes	Yes	Yes	Angola**	Village	Yes (2003)	Yes	Yes	Yes
Clarence	Town	Yes (2007)	Yes	Yes	Yes	Blasdell	Village	Yes (1992)	Yes	Yes	Yes
Colden	Town	Yes (2002)	Yes	Yes	Yes	Depew**	Village	Yes (2000)	Yes	Yes	Yes
Collins	Town	Yes (1999)	Yes	Yes	No	East Aurora	Village	Yes (2002)	Yes	Yes	Yes
Concord**	Town	Yes (1999)	Yes	Yes	Yes	Farnham	Village	Yes (2003)	No	No	No
Eden**	Town	Yes (2000)	Yes	Yes	Yes	Gowanda**	Village	Yes (1999)	Yes	No	Yes
Elma**	Town	Yes (2008)	Yes	Yes	Yes	Hamburg	Village	Yes (2012)	Yes	Yes	Yes
Evans**	Town	Yes (1999)	Yes	Yes	Yes	Kenmore	Village	Yes (2003)	Yes	Yes	Yes
Grand Island**	Town	Yes (2011)	Yes	Yes	Yes	Lancaster	Village	Yes (2000)	Yes	Yes	Yes
Hamburg	Town	Yes (2008)	Yes	Yes	Yes	North Collins**	Village	Yes (1969)	Yes	Yes	Yes
Holland**	Town	Yes (2002)	Yes	Yes	Yes	Orchard Park	Village	Yes (2002)	Yes	Yes	Yes
Lancaster**	Town	Yes (2000)	Yes	Yes	Yes	Sloan	Village	No	Yes	No	No
Marilla	Town	Yes (1998)	Yes	Yes	Yes	Springville	Village	Yes (2015)	Yes	Yes	Yes
Newstead**	Town	Yes (2001)	Yes	Yes	Yes	Williamsville	Village	Yes (2008)	Yes	Yes	Yes
						TOTALS	44	43	43	40	41

**indicates municipalities updating their comprehensive plans during Phase 2

Table 6.2 Status of Municipal Planning & Zoning Tools for Niagara County

Municipality	Type	Comp. Plan	Zoning	Sub-division	Site Plan Review	Municipality	Type	Comp. Plan	Zoning	Sub-division	Site Plan Review
Lockport	City	Yes (1999)	Yes	Yes	Yes	Pendleton	Town	Yes (2008)	Yes	Yes	Yes
Niagara Falls	City	Yes (2009)	Yes	Yes	Yes	Porter	Town	Yes (2004)	Yes	Yes	Yes
N. Tonawanda	City	Yes (2008)	Yes	Yes	Yes	Royalton	Town	Yes (2009)	Yes	Yes	Yes
Cambria	Town	Yes (1997)	Yes	Yes	Yes	Wheatfield	Town	Yes (2012)	Yes	Yes	Yes
Lewiston	Town	Yes (2011)	Yes	Yes	Yes	Lewiston	Village	Yes (2004)	Yes	Yes	Yes
Lockport	Town	Yes (1999)	Yes	Yes	Yes	Youngstown	Village	Yes (1972)	Yes	Yes	Yes
Niagara	Town	Yes (1972)	Yes	Yes	Yes	TOTALS	13	13	13	13	13

Table 6.3 Status of Municipal Planning & Zoning Tools for Genesee and Orleans Counties

Municipality	Type	Comp. Plan	Zoning	Sub-division	Site Plan Review	Municipality	Type	Comp. Plan	Zoning	Sub-division	Site Plan Review
Batavia	City	Yes (1997)	Yes	Yes	Yes	**Pembroke**	Town	Yes (2007)	Yes	Yes	Yes
Alabama	Town	Yes (2004)	Yes	Yes	Yes	**Stafford**	Town	Yes (2009)	Yes	Yes	Yes
Alexander	Town	Yes (2003)	Yes	Yes	Yes	**Alexander**	Village	Yes (2003)	Yes	Yes	Yes
Batavia	Town	Yes (2007)	Yes	Yes	Yes	**Corfu**	Village	Yes (2008)	Yes	Yes	Yes
Bethany	Town	Yes (2007)	Yes	Yes	Yes	**Shelby***	Town	Yes (2003)	Yes	Yes	Yes
Darien	Town	Yes (2005)	Yes	Yes	Yes	**TOTALS**	**11**	**11**	**11**	**11**	**11**

* Shelby (Town) is in the County of Orleans

Table 6.4 Status of Municipal Planning & Zoning Tools for Wyoming and Allegany Counties

Municipality	Type	Comp. Plan	Zoning	Sub-division	Site Plan Review	Municipality	Type	Comp. Plan	Zoning	Sub-division	Site Plan Review
Arcade	Town	Yes (1996)	Yes	Yes	Yes	**Warsaw**	Town	Yes (2004)	Yes	Yes	Yes
Attica	Town	Yes (2011)	Yes	Yes	Yes	**Wethersfield**	Town	No	No	No	No
Bennington	Town	Yes (2005)	Yes	No	Yes	**Arcade**	Village	Yes	Yes	Yes	Yes
Eagle	Town	No	No	No	No	**Attica**	Village	Yes (2003)	Yes	Yes	Yes
Java	Town	Yes (1987)	Yes	No	Yes	**Centerville***	Town	No	No	No	No
Middlebury	Town	Yes (2009)	Yes	No	Yes	**Rushford***	Town	Yes (2013)	Yes	Yes	Yes
Orangeville	Town	Yes (2009)	Yes	No	Yes	**TOTALS**	**14**	**11**	**11**	**6**	**10**
Sheldon	Town	Yes (2011)	Yes	No	No						

*Centerville (Town) and Rushford (Town) are in the County of Allegany

Table 6.5 Status of Municipal Planning & Zoning Tools for Cattaraugus County

Municipality	Type	Comp. Plan	Zoning	Sub-division	Site Plan Review	Municipality	Type	Comp. Plan	Zoning	Sub-division	Site Plan Review
Ashford	Town	In Progress	Yes	Yes	Yes	**New Albion**	Town	Yes (1997)	Yes	Yes	No
Dayton	Town	Yes (2009)	Yes	Yes	Yes	**Otto**	Town	In Progress	Yes	No	Yes
East Otto	Town	Yes (pending)	Yes	Yes	Yes	**Perrysburg**	Town	Yes (1971)	Yes	Yes	No
Ellicottville	Town	Yes (2006)	Yes	Yes	Yes	**Persia**	Town	In Progress	Yes	Yes	Yes
Farmersville	Town	No	No	No	No	**Yorkshire**	Town	Yes (1995)	Yes	Yes	Yes
Freedom	Town	Yes	No	No	No	**Cattaraugus**	Village	Yes (2004)	Yes	Yes	No
Machias	Town	No	No	No	No	**Delevan**	Village	Yes	Yes	Yes	Yes
Mansfield	Town	Yes (2004)	Yes	Yes	Yes	**TOTALS**	**15**	**13**	**12**	**11**	**9**

Table 6.6 Status of Municipal Planning & Zoning Tools for Chautauqua County

Municipality	Type	Comp. Plan	Zoning	Sub-division	Site Plan Review	Municipality	Type	Comp. Plan	Zoning	Sub-division	Site Plan Review
Dunkirk	City	Yes (1997)	Yes	Yes	Yes	**Sheridan**	Town	No	Yes	Yes	Yes
Arkwright	Town	No	Yes	Yes	No	**Sherman**	Town	No	No	No	No
Charlotte	Town	No	No	No	No	**Stockton**	Town	No	Yes	No	Yes
Chautauqua	Town	In Progress	Yes	No	Yes	**Villenova**	Town	No	Yes	Yes	No
Dunkirk	Town	In Progress	Yes	No	Yes	**Westfield**	Town	Yes (1997)	Yes	Yes	No
Hanover	Town	Yes (2000)	Yes	Yes	Yes	**Brocton**	Village	No	Yes	No	No
Mina	Town	Yes (2006)	Yes	Yes	No	**Fredonia**	Village	Yes	Yes	Yes	Yes
Pomfret	Town	Yes (2011)	Yes	No	Yes	**Silver Creek**	Village	No	Yes	No	No
Portland	Town	Yes (2016)	Yes	No	Yes	**Westfield**	Village	Yes (1997)	Yes	Yes	Yes
Ripley	Town	Yes (2017)	Yes	No	Yes	**TOTALS**	**19**	**11**	**17**	**9**	**11**

Comprehensive Plans

96 of the 116 Regional Niagara River/Lake Erie Watershed municipalities have developed Comprehensive Plans.

Comprehensive plans or municipal plans are guidance documents developed with widespread community input, to identify and define a community's vision and goals for the future. The planning process analyzes current conditions and trends, plus community needs and challenges, and then relates those findings to the public's vision for the future. The outcome of the planning process is a broad set of goals and strategies to guide the community's future direction for a variety of topic areas, such as land use and development, natural resource conservation, affordable housing, economic development, and municipal services. By incorporating water quality goals and strategies into a community's comprehensive plan, local municipalities can have a long lasting impact on protecting and improving the surrounding watershed.

Almost every municipality in the watershed has a comprehensive plan, but many of them have not been updated on a regular basis, which can lessen their effectiveness. At the time of Phase 1 of this study (in 2014) approximately 22 communities had recently updated their comprehensive plans (within the last 5 years), and only three (3) communities had comprehensive plans over 20 years old. A majority of the remaining plans were developed in the early-to-mid 2000's. For Phase 2 in 2017, the number of municipalities in the watershed was increased from 71 to 116. At this time, eight (8) communities had updated their plans within the last 5 years, and 18 were currently updating their plans (13 of them in Erie County). Approximately sixteen (16) communities' plans were over 20 years old.

It should also be noted that the best comprehensive plans are only as effective as the tools by which they are implemented, such as updating zoning regulations to align with the plan's recommendations, conservation and affordable housing programs, and capital budget plans.

Zoning Regulations

Zoning is the most common and extensively used way of regulating local land use and development. It also serves as the primary tool for implementing comprehensive plan recommendations. Zoning generally regulates the use, density, siting, and form of development on individual parcels of land. Zoning directs the way a community develops. Just as zoning controls the relationship between different – and potentially conflicting - uses, it also can control how development impacts water quality.

106 of the 116 Regional Niagara River/Lake Erie Watershed municipalities have adopted Zoning Regulations.

Having zoning regulations in effect does not necessarily mean the watershed is protected from poor development decisions. More so, it is how the zoning regulations are designed, what existing natural site features, if any, are taken into account during permitting, and how effectively these regulations are enforced. Without proper enforcement of local ordinances, it's almost as if no regulations are in effect at all.

Site Plan Review

Site Plan Review is a component of zoning that is used to review the layout and design of development on individual projects. Depending on how elaborate the local site plan review requirements are, the Planning Board (or local legislature or other designated review board) can use it to dictate such specifics as building placement, vehicular access and parking, drainage and stormwater design, landscaping, and the protection and maintenance of natural features existing on the site. It is an essential zoning tool for a community to control the way its land is developed. Lack of an adequate site plan review process limits the Planning Board (or other designated review body) the authority and ability to modify development on a site-specific basis. Two model site plan review laws are provided in Appendix F.

94 of the 116 Regional Niagara River/Lake Erie Watershed municipalities have a Site Plan Review process.

While a majority of the watershed communities have a site plan review process, how effective the review process will be in reducing development impacts to water quality and natural site features will be completely dependent upon the reviewing body (i.e. planning board or other administrative agency), the review criteria specified in their codes, and how strictly they apply the criteria. It is also important for zoning regulation language to be as clear and specifically written as possible (i.e. findings of fact, district intent, review criteria), in order for the reviewing body to have distinct authority to modify site plans or place additional conditions on permits.

Subdivision Regulation

One of the most common land use activities is the subdivision of land. Subdivision regulations control the way that land is divided into smaller parcels. These regulations ensure that when development occurs parcels are of adequate size and shape, and streets, lots, open space, and infrastructure are adequately designed and provided for. Subdivision regulations can affect where new development occurs, the future density of a community, the layout and extension of municipal infrastructure, and the protection of open spaces and other natural features (i.e. cluster development). Model subdivision ordinances are included in Appendix G.

89 of the 116 Regional Niagara River/Lake Erie Watershed municipalities have Subdivision Regulations.

It should be noted that in Phase 1, a number of municipalities within the watershed did not have subdivision regulations because they considered themselves "built-out" and were no longer allowing subdivision of land, such as the Village of Sloan. However, during Phase 2, the addition of more rural communities results in an additional number of municipalities that do not have subdivision specifications, mostly because development is limited enough to be handled case-by-case, and the community has not yet been pressured by large scale development. Communities may wish to adopt subdivision regulations ahead of development proposals to be better prepared to address them as needed.

Environmental Protection Overlay Districts

There are several different types of overlay districts, such as those that address flooding, wetlands, riparian buffers, special habitats, scenic view sheds, and urban design standards. Environmental Protection Overlay Districts are a type of zoning specifications designed to address environmental concerns. The nature of this zoning tool, as an overlay, means it overlaps the underlying zoning districts to provide additional regulations specific to the goals of the community. Table 6.7 outlines the watershed municipalities that have enacted overlay regulations as part of their zoning code to protect or conserve special environmental features related to water quality. It is worth noting that as of 2017, several Genesee County municipalities were considering a model Stream Corridor Overlay through the Green Genesee Smart Genesee Project. Communities undergoing Comprehensive Plan updates were also considering some environmental overlays.

9* of the 116 Regional Niagara River/Lake Erie Watershed municipalities have Environmental Overlay Regulations.

Table 6.7 Environmental Protection Overlay Districts

Municipality	Overlay	Overlay Intent/Purpose
Town of Ellicottville	Conservation District	The purpose of the Conservation District is to establish and preserve important view corridors, wetlands, floodways, and floodplains. These areas are to remain essentially free of development and continue to be open space.
Town of Arkwright	*	*
Village of Brocton	*	*
Town of Charlotte	*	*
Town of Chautauqua	*	*
City of Dunkirk	*	*
Town of Dunkirk	*	*
Village of Fredonia	*	*
Town of Hanover	*	*
Town of Mina	*	*
Town of Pomfret	*	*
Town of Portland	*	*
Town of Ripley	*	*
Town of Sheridan	*	*
Town of Sherman	*	*
Village of Silver Creek	*	*
Town of Stockton	*	*
Town of Villenova	*	*
Town of Westfield	*	*
Town of Alden	*	*
Village of Alden	Conservation Sector	Established to limit development on flood-prone lands abutting Ellicott Creek, including its tributaries, for the following purposes: (1) to allow Ellicott Creek to carry and store its maximum amount of water without restrictions; (2) To prevent encroachments on its floodplain which would increase floodwater levels; (3) To prevent increased threat to health, safety and property to the immediate area as to those downstream; (4) To protect the water quality and general ecology of the above watercourse by controlling land use which might have adverse effects thereon by location in or on its floodplain.

	Water Supply: Protection from Contamination	Protects the areas within and directly outside the Village of Alden that overlay the Village of Alden water supply/recharge for the Village wells, which provide potable water to Village residents. This overlay is divided into zones to address various construction and other activities that may be proposed in the aquifer areas.
Town of Amherst	*	*
Village of Angola	*	*
Town of Aurora	*	*
Village of Blasdell	*	*
Town of Boston	*	*
Town of Brant	*	*
City of Buffalo	*	*
Town of Cheektowaga	*	*
Town of Clarence	Open Space Design Overlay	Encourages the creation of clustered development to preserve natural and scenic qualities of open land. Applicants are encouraged at the Town Board's discretion to established lots and cluster development in a way that important lands and/or resources are preserved (e.g. green space, woodlands, significant views, prime farmland, etc.
Town of Colden	*	*
Town of Collins	*	*
Town of Concord	*	*
Village of Depew	Land Conservation District	The Land Conservation District is established as an overlay district to prohibit substantial development in the form of buildings or structures due to special and/or unusual conditions of topography, drainage, floodplain or other natural conditions, whereby considerable damage to buildings or structures and possible loss of life may occur due to the process of nature.
Town of Eden	*	*
Town of Elma	*	*
Town of Evans	*	*
Village of Gowanda	*	*
Town of Grand Island	*	*
Town of Hamburg	*	*
Town of Holland	*	*
Village of Kenmore	*	*

City of Lackawanna	Smokes Creek Overlay	Riparian protections on Smoke(s) Creek. Establishes 15 ft vegetative shoreline buffers; 50 ft buffers for development setbacks/adverse land uses, exempting trails, water-related activities, and stormwater retention/detention facilities from development/setback restrictions.
Town of Marilla	*	*
Town of North Collins	*	*
Town of Orchard Park	*	*
Town of Sardinia	*	*
Village of Sloan	*	*
Village of Springville	Wellhead Protection	The purpose and intent of this section is to establish, protect, preserve, and promote the safe use of the existing and potential groundwater supply from developmental or land use practices that may adversely affect the quality or availability of water from the Village wells; to protect and preserve potential sources of future water supply for the public health, safety and general welfare; and to assure an adequate supply of suitable drinking water for the residents of the Village.
	Floodplain	It is the purpose of this section to promote the public health, safety and general welfare and to minimize public and private losses due to flood conditions in specific areas by provisions designed to:(1) Regulate uses which are dangerous to health, safety and property due to water or erosion hazards or which result in damaging increases in erosion or in flood heights or velocities; (2) Require that uses vulnerable to floods, including facilities which serve such uses, be protected against flood damage at the time of initial construction; (3) Control the alteration of natural floodplains, stream channels and natural protective barriers which are involved in the accommodation of floodwaters; (4) Control filling, grading, dredging and other development which may increase erosion or flood damages; (5) Regulate the construction of flood barriers which will unnaturally divert floodwaters or which may increase flood hazards to other lands; (6) Qualify for and maintain participation in the National Flood Insurance Program.
City of Tonawanda	*	*
Town of Tonawanda	River Road Overlay District	This overlay district is intended to encourage the development and redevelopment of uses that are in harmony with the surrounding area, improve the visual character of the area, protect adjoining environmental resources and enhance the character of the area as an important gateway to the Town of Tonawanda and its waterfront.
Town of Wales	*	*
Town of West Seneca	*	*
Village of Williamsville	*	*

Town of Batavia	Wellhead Protection Overlay Zone (WPO)	The Wellhead Protection Overlay Zone (WPO) is established to preserve and protect those areas of the town which are important to ensuring a safe and healthful drinking water supply for the Batavia area, local residents, employees and the general public through the preservation of the town's groundwater sources. The designation of two Wellhead Protection Areas (WPA) within the Wellhead Protection Overlay Zone and the careful regulation of activities with these zones will reduce the potential for groundwater contamination. The Wellhead Protection Overlay Zone will preserve and maintain the existing and potential groundwater supplies, aquifers, and aquifer recharge areas of the town and protect them from adverse development or land use practices. The Wellhead Protection Overlay Zone will also conserve the natural resources of the town and prevent pollution.
Town of Cambria	*	*
Village of Lewiston	*	*
Town of Lewiston	*	*
Town of Lockport	*	*
City of Lockport	*	*
City of Niagara Falls	*	*
City of North Tonawanda	*	*
Town of Porter	*	*
Town of Royalton	*	*
Town of Wheatfield	*	*
Village of Youngstown	*	*
Town of Shelby	Wildlife Refuge Protection Overlay District	Limit uses within the District that present potential harm to the Iroquois National Wildlife Refuge and loss of benefits it provides to the Town.
Village of Arcade	*	*
Town of Arcade	*	*
Village of Attica	*	*
Town of Attica	*	*
Town of Bennington	*	*
Town of Eagle	*	*
Town of Java	*	*

Town of Middlebury	*	*
Town of Orangeville	*	*
Town of Sheldon	*	*
Town of Warsaw	*	*
Town of Wethersfield	*	*

* Indicates responses pending

Local Laws, Practices, and Programs that Affect Water Quality

In addition to the common planning and zoning tools, there are also some lesser utilized laws, practices, and programs that municipalities can undertake to further protect local water resources.

1. **Open Space, Conservation and Natural Space Planning & Preservation**
   Open space is a valuable asset for many reasons. It increases surrounding property values, provides a psychological "rest" from the urban environment and has numerous environmental and water quality benefits including allowing stormwater to infiltrate the ground. Preservation of open space can be a very effective way of preserving water quality by limiting development in sensitive and unique areas, such as riparian buffers, wetlands, floodplains, and other natural infrastructure. Municipalities should undertake open space or conservation planning, to inventory these resources and prioritize key areas for protection.

   Protecting important open spaces can be done through a variety of ways, such as through the transfer of development rights, conservation easements, or purchase. Regionally, the Western New York Land Conservancy has protected more than 6,000 acres of meadows, forests, farmland, and wildlife habitat in 21 watershed municipalities in the region. Watershed municipalities with significant efforts in open space planning and conservation include the Towns of Amherst, Clarence, Eden, and Marilla.

   Two model ordinances for conservation/open space protection are provided in Appendix H.

2. **Sewer and Water Infrastructure**
   Sewer and water infrastructure is built and/or operated by municipalities or regional authorities. Careful planning and review of all such infrastructure is important because new or upgraded sewer systems can significantly improve water quality in an area with failing onsite wastewater treatment systems. However, new sewer and water infrastructure may lead

to inappropriate growth and development, more impervious surface area, and the potential water quality problems that are associated with development. Communities should carefully plan future land use and determine where this infrastructure will be needed and allowed to expand in the future and where it should be limited. Communities may also consider establishing policies that limit access to these services, thereby discouraging development in sensitive areas and preventing sprawl. Maintenance and/or improvement of existing infrastructure should be prioritized over new infrastructure.

For example, Genesee County had prepared a Smart Growth Plan to ensure that the provision of public water does not result in additional new development that is inconsistent with the principles of smart growth. The Plan includes a map designating areas where development and redevelopment will be encouraged and the County will not restrict access to the County water system. New non-agricultural water hookups will be limited for development that occurs outside of designated growth areas.

3. **Onsite Wastewater**

Onsite wastewater systems can be one of the leading sources of water pollution and one that is rather hard to detect. Such systems tend not to be properly maintained (pumped every 2 to 5 years), may not be replaced on a timely basis, or may be installed on sites and/or in soils that are not optimal. Failing septic systems can discharge significant pollutants, including phosphorus and nitrogen, which can impair waterways and private wells. Septic systems have a life span of 20 years if properly maintained, and only a small percentage of New York's soils are well suited for traditional systems.

Approximately 89 of the 116 watershed municipalities have onsite wastewater systems within their jurisdiction. Onsite systems are regulated by county and NYS health laws that specify installation, maintenance and minimum inspection requirements. County Departments of Health require inspections prior to the sale of properties, yet it may be decades between title transfers.

Municipalities should consider creating an additional layer of regulation at the local level to ensure systems are operating properly, such as requiring regular inspections or additional requirements for old systems. For example, Chautauqua County has adopted a law as of 2016 that mandates the Chautauqua County Department of Health and Human Services to inspect onsite wastewater treatment systems less than 250 feet from Lake Erie if they are unpermitted or were permitted more than 30 years ago. Municipalities could adapt this policy to include all bodies of water within their borders, and/or require more frequent inspections than 30 years or transfer of title (such as every 10 years). A model onsite wastewater ordinance is included in Appendix I.

4. **Environmentally Sensitive Areas: Hazard Planning & Floodplain Management**

Floodplains are environmentally sensitive areas that are located near or adjacent to water courses, lakes, ponds, and wetlands. The intent of floodplains is to store stormwater, seasonally or during extreme/extended rain events; in other words, they are meant to flood.

Unfortunately, when development patterns have restricted the waters' access to the floodplain or reduced a floodplain's storage capacity (with infill), the risk for damage to property, infrastructure, and natural areas increases.

Municipalities should identify natural conveyance systems and potential hazards, such as steep slopes or unstable banks, and update their codes and practices to minimize vulnerabilities.

Proper management of floodplains improves public safety and can restrict development impacts on water quality. All but two municipalities in the watershed participate in the National Flood Insurance Program, meaning they regulate development in their Special Flood Hazard Areas (floodplains). A majority of these regulations are a version of the NYS Department of Environmental Conservation's model Flood Prevention Ordinance. It is important that municipal officials, staff, and boards enforce their Flood Prevention Ordinance properly and refer to their FEMA Flood Insurance Rate Maps when making land use decisions. Flood prevention concepts should be integrated into zoning laws, subdivision and site plan reviews. A model floodplain regulation ordinance developed by FEMA that focuses on protecting fish habitats is provided Appendix J.

Currently, all but four of the watershed municipalities have been mapped by FEMA for Special Flood Hazard Areas, but 73 of the communities have maps that are over 30 years old and should be redone. Communities should work with FEMA to update maps and establish base flood elevations for all floodplains to assist with regulation and enforcement. Additional details on the flood zones in the Niagara River/Lake Erie Watershed are included in Chapter 2.

5. **Environmentally Sensitive Areas: Wetlands and Riparian Areas**

Wetlands, riparian areas, and other environmentally sensitive lands neighboring water features have important functions that protect water quality. Besides being some of the most biologically diverse areas, wetlands can purify water, recharge groundwater, assist in flood control, and improve shoreline stability. Additional information can be found in Chapter 2.

A majority of wetlands are regulated at the State and Federal level by the NYS Department of Environmental Conservation and US Army Corps of Engineers, respectively. However, there are many smaller un-mapped wetlands not protected under federal or state regulations that municipalities should document and extend protections to. It is important to preserve natural wetlands for their stormwater retention abilities. Wetlands often lessen the need (and cost) for constructed municipal or private stormwater infrastructure. Two model wetlands ordinances are included in Appendix K.

Riparian areas are those lands that are directly adjacent to water features and contribute greatly to the health and function of the water features they surround. If properly vegetated, riparian lands can stabilize banks, reduce erosion and sedimentation, lower water temperatures, slow flood waters, filter run-off, aid groundwater infiltration, and support wildlife habitat. Municipalities should protect existing riparian buffers from vegetative clearing and development, and re-establish riparian buffers where they have been lost. Model ordinances for riparian and shoreline protection are provided in Appendix L.

Environmental overlay districts are one of the best ways to protect wetlands and riparian buffers at the local level. However, municipalities can also add provisions to their zoning setback requirements, subdivision regulations, sediment and erosion control laws, and site plan review process to protect these areas. Table 6.7 includes a list of municipalities with environmental overlays.

6. **Stormwater Management and Drainage**

Municipalities are responsible for managing stormwater runoff after it leaves private property. A vast majority of stormwater infrastructure in the watershed is made up of drainage systems that direct stormwater to natural watercourses, and include such things as storm drains, ditches, culverts, catch basins, and retention ponds. If poorly designed or improperly maintained, public drainage infrastructure can cause erosion of waterways and sedimentation of waterways. Besides being a significant source of non-point source pollution, poorly designed systems also increase municipal costs for ditch and storm drain cleaning.

New York State regulates municipal stormwater systems as Municipal Separate Storm Sewer Systems (MS4s) under the State Pollution Discharge and Elimination System (SPDES) if they are contiguous to a U.S. Census designated urbanized area. There are some urbanized municipal stormwater systems that are not contiguous and are therefore not regulated.
Presently these regulated municipalities make up 35% of the Regional Niagara River/Lake Erie Watershed Management Plan's municipalities and all participate in the WNY Stormwater Coalition, a group comprised of 40 MS4 municipalities in Erie and Niagara Counties that share resources and work together to ensure compliance with SPDES Phase II stormwater requirements. More information can be found in Chapter 2.

Improving system construction, operation, and maintenance can be done by ensuring that highway/public works departments are trained in and use BMPs, such as promptly seeding newly cleaned ditches. The key is ensuring consistent use of BMPs. The *Highway Superintendent Road and Water Quality Handbook*[2] is a good information resource for departmental operations, as is the *Stormwater Management Gap Analysis Workbook for Local Officials*[3]. Municipalities should appropriate adequate resources for staff trainings on BMPs, as well as staff time towards consistent and effective enforcement.

To assist with the financial costs associated with stormwater infrastructure, municipalities can create special drainage taxing districts. Drainage districts can provide stable funding sources for the improvement, construction, operation, and maintenance of drainage structures, retention ponds, ditches and culverts. Drainage infrastructure often requires regular specialized maintenance. Developers, property owners, or homeowners associations cannot always be relied on to properly maintain stormwater facilities for the long term.

7. **Erosion and Sediment Control**

Soil erosion affects water quality by increasing turbidity and sedimentation. Activities involving land clearance and modification such as the construction of new buildings, roads and parking lots, and the clearing of land can all create soil erosion and sediment laden run-off. Sedimentation of waterways reduces channel flow and depth, creating issues with conveyance, temperature, and habitat health. Besides being a significant source of non-point source pollution, sedimentation can also increase municipal costs for maintaining stormwater

[2] Produced by the NYSDEC. Finger Lakes Lake Ontario Watershed Protection Alliance, and the NYS Soil and Water Conservation Committee.
[3] Produced by the NYSDEC, Division of Water.

Ellicott Creek Erosion (Tonawanda, NY)
Courtesy of Buffalo Niagara Riverkeeper

infrastructure. Development in areas adjacent to water bodies with steep slopes, or highly erodible soils are of special concern as the potential for increased erosion is greater.

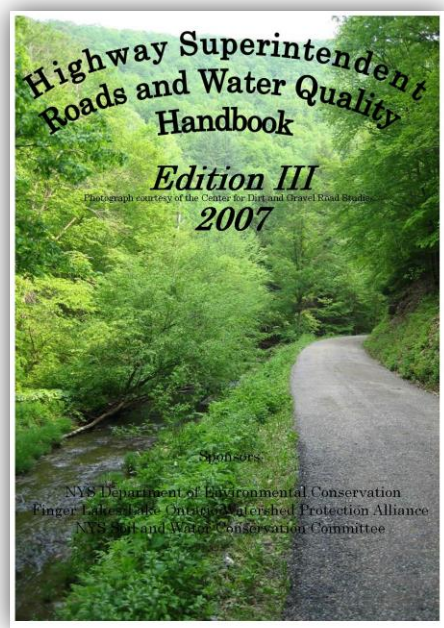
Landowners can take simple measures to reduce erosion of their property and sedimentation runoff, such as maintaining riparian buffers along waterways, and using water bars (or similar strategies such as rubber razors or open-top culverts) on steep driveways with concentrated flows to divert water to stable vegetated areas.

Municipalities should limit the impact of development activities through effective erosion and sediment control laws and proper enforcement of Stormwater Pollution Prevention Plans (SWPPPs) during and following construction activities. The NYSDEC's *Sample Local Law for Stormwater Management and Erosion and Sediment Control* can be used as a baseline model and is designed for MS4 regulated communities who need to meet Phase II SPDES requirements. Non-MS4 communities should also consider integrating the Phase II Stormwater requirements into their stormwater management laws in order to more comprehensively address stormwater issues. Model stormwater management laws are also available from the NYSDEC. Two model ordinances addressing stormwater management, sediment and erosion control are included in Appendix M.

Municipalities should also consider limiting development in areas prone to erosion, such as steep slopes (with grades higher than 15%) and highly erodible soils. These areas can be protected via special provisions in ordinances for subdivision, site plan review, or a special overlay. Model regulations addressing protection of/development on steep slopes are provided in Appendix N.

8. **Road Maintenance**

Maintenance of local roads has a big impact on the health of the surrounding watershed as this infrastructure is so closely integrated with stormwater drainage systems. For example, road de-icing and other winter road maintenance practices, negatively affect water quality when materials migrate to waterways via surface run-off. However, by doing little things such as pre-salting (de-icing before a storm rather than after, which can reduce the amount of deicer needed by up to 70%) or by using more sustainable and less damaging options than traditional road salt, municipalities can limit water quality impacts.



Municipalities should follow Best Management Practices as outlined in the latest version of the *Highway Superintendent Road and Water Quality Handbook* and incorporate practices into departmental policies. Highway and public works staff should also be encouraged to attend Cornell Local Roads trainings regularly.

9. **Junk Yards & Waste Storage**

Junk yards and the storing of waste materials can have significant impacts on water quality as garbage, vehicles, appliances, and other waste can leak hazardous liquids into the soil and groundwater. Also, dumpsters and other receptacles for waste should be addressed in local regulations and detail proper siting and use for such facilities.

Municipal code should go beyond basic NYS environmental permitting, to limit junk yards to less environmentally sensitive areas or prohibit them altogether. If junk yards are addressed in municipal code, the definition of junk should be expanded to include such things as old appliances and household waste, as this provides the ability for local regulations to address materials not covered by state regulations. The NYS Department of State also has a model junk storage law that provides a good starting point for local regulation. An additional model ordinance is provided in Appendix O.

10. **Mining & Drilling**

Mining and drilling operations can dramatically alter water infiltration patterns and groundwater levels, as well as create erosion and sedimentation issues for neighboring watercourses. Municipalities can limit or completely prohibit mining operations from within their jurisdiction. For municipalities who choose to allow mining operations, local knowledge and awareness of mining activities and their impacts are important for developing effective regulations. Larger mines are subject to the NYSDEC permitting process through the Mined Land Reclamation Law (MLRL), which municipalities should participate in. Local regulations can be developed to directly regulate smaller mines (outside of state jurisdiction), and should be comprehensive enough to address both site design and operations.

Gravel mining can cause impacts to the ecosystem by creating dust, impacting nearby vegetation, and destroying habitat. In a 2000 study for the Cattaraugus County Legislature[4], the suggestion was made for municipalities to use an ecosystem approach and sustainable development principles when assessing gravel mining practices in comprehensive planning efforts including assessing the cumulative impacts from more than one mining operation in a sub-watershed. Reclamation planning efforts must also be included in comprehensive plans including the consideration of returning impacted lands to quality habitat, open space, recreational areas, or other land uses with an ecosystem benefit.

Presently oil and gas well development, production, and utilization are regulated at the state and federal level. The NYSDEC also regulates wells for the underground storage of gas, salt solution mining and geothermal purposes. The State Regulated Gas Wells map in Chapter 2 depicts the current and past wells within the watershed.

11. Agriculture

Depending on the design and use of farm land, and farming practices, agriculture can have significant impacts on water quality. Agricultural runoff can carry pesticides, fertilizers, and animal wastes into neighboring waterways. This can lead to nutrient loading, increased pathogens and chemical contaminants in surface and ground waters. Farming practices can also increase erosion of soils and sedimentation of waterways, through plowing practices and farm yard operations. Most agricultural land use issues are regulated at the state level by the Departments of Agriculture

[4] A New Look at Gravel Mining in Cattaraugus County (Twenty First Century Planning for the Route 16 Corridor) prepared for Cattaraugus County Legislature by Terry Martin, Cattaraugus County Department of Economic Development, Planning and Tourism, September 26, 2000.

and Markets, and Environmental Conservation (NYSDEC). The NYSDEC also oversees State Pollution Discharge Elimination System (SPDES) permitting for farming facilities identified as Concentrated Animal Feeding Operations (CAFOs). CAFO's are classified into three size levels: large, medium, and small; and NYSDEC maintains a SPDES General Permit to assist in meeting US EPA's Clean Water Act requirements[5]. A map depicting the Concentrated Animal Feeding Operations within the watershed is available in Chapter 4.

Under the SPDES General Permit coverage farms are not permitted to discharge from their production area to surface waters of the State. They are also required to develop and maintain Comprehensive Nutrient Management Plans (CNMP), which identify agricultural Best Management Practices necessary to limit impacts to water resources specific to each farm, and establish an implementation schedule. For instance, manure spreading is prohibited on saturated or frozen soils to reduce the potential for runoff to waterways. Large CAFOs must have implemented all CNMP management practices to have coverage under the general permit, while all medium CAFOs must have implemented all non-structural management practices identified in the plans.

Local awareness and encouragement of agricultural Best Management Practices is also helpful to address water quality issues stemming from smaller farming operations. Municipalities should encourage farmers to access the multitude of resources and voluntary programs offered by the Natural Resources Conservation Service, County Soil and Water Conservation Districts, and Cornell Small Farms Program aimed at reducing the environmental impacts of agriculture.

12. **Forest Management**

As with any land disturbance, timber harvesting can have significant environmental impacts. However, local municipalities can regulate harvesting practices to limit erosion and sedimentation. The most comprehensive method includes adopting a timber harvesting law. A model timber harvesting law from the

[5] See NYSDEC State Pollution Discharge Elimination System (SPDES) General Permit for Concentrated Animal Feeding Operations (CAFOs) General Permit No. GP-0-09-001(modified 7/29/13) for state definitions of CAFOs, their size thresholds, and environmental permitting requirements.

Canandaigua Watershed Council (Appendix P) provides a starting point.

Municipalities can also encourage property owners to work with County Foresters in developing Forest Stewardship Plans, which are property-specific plans to implement a sustainable harvesting schedule and logging best management practices.

13. **Boating & Marinas**
    Recreational boating can have significant water quality impacts from facility construction, waste disposal, boat maintenance and fueling, as well as influencing the spread of aquatic invasive species and shoreline erosion (wakes). Only 20 of the municipalities in the Regional Niagara River/Lake Erie Watershed Management Plan have frontage on a navigable waterway that support marinas, docks, and boat launches for larger motorized watercraft (Lake Erie, Black Rock Canal, Erie Canal, Tonawanda Creek, and Niagara River). Certain statewide boating regulations are in force along the Erie Canal, including speed limitations, vessel waste treatment and disposal restrictions (No Discharge Zone), and design and construction requirements for residential/non-commercial docks, decks, platforms and boat launches/ramps[6].

    Boat launches and marinas are generally subject to local development review processes so that there is oversight on where and how these facilities are built. However, some aspects of municipal regulation of navigable waterways are sometimes limited by state and federal regulations, depending on the water body or watercourse involved. Local zoning regulations addressing boating facilities or water-dependent uses should have specific provisions to address siting issues, and appropriately manage pollution from vessel waste and maintenance practices. Two model ordinances regarding marinas and docks are provided in Appendix Q.

    In 2014, Lake Erie and the Upper Niagara River to Niagara Falls were designated as a Vessel Waste No Discharge Zone (NDZ) by New York State, making it illegal for boaters to discharge on-board sewage into Lake Erie. The designation addresses both treated and un-treated sewage. Boaters must dispose of sewage at pump out stations.

In-Depth Assessment of Local Planning & Development Tools

In-depth assessments were conducted for 18 municipalities in the Niagara River/Lake Erie Watershed to gain a better understanding of the local laws and practices implemented to protect watershed resources. The assessment process was based on the *Protecting Water Resources through Local*

[6] Pursuant to the NYS Law (21 NYCRR Sub-chapter D, Parts 150-156), all activities on the Erie Canal are regulated by the New York State Canal Corporation.

Controls and Practices: An Assessment Manual for New York Municipalities guide developed by the Genesee/Finger Lakes Regional Planning Council and the NYS Department of State.

The following municipalities received in-depth assessments:

- Phase 1
  - Town of Tonawanda
  - City of Lackawanna
  - City of Niagara Falls
  - City of North Tonawanda
  - Town of Sheldon
  - Town of Elma
  - Town of Newstead
  - Town of Grand Island
  - Town of Colden
  - Village of Williamsville
  - Town of Batavia*
  - Town of Bethany*
  - Town of Orangeville*
- Phase 2
  - Village of Springville
  - Town of Concord
  - Town of Holland
  - Town of Westfield
  - Town of Yorkshire

**Indicates Assessments completed by Genesee Finger Lakes Regional Planning Council during Black and Oatka Creeks watershed planning.*

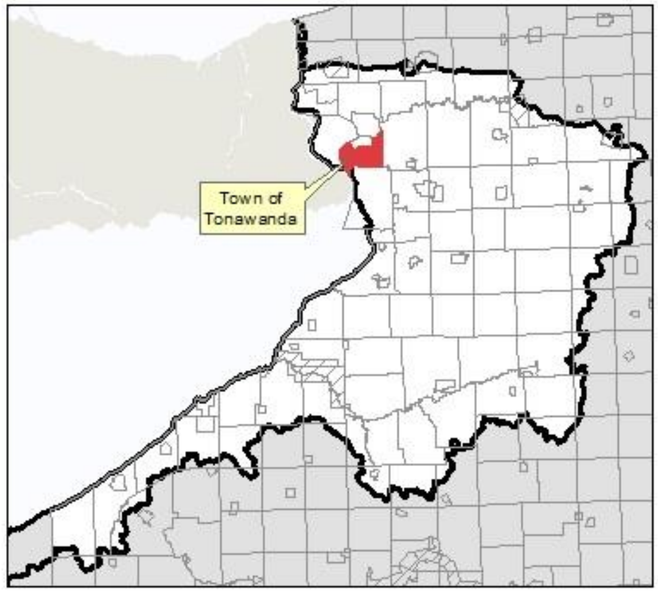
For the assessment process, Buffalo Niagara Riverkeeper (Phase 1) and Erie County's Department of Environment and Planning (Phase 2) reviewed local codes and ordinances for 151 different Best Management Practices across six different categories:

- Development
- Forestry & Agriculture
- Waterways & Wetlands
- Marinas
- Roads and Bridges
- Onsite Wastewater Treatment Systems

Local meetings were then held with municipal staff to discuss any BMPs they may be employing in local programs or undocumented departmental policies. The findings from the code review and local meetings were then combined into an assessment form[7] and scored based on the level to which they employ the BMPs. The findings and recommendations from the assessments were then presented to each community who participated for review and discussion. Assistance was also provided by the County Planning Departments, Soil and Water Conservation Districts, and the Advisory Committee, who reviewed the assessments and assisted in drafting recommendations.

[7] Assessment Forms (with scoring information) for each of the 18 municipalities are provided in Appendix R.

Town of Tonawanda, NY (Phase 1) Erie County



The Town of Tonawanda is a relatively compact suburban community located along the Niagara River. According to the 2010 Census it had a population of 73,570 within its 20.4 square miles. As a first ring suburb of the City of Buffalo it built-out long ago with residential development surrounding vibrant community centers, such as the Village of Kenmore. Historically, major industry and employment areas located along the Niagara River front, limiting opportunities for citizen access today, despite over 25,000 linear feet of water frontage.

The in-depth assessment conducted for Tonawanda found the town to be proactive and rather advanced in protecting local water resources, incorporating many Best Management Practices (BMPs) into code and departmental practices. Of the 125 BMP categories used in the assessment Tonawanda employs 74 directly through local regulations and another 23 through local practices (78% met in total)[8]. Further still, Tonawanda has implemented several green infrastructure pilot projects and requires Stormwater Pollution Prevention Plans for developments under the 1 acre threshold (certain cases).

The following town documents were reviewed for the assessment:

- *Town of Tonawanda Zoning Ordinance* (April 1982)
- *Town of Tonawanda Stormwater Management Ordinance* (November 2007)
- *Town of Tonawanda Sewers Ordinance* (March 2007)
- *Town of Tonawanda Solid Waste Management* (March 2007)
- *Town of Tonawanda Subdivision of Land Ordinance* (March 2007)
- *Town of Tonawanda Trees & Shrubs Ordinance* (May 1984)
- *Town of Tonawanda Building Code Administration Ordinance* (March 2007)
- *Town of Tonawanda Environmental Conservation Commission Ordinance* (December 1972)
- *Town of Tonawanda Model Stormwater Management Plan* (November 2010)
- *Town of Tonawanda Local Waterfront Revitalization Program Ordinance* (April 1993)
- *Town of Tonawanda Local Waterfront Revitalization Program* (September 2008)

[8] Of the 151 total BMPs in the assessment, only 125 are applicable to Tonawanda.

- *Town of Tonawanda Website* (www.tonawanda.ny.us)

Meetings were held with the following Town of Tonawanda staff:

Jim Jones, P.E. – Town Engineer
Michael Kaiser – Technical Support Department Director
James Hartz, AICP – Director of Community Development
Jeff Ehlers – Youth, Parks and Recreation Department Director
Carl Heimiller – Supervising Code Enforcement Officer
Larry Hoffman – Assistant Code Enforcement Officer
Steve Tartick – Highway Department Supervisor

New & Existing Development

Tonawanda's codes currently establish a multitude of BMPs to prevent impacts to local water resources from development, many of which are model regulations[9] developed by New York State to assist MS4 communities in meeting their Phase II SPDES requirements. Also, a majority of Tonawanda's education and outreach materials are WNY Stormwater Coalition and Erie County Water Quality Committee publications.

Overall, Tonawanda is still in the process of codifying a few BMPs into something the town can effectively require and enforce. To accomplish this, Tonawanda should consider strengthening and clarifying existing ordinances. A few examples include, creating consistent setbacks across all waterfront/shoreline areas, applying more weight to maintaining/restoring vegetation in riparian areas, developing aesthetic maintenance provisions for stormwater management systems[10], creating specific provisions to minimize the creation of impervious surfaces, codifying the preference for native vegetation, and developing fines for violations to assist with enforcement.

Agriculture & Forestry

Not applicable, Tonawanda has no active commercial farming or silviculture occurring at this time.

Waterways & Wetlands

In addition to the Niagara River, Tonawanda Creek, Ellicott Creek, Two-mile Creek, and Rattlesnake Creek course through the town. Tonawanda's waterways and shorelines are quite protected through various provisions within stormwater management, sewer, erosion and sediment control, and zoning

[9] *Sample Local Law for Stormwater Management and Erosion & Sediment Control* (March 2006), and *Model Local Law to Prohibit Illicit Discharges, Activities and Connections to Separate Storm Sewer System* (April 2006).
[10] Tonawanda would like to extend the Stormwater Management Officer's ability to enforce maintenance of stormwater systems beyond functionality (i.e. litter, overgrown vegetation).

regulations. However, opportunities still exist to expand protections or codify existing practices, such as with increased shoreline setbacks, provisions that protect/restore riparian buffers, and regulations addressing small private docks in Tonawanda Creek.

Tonawanda's shoreline maintenance practices focus on utilizing vegetative erosion control measures as much as possible. However, actual shoreline stabilization initiatives are few and far between, as they are triggered by significant erosion and property owner complaints. The town would benefit from proactively evaluating shoreline stability and educating property owners on maintaining riparian vegetation.

Wetlands are taken into consideration in new or substantial redevelopment, as part of town zoning, stormwater management, and subdivision codes. Tonawanda also relies on the NYS Dept. of Environmental Conservation (NYSDEC) and the Army Corps of Engineers (ACOE) to review and comment on all projects where state and federal wetlands have been identified. The town considers wetland "mitigation" on par with protection, leading to the movement and re-establishment of wetland areas around town. Prior to relocating wetlands, the town should consider adopting policies that evaluate wetlands in their capacity as local non-point source pollution control infrastructure (essentially stormwater infrastructure) within their existing location.

Marinas

For a waterfront municipality, there is little mention of marinas within the town's zoning code. This is not an oversight from the Town, but rather due to the limited ability to develop new marinas along the Niagara River, given the constraints of current and former land uses (i.e. brownfields, existing industry, limited public land, hardened shoreline). Future marina development and operations are guided by the Town of Tonawanda Local Waterfront Revitalization Program (LWRP) which ensures that actions to be undertaken, approved or funded by town, State, and federal agencies within the town's coastal area be undertaken in a manner consistent with the policies and purposes of the Town's LWRP. While the policies in the LWRP provide some protections and BMPs, the design/construction guidelines in the LWRP are not comprehensive. There are four privately owned marinas in town, but the town has no authority to enforce BMPs for operations at those marinas at this time.

As Tonawanda is looking to encourage new land uses, development, and reuse of vacant/underutilized property along the Niagara River waterfront, it is important for the Town to codify BMPs for marina design and operations.

Roads & Bridges

Tonawanda hasn't seen the development of a new road in 30 years; so much of their influence on water quality in this category relates to regular road maintenance, improvement projects, and rebuilds. Town officials are already careful to ensure construction practices follow BMPs, many of which are addressed in road construction Stormwater Pollution Prevention Plans (SWPPPs). Even when SWPPPs are not required, town staff follows BMPs to limit erosion from roadway work. The town's Highway Department and Engineering Department utilize the *NYS Dept. of Transportation Highway Design Manual & Guidelines* which does include BMPs for roadway stormwater system design and SWPPP development. The town has also been investigating green infrastructure pilot projects for roadway generated run-off and is currently in the process of developing a recreation trail with porous pavement.

The town should consider incorporating BMPs from the *NYS Highway Superintendent Roads and Water Quality Handbook* into departmental policies, in regards to monitoring and maintenance practices for all roadway drainage structures; use of vegetation to stabilize banks and filter road run-off; and, minimizing encroachment to wetland and floodplain areas. Highway maintenance staff should also continue to participate in continuing education opportunities, (i.e. Cornell Local Roads trainings).

Onsite Wastewater Systems

Not applicable, as Tonawanda has no onsite wastewater systems.

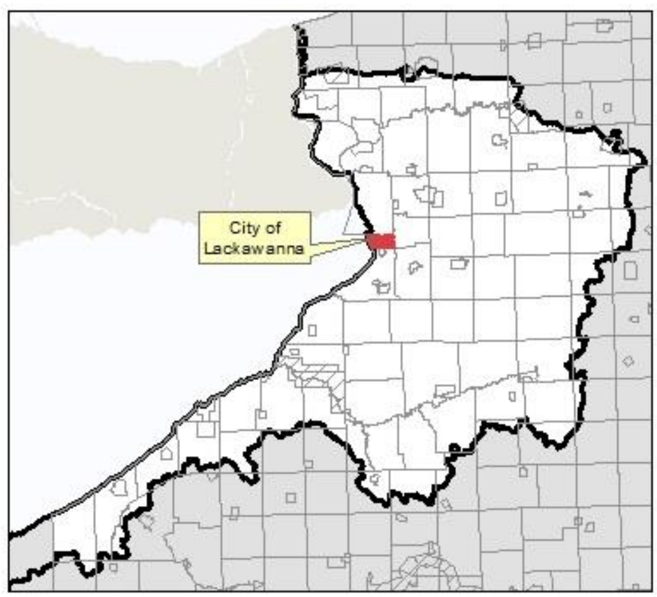
Recommended Future Actions for the Town of Tonawanda

- Provide additional shoreline protections to the Niagara River, Two Mile Creek, Ellicott Creek, and Tonawanda Creek by increasing development setback distances and maintaining consistent setbacks throughout the entire shoreline (despite varying zoning districts).
- Develop zoning provisions that maintain and restore vegetative buffers in riparian areas, including shorelines, wetlands, floodplains, and special habitats, with preferences for native vegetation.
- Ensure proper maintenance and upkeep of private stormwater management systems by adopting codes that strengthen enforcement authority (i.e. establishing fines for violations).
- Create zoning provisions that limit the creation of impervious surfaces and encourage the use of green stormwater infrastructure (i.e. lot coverage, porous materials).
- Conduct waterfront property owner outreach and education on limiting streambank erosion and improving stability through maintaining naturalized shorelines and riparian vegetation.

- Update zoning provisions to reflect and strengthen the policies outlined in the Town of Tonawanda's Local Waterfront Revitalization Program.
- Adopt specific ordinances to codify BMPs for marina design and on-going maintenance.
- Evaluate wetlands for their capacity as local non-point source pollution control (stormwater) infrastructure to better inform relocation or mitigation actions.
- Incorporate BMPs from the *NYS Highway Superintendent Roads and Water Quality Handbook* into Tonawanda Highway Department's Policies.
- Create regulations to oversee appropriate site design for small private docks along Tonawanda Creek.
- Encourage highway maintenance staff to continue participating in Cornell Local Roads trainings.

City of Lackawanna, NY (Phase 1) Erie County

Lackawanna is a formerly industrial waterfront city located along Lake Erie. It is bordered by the city of Buffalo to the North, the Village of Blasdell and Town of Hamburg to the South, and the Town of West Seneca to its East. In 2010, the City had a population of 18,141 within its 6.1 square miles. Formerly the home of Bethlehem Steel, its waterfront now is home to Steel Winds, one of the largest urban wind energy projects in the world. While this project is said to be an exemplary brownfield re-use project, it also acts as a waterfront barrier for Lackawanna residents.



Lackawanna is a member of the WNY Stormwater Coalition, and has adopted their model stormwater ordinance. Presently, Lackawanna is ahead of other older cities in their approach to stormwater control. A big focus of the city is reducing impervious surfaces and increasing green space for new development and redevelopment projects. This is done through re-greening parking lots, and restoring demolished properties to shovel ready, green sites. Their approach to reducing impervious surfaces is one that other municipalities could look to as a guide.

The challenges for Lackawanna come with its re-imagination and redevelopment of itself. There is a lot of demolition happening in the City as the economy transitions. How that demolition is done, what will be rebuilt and how it is rebuilt are the questions which need to be answered, and ensure those projects incorporate Low Impact Design and Best Management Practices in order to protect the Smoke(s) Creek Sub-watershed.

Lackawanna's assessment yielded a score of 155 out of a total 212 points, with 79% of the Best Management Practices evaluated being either fully or partially implemented.

The following city documents were reviewed for the assessment:

- *City of Lackawanna Cluster Development Ordinance (2002)*
- *City of Lackawanna Erosion & Sediment Control Ordinance (2008)*
- *City of Lackawanna Garbage & Refuse Ordinance (1987)*
- *City of Lackawanna Hazardous Chemicals Ordinance (1987)*
- *City of Lackawanna Landscaping Ordinance (1985)*
- *City of Lackawanna Sewers Ordinance (1987)*
- *City of Lackawanna Smoke Creek Overlay District Ordinance (2002)*
- *City of Lackawanna Stormwater Management Ordinance (2008)*
- *City of Lackawanna Local Waterfront Revitalization Plan (1989)*
- *City of Lackawanna Waterfront Revitalization Program (1989)*
- *City of Lackawanna Zoning Ordinance (1963, amended in its entirety in 1985)*
- *City of Lackawanna Website (www.lackawannany.gov)*

In addition to reviewing local documents, a meeting was held with the following City of Lackawanna staff members to discuss local practices and departmental policies:

- Ralph Miranda – Development Officer
- Steve Bremer – Code Enforcement Officer/Stormwater Officer

New & Existing Development

Lackawanna's code addresses developmental impacts to local water resources through several adopted New York State-developed model regulations. The city is focusing on reducing impervious surfaces in new development and redevelopment by requiring green space and green infrastructure to be implemented. The city has a requirement that residential properties must be at least 50% green. This has become a regulation they have had to enforce more regularly, as it was brought up in the meeting that many residents want to expand their driveways or pave their front yards in order to park more vehicles off-street.

Despite being almost entirely built out, the city currently has two new development projects. One is a subdivision on Martin Road, and abuts, without encroaching upon, a large wetland. The city evaluated the wetland and its stormwater potential before approving final subdivision plans. The second project is infill development within the First Ward.

Agriculture & Forestry

Not applicable as Lackawanna has no active commercial farming or silviculture at this time.

Waterways & Wetlands

Lackawanna has Smoke(s) Creek running through it, which is a significant fish habitat and wildlife corridor. The city has implemented an environmental overlay around the creek, limiting development and encroachment upon the creek and surrounding habitat (within 50 ft.) With the exception of Smoke(s) Creek and several parks, the rest of Lackawanna is built out.

The end of Smoke(s) Creek closest to the lake has recently been dredged with the prospect of future, regular dredging to come. The creek is fed by other waterways that pass through other municipalities, often making it the "last stop" before Lake Erie. Because of this, the city often attends meetings in other municipalities regarding water issues, and adds comments to the various projects regarding the creek's management.

There are many wetlands within the city, most bordered by cemeteries owned by the Catholic Diocese of Buffalo. Because of this, the city does not own many wetlands within its borders nor expects development encroachment on the existing wetlands. The city has no engineers on staff, so most wetland certification/evaluation is done by the city and then commented on by either a private contractor or the NYSDEC.

Marinas

The majority of Lackawanna's waterfront is an industrial brownfield. There are no city-owned marinas within the municipal boundaries at this time. All of the waterfront land is privately owned, including the shipping port by the former Bethlehem Steel site, which is the deepest freshwater port in the world and is periodically dredged to ensure its future viability. The lands surrounding this port have been redeveloped as an industrial park, but are currently vacant. At this time the future likelihood of a new marina establishing on Lackawanna's waterfront is highly unlikely, however it is still a potential given the current allowed uses in the zoning code.

Roads & Bridges

The city follows and enforces many best management practices that were recommended through a previous consultant evaluation of public works departmental performance, as well as those provided in the NYS *Highway Superintendent's Roads and Water Quality Handbook*. The city also performs regular and thorough inspections of the streets and bridges throughout the year, as there have been issues with city bridges in the past.

Onsite Wastewater Systems

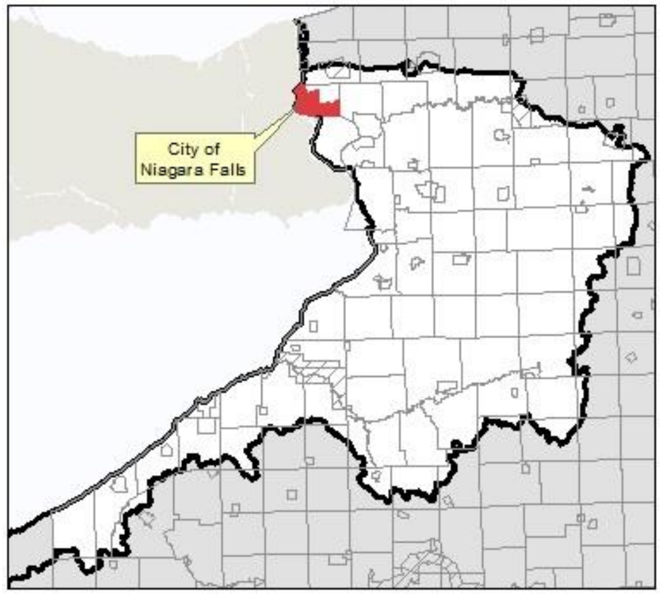
There are no onsite wastewater systems within the city. The city maintains separate stormwater and sewer systems that they currently have no issues with.

Recommended Future Actions for the City of Lackawanna

- Extend the buffer distance of the Environmental Overlay surrounding Smoke(s) Creek from 50' to a minimum of 100' and add provisions limiting the removal of established shoreline (riparian) vegetation within a portion of the buffer zone.
- Develop zoning provisions that maintain and restore vegetative buffers in riparian areas, including shorelines, wetlands, floodplains, and special habitats, with preferences for native vegetation.
- Incorporate principles of Low Impact Design into zoning regulations and train municipal boards and staff on conducting site plan review with a lens towards water quality.
- Create zoning provisions that limit the creation of impervious surfaces and encourage the use of green stormwater infrastructure (i.e. lot coverage. porous materials).
- Encourage highway maintenance staff to participate in Cornell Local Roads trainings.
- Adopt specific ordinances to codify BMPs for marina design and on-going maintenance or remove marinas as a permitted development within city zoning ordinances.
- Create educational pamphlets for landowners along Smoke(s) Creek to outline best management practices to reduce erosion in the creek.
- Collaborate with the Catholic Diocese on the management of their land surrounding Smoke(s) Creek and federal and state wetlands, especially in regards to mowing practices, riparian vegetation protection and maintenance, high erosion areas, and fertilizer application practices.
- Outline the restoration of Smoke(s) Creek's shorelines, meander, wetlands, and floodplains for the creek's portion within the former Bethlehem Steel site, as part of the Lackawanna Brownfield Opportunity Area Planning effort.

- Request additional studies from Army Corp of Engineers regarding Smoke(s) Creek's erosion issues.

City of Niagara Falls, NY (Phase 1) Niagara County



Niagara Falls is a city in Niagara County, New York across the Niagara River from the city of Niagara Falls, Ontario. The city is built along the upper and lower sections of the Niagara River. The city hosts the US side of the Niagara Falls waterfall, where the river flows over the escarpment, and downstream along the Niagara Gorge.

As of the 2010 census, the city had a total population of 50,193, down from the 55,593 recorded in the 2000 census. The City has had economic difficulty for decades with the loss of industry and high unemployment, leaving vast swaths of vacant industrial land and brownfields. The City has a fractured urban core and decayed urban neighborhoods. As the economy brightens the City is pursuing strategies to become a more compact, attractive and manageable. They plan to revitalize communities and make living in the core city more attractive by committing to sustained small-scale incremental change. This gives the city the opportunity to guide new in-fill development that is sustainable and supporting of water and air quality.

As an older city, Niagara Falls' ordinances have been updated in a piecemeal fashion over the years. The city would really benefit from a complete rewrite of their code to make it more user-friendly and incorporate newer zoning tools to guide the type of redevelopment the city desires. Despite their ordinances, the city has continued to work on water quality related initiatives over the years. Unfortunately only some of these initiatives have remained or are implemented due to financial constraints, limited city staff, and volunteer burnout. Still the City's Planning Department does attempt to implement green infrastructure, remove impervious cover, restore habitat and utilize native plantings when the opportunity arises with public and private development projects.

The City received a score of 77 out of a total of 238 possible points. This is mostly due to the lack of any marina regulations and provisions that specifically address riparian buffer, floodplain and wetland protections.

The following city documents were reviewed for the assessment:

- *City of Niagara Falls Comprehensive Plan* (2009)
- *City of Niagara Falls Zoning Code* (2009)
- *City of Niagara Falls website* (www.niagarafallsusa.org)

In addition to reviewing local documents, a meeting was held with the following City of Niagara Falls staff members to discuss local practices and departmental policies:

- Tom DeSantis – Director of Planning and Economic Development
- Alan Nusbaum – Environmental/GIS Coordinator
- James Bragg – Planner II/Historic Preservation Specialist

New & Existing Development

The city does have numerous vacant properties and former industrial land. In some areas of the city in-fill development is occurring here and there, it is extremely limited and concentrated in the downtown tourist areas. For stormwater BMPs, the city defers to the Niagara Falls Water Board, which is a private utility that runs the city's water and sewer systems. Engineers review developments and issue permits in accordance with MS4 – SPDES Phase II Stormwater Regulations.

Beside stormwater oversight during construction, very few BMPs are employed during the review of proposed developments. For environmental assessment of proposed developments city staff indicated they rely on the State Environmental Quality Review Act (SEQRA) to identify environmental impacts and address them during design review and permitting. The city has adopted separate, more stringent Type I SEQRA Actions, which allow development projects to trigger environmental review more often and at lower thresholds than is typically seen in other municipalities. Still the city may benefit from improved zoning regulations that clearly outline the type of environmental protections they are looking for rather than rely on the SEQRA process to better streamline development review and permitting processes.

As mentioned previously, the city would benefit from developing formal provisions in ordinances to employ water quality BMPs during redevelopment, such as performance standards and incentive zoning.

Agriculture & Forestry

Not applicable, as there is no agriculture or forestry in the city.

Waterways & Wetlands

While the City of Niagara Falls has limited ability to regulate the state lands along the Niagara River shoreline, Cayuga Creek, Little Niagara River, and Gill Creek are prominent waterways that they do have jurisdiction over. Cayuga Creek (Niagara County) is in need of more stringent protections, as it has flooding issues, wetland encroachment, erosion and sedimentation problems, and water quality issues stemming from adverse adjacent land uses. Gill Creek, up to the Hyde Park Dam, has been recently added to the Niagara River Area of Concern and has numerous issues associated with flooding and legacy contamination. Both waterways are in need of complete restoration plans to improve function, restore habitat and water quality, and limit impacts to city infrastructure and private property.

For Little Niagara River and Cayuga Island, issues remain on private waterfront properties regarding private docks, the removal of riparian vegetation, and fertilizer and pesticide usage.

Unfortunately, the city's zoning code contains little mention of specifically protecting streams or managing stormwater in a way that is conscious of the issues present at Little Niagara River, Cayuga and Gill Creeks. Language that does exist is general and vague, with few enforceable specifics. Again the city referenced a reliance on the SEQRA process to identify and mitigate environmental impacts to the creek systems. Unfortunately, this approach doesn't seem to have been beneficial for the creek corridors to-date.

A Waterfront Overlay District does exist in Niagara Falls Zoning Ordinance, but it is structured to regulate scenic views only.

The City does regulate development within floodplains according to the FEMA National Flood Insurance Rate Program. Regulations prohibit filling and certain projects, but development and expansion of floodplain structures is still allowed.

Marinas

Marinas, private docking facilities, boat ramps and boat lifts are a permitted use in the LaSalle sub-district of the Watershed overlay district with no additional provisions dictating BMPs for design, operations, and maintenance. There is one small marina on Little Niagara River, but it has been out of operation for some time. Many residents in this area do have private docks, which the city relies on NYSDEC and the U.S. Army Corp of Engineers to regulate. For most of the city's riverfront the water flow is too fast for boats to navigate safely and a majority of the land is owned by New York State.

Roads & Bridges

Niagara Falls has built no new roads in quite a while. While it's not outlined in code, the Public Works Department does implement many of the BMPs associated with road and bridge maintenance through the Stormwater Regulations, which are similar to the model developed by Erie County and promoted by the WNY Stormwater Coalition. The city should improve upon BMP training opportunities for Public Works Department staff, as part of the Cornell Local Roads Program.

Onsite Wastewater System

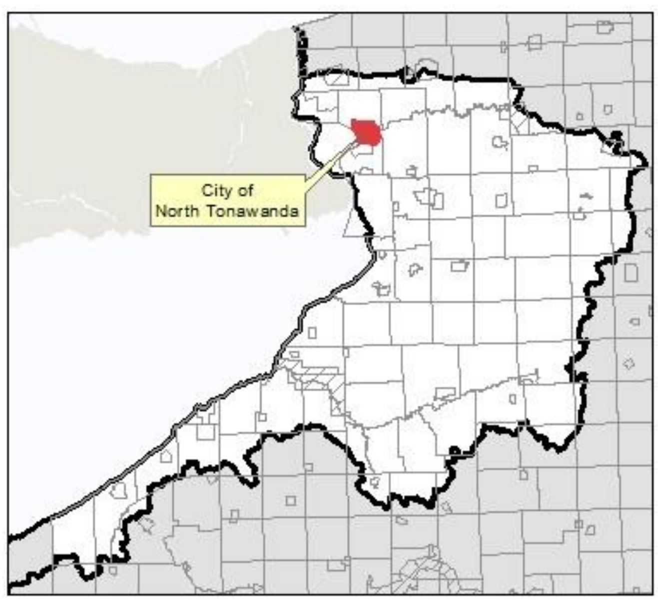
The city is entirely sewered. There are no known onsite septic systems within the city limits. Private septic is no longer allowed.

Recommended Future Actions for the City of Niagara Falls:

- Identify vacant and underutilized land in the City to reclaim and restore as buffers for urban creek systems, and incorporate the re-creation of wetlands, floodplains, and greenways.
- Upgrade the City's zoning code to implement sustainable practices that direct redevelopment away from the city's brownfield past and towards a more environmental "green city" image.
- Work with NYS Parks Department to upgrade habitat along the Niagara River Shoreline as the Robert Moses Parkway is downgraded.
- Coordinate with NYS Parks Department to naturalize the Niagara River shoreline and Niagara Gorge with native plantings.
- Collaborate with the State of New York to implement a local ordinance consistency review for any state actions taken on waterfront lands within the Niagara Falls Coastal Zone.
- Regulate the design of private docks in accordance with BMPs.
- Implement marina design and maintenance BMPs into the waterfront overlay. Legally the Township has jurisdiction 1100' out into the river and can pursue their regulatory authority.
- Develop zoning Conservation District overlays for Little Niagara River, Cayuga Creek and Gill Creek to preserve and protect the creek corridors, implement riparian buffers and habitat protection.
- Incorporate performance standards or stricter regulations into zoning and site plan review ordinances in order to encourage low impact design, green infrastructure, and reduction of impervious cover in private development.
- Revisit the City's Local Waterfront Revitalization Planning process to address the changing waterfront and better guide its development.

- Train local boards and officials on low impact development and other green methods of development that protect water quality.
- Document green initiatives and practices initiated by municipal staff into formal program documents and policies in order to retain this departmental knowledge and efforts as staff change-over occurs.
- Develop outreach and educational materials for waterfront landowners that addresses better yard management practices, riparian buffer design, and how best to mitigate shoreline erosion.
- Strengthen zoning provisions that maintain and restore vegetative buffers in riparian areas, including shorelines, wetlands, floodplains, and special habitats, with preferences for native vegetation.
- Encourage highway maintenance staff to participate in Cornell Local Roads trainings.
- Add zoning provisions to protect wetlands during site plan review.
- Provide additional shoreline protections to the Niagara River, Little Niagara River and Gill Creek by increasing development setback distances, and include vegetation requirements.
- Collaborate with Niagara County Department of Economic Development (planning arm) to work with upstream communities and effectively plan for the community resiliency in regards to flooding issues.

City of North Tonawanda, NY (Phase 1) Niagara County



The City of North Tonawanda is located along the Niagara River at the southwestern corner of Niagara County. North Tonawanda is fortunate to have an abundance of waterfront property, with Niagara River and Tonawanda Creek forming the west and south/east boundaries of the city. These waterways are designated as navigable, as Tonawanda Creek, in this portion, serves as the Erie Canal. In 2010 the city had a population of 31,568 according to the 2010 US Census. The small city is reinventing itself from a former industrial hub to a destination city, much like Niagara of the Lake in Ontario, Canada.

North Tonawanda is working on several green infrastructure projects. One of them is the installation of rain gardens in city-owned parking lots. Through these gardens the city is filtering and detaining water before expelling it into the river. Another project is through a green infrastructure grant totaling $600,000. In conjunction with Bergmann Associates, the city will eliminate planter boxes on Webster Street and install pre-fabricated filter units where trees used to be. These units would filter approximately a 1,100 foot stretch that is currently impervious. Finally the city hopes to install stone filter strips at a public marina to filter water before entering the river. This would be done with grant money from a federal boat infrastructure program.

The city has major flooding issues stemming from their downstream location. Delayed flooding is occurring more and more upstream development occurs in the towns of Wheatfield, Pendleton, Lockport, Newstead, Amherst and Clarence.

The city's assessment yielded a score of 153 out of a possible 268 points. Much of this was due to the limited number of marina-related BMPs that are codified or practiced, despite 6 city-owned marinas.

These main documents published by the city were reviewed for this assessment:

- *The City of North Tonawanda Boat Docks Ordinance*
- *The City of North Tonawanda Comprehensive Plan (2008)*
- *The City of North Tonawanda Dogs Ordinance*
- *The City of North Tonawanda Erosion & Sediment Control Ordinance*
- *The City of North Tonawanda Local Waterfront Revitalization Program (1988)*
- *The City of North Tonawanda Site Development Ordinance*
- *The City of North Tonawanda Solid Waste Ordinance*
- *The City of North Tonawanda Stormwater Management Ordinance*
- *The City of North Tonawanda Storm Sewers Ordinance*
- *The City of North Tonawanda Tree Ordinance*
- *The City of North Tonawanda Waterfront District Ordinance*
- *The City of North Tonawanda Wetlands Ordinance*
- *The City of North Tonawanda zoning ordinance (2002 Revisions 2008)*

In addition, personal interviews were conducted with:

- Dale Marshall – City Engineer/Stormwater Management Officer
- Richard Tindell – Community Development Director
- Jaime Davidson – PE at Wendel

- Robert Welch – Executive Assistant to Mayor

Existing and New Development

North Tonawanda is primarily built out, with the potential for only about 400 new builds within the city limits. Many of the existing and new development Best Management Practices are codified via the city's Grading and Stormwater Regulations that were developed in the 1970's and updated to reflect the model stormwater ordinance developed by Erie County.

Much of the new development occurring is single family residential located on former agricultural fields, as well as waterfront condos located on former industrial land. Site development and stormwater regulations do aim to preserve natural water features, but provisions could be clearer and/or structured as performance standards. The city's code also allows for cluster development, which is a focus in the waterfront condo areas.

The city is attempting to direct more stormwater into ground infiltration through green infrastructure projects on city land as a means to lessen the impact on their combined sewer system. The city's sewers are only combined in a small portion in the older urban waterfront areas. Limiting impervious cover is mostly addressed in code through new development (only 25% of a yard can be covered with built structures). Town officials indicated it is difficult to implement porous infrastructure as the soils in North Tonawanda are extremely hydric.

Agriculture & Forestry

Not applicable, the City of North Tonawanda no longer has forestry or agricultural land uses.

Waterways & Wetlands

North Tonawanda addresses wetlands and their functions in an extremely limited manner through their Grading and Stormwater ordinance and Freshwater Wetland ordinance. Both of these ordinances are quite limited in their approach to wetlands. For stormwater purposes, development review, and subdivision, the city primarily defers to state and federal regulations regarding wetlands. The Freshwater Wetlands ordinance gives authority to the City Council regarding wetland protections, but has no specific provisions included with it, as if it's an incomplete ordinance that would be clarified at a later date.

Waterway protections are also extremely limited in town ordinances and officials did not indicate that special consideration was given by city boards during development review. The bulk of the BMPs are outlined in Grading and Stormwater Management terms and have limited impact in protecting riparian buffers and existing vegetation. This might be due to the fact that much of the waterfront land located along Tonawanda Creek is owned and managed by the Canal Corporation and development in these areas requires a permit from the State. The Niagara River is not subject to Canal Corporation jurisdiction however.

Marinas

North Tonawanda has many marinas along its waterfront; six are owned and run by the city itself. Despite having a very active marina and docking waterfront, the city does not currently regulate marinas. Marinas are a permitted use in the city's zoning code with no additional provisions dictating BMPs for design, operations, and maintenance. At the city owned marinas only a handful of the maintenance and operation BMPs are implemented. The city indicated it hopes to implement more fisherman amenities and education in the future at city owned marinas.

Private boat docks are regulated in the zoning code; however BMPs addressing their design, operation and maintenance are extremely limited.

North Tonawanda's marinas and waterfront are a large component of the city's efforts to reinvent itself. As it develops waterfront and water dependent uses along the Niagara River and the Erie Canal it is important for the City to codify BMPs for marina design and operations. This should be part of the City Marina Study for the rehabilitation of the City Marina on River Road. Clean Marina programs have been proven to bring economic benefits and should be pursued.

Roads & Bridges

North Tonawanda has had no new roads built in quite a while. While it's not outlined in code, the Public Works Department does implement almost all of the BMPs associated with road and bridge maintenance.

Onsite Wastewater System

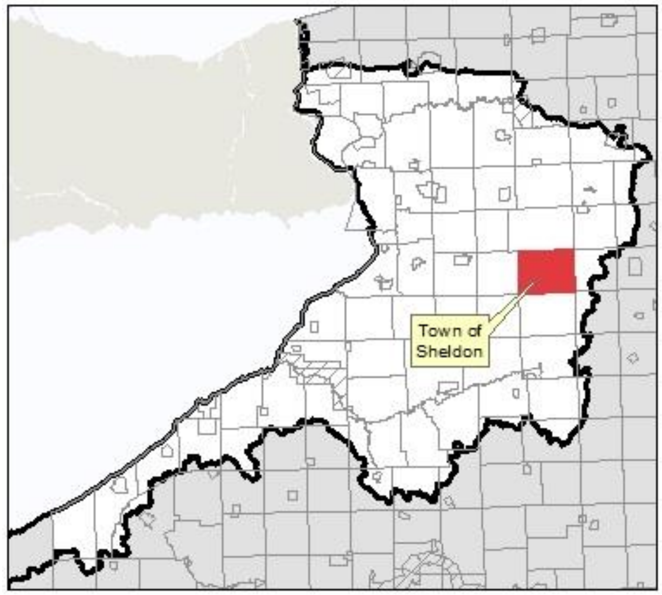
The city is entirely sewered, through both a separate system and a combined system (older downtown area). There is only one known onsite septic system within the city limits. Private septic is no longer allowed and is abated when found.

Recommended Future Actions for the City of North Tonawanda

- Implement many recommendations from existing planning documents that aim to protect water quality and ensure waterfront development occurs appropriately.
- Update the City's Local Waterfront Revitalization Plan to address the changing waterfront and better guide its development.

- Train local boards and officials on low impact development and other green methods of development that protect water quality.
- Document green initiatives and practices initiated by municipal staff into formal program documents and policies in order to retain this departmental knowledge and efforts as staff change-over occurs.
- Develop outreach and educational materials for waterfront landowners that addresses better yard management practices, riparian buffer design, and how best to mitigate shoreline erosion.
- Strengthen zoning provisions that maintain and restore vegetative buffers in riparian areas, including shorelines, wetlands, floodplains, and special habitats, with preferences for native vegetation.
- Incorporate performance standards or stricter regulations into zoning and site plan review ordinances in order to encourage low impact design, green infrastructure, and reduction of impervious cover in private development.
- Adopt a Clean Marina citizen education program to improve management of private marinas and docking facilities.
- Implement marina design and maintenance BMPs into the waterfront overlay. Legally the Township has jurisdiction 1100' out into the river and can pursue their regulatory authority.
- Create regulations to oversee appropriate site design for small private docks along Tonawanda Creek.
- Encourage highway maintenance staff to continue participating in Cornell Local Roads trainings.
- Add provisions to the Freshwater Wetlands ordinance that specify in what capacity the City Council will carry out the intent of this regulation. Cross reference this statute to other areas of the zoning code to better protect wetlands.
- Provide additional shoreline protections to the Niagara River, Tonawanda Creek, and Tonawanda Island by increasing development setback distances and maintaining consistent setbacks throughout the entire shoreline (despite varying zoning districts).
- Collaborate with Niagara County Department of Economic Development (planning arm) to work with upstream communities and effectively plan for the community resiliency in regards to flooding issues.

Town of Sheldon, NY (Phase 1) Wyoming County



According to the United States Census Bureau, the Town of Sheldon has a total area of 47.4 square miles of which approximately 0.06% is water. The west town line is the border of Erie County, New York. U.S. Route 20A passes across the north part of the town and intersects New York State Route 77 at Persons Corners. It is a rural agricultural community that strives to maintain its rural character. There are 834 residential properties and 257 agricultural properties in the Town of Sheldon.

It is predominantly flat upland with steep ravines along the creeks. Cayuga Creek's headwaters and a portion of Upper Tonawanda Creek's headwaters are located in town. Cayuga Creek flows northward through the east part of the town and the Buffalo Creek flows through the southwest part. It covers three sub-watersheds; Cayuga Creek in the center, Buffalo Creek to the west and the Upper Tonawanda to the east.

Wind turbines and energy conversion has become important to the Town of Sheldon. The Town Board has not levied any Town taxes since 2007. Revenue received from the wind farms has covered all costs of the yearly Town budget.

The following city documents were reviewed for the assessment:

- *Town of Sheldon Zoning Ordinance (2009)*
- *Town of Sheldon Website (www.townofsheldon.com)*
- *Town of Sheldon, NY Comprehensive Plan (2001)*

A meeting was not obtained with Town of Sheldon staff members to discuss local practices and departmental policies. The assessment thus far is based solely on town codes. Sheldon scored 37 points out of a total of 100 possible points for the assessment.

New & Existing Development

The Town of Sheldon is predominantly agricultural; any new development occurring in town is usually related to agriculture or residential development. Subdivisions are rare. The zoning ordinance was written to enhance the rural character and appearance of the Town of Sheldon as a whole. The

Town is currently conducting a survey on its website to update the comprehensive plan. Town zoning supports agricultural land uses. It does use Mixed-Use Rural Hamlet districts to guide density development to existing unincorporated locations that have enough of a history to have a name. These districts have design guidelines which encourage development to revitalize old housing stock. To preserve green space, only ten (10) new residential dwelling building permits will be issued per calendar year.

The Comprehensive plan states the Town's goals to preserve and protect the Town's important natural areas and resources including quality of surface water, ground water and air. Some of this is embedded in their code, but some of the strategies have yet to be enacted as best practices or lack specificity in code.

Agriculture & Forestry

The code protects farming, farming-related land uses, and economic activities with a Right to Farm Law. It does not however have any agriculture related BMPs codified.

Forestry operations are possible as there are predominant forested lands in the town; however no regulations exist to protect large forest tracts. This is concerning since Sheldon hosts headwater forests for both the Cayuga Creek and Upper Tonawanda Creek Sub-watersheds.

Waterways & Wetlands

Protections for rivers, creeks and wetlands are limited in Sheldon's code. Currently buffers are encouraged for landscaping and visual purposes, not to protect water quality. The Comprehensive plan requires vegetative buffers along all watercourses in conservation overlays, but lacks specific enactment in code.

Site plan review provisions do aim to protect natural areas, including waterways, riparian buffers, and wetlands. Special Development provisions also identify steep slopes and erosion areas as elements to consider. Special Use permits are also required for some development activities that have the potential to negatively impact waterways and wetlands, such as excavation and the use of wetlands for stormwater retention.

Roads & Bridges

It is not clear from local laws whether Best Management Practices are followed for roadway design, or highway and bridge maintenance in the Town of Sheldon.

Onsite Wastewater Systems

The plan encourages the Town to investigate sewer and water systems in hamlets to spur development in those districts. It seems unlikely that the Town will get public water and sewer service in the traditional sense however. More likely is the installation of a small sewage system that would serve 30-50 residents at most. If installed, sewer systems would most likely not expand beyond existing hamlets.

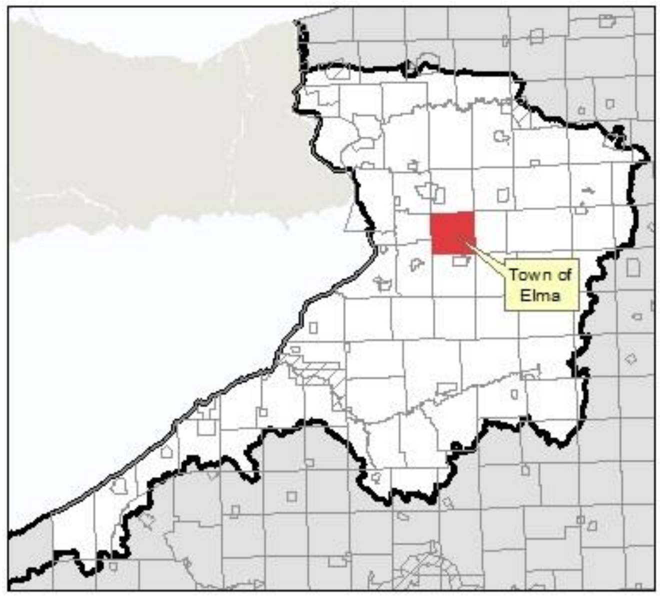
Similar to other municipalities, onsite septic systems are minimally regulated. This is due to many communities relying on the County Health Departments to oversee proper septic operations through the property transfer process.

Recommended Future Actions for the Town of Sheldon

- Complete an inventory of natural resources then identify and prioritize them for protection. Priority should be given to the major creek/tributary corridors. The creeks contribute to the rural character of the area, provide open space corridors for wildlife, and are connective features linking the region.
- Develop zoning Conservation District overlays for Buffalo and Cayuga Creeks and tributaries to preserve and protect headwater forests, the creek corridors, implement riparian buffers and habitat protection.
- Create stormwater, erosion and sedimentation regulations, which due to the topographic character of the area would be particularly beneficial.
- Purchase or place permanent easements on headwater forests.
- Educate officials and the public about BMPs and wetland protection programs.
- Rather than exempting agricultural land from regulations the town should be forward thinking in educating and promoting BMPs as a means of promoting farming. They can sell themselves as a pro-active farming township.
- Implement findings from the Wyoming County Agricultural and Farmland Protection Plan, such as conducting workshops about conservation options for rural landowners, and purchasing Development Rights in priority agricultural areas which are experiencing the most developmental pressure.
- Develop public education materials about proper maintenance of onsite sanitary waste disposal and distribute with town mailings.
- Strengthen zoning regulations that protect wetlands from development encroachment. Add provisions that implement Best Management Practices.

- Promote agricultural Best Management Practices through educational brochures and collaborative workshops with County Soil & Water professionals.
- Develop regulations to address BMP forestry practices, site clearing, and limit vegetation removal along creeks, wetlands, and in floodplains.
- Train highway staff on BMPs for road, roadside ditch and culvert design and maintenance.

Town of Elma, NY (Phase 1) Erie County



Elma is located in the south central part of Erie County. According to the 2010 US Census it had 11,317 residents spread over the Town's approximately 36 square miles. Elma Central is a small hamlet in the center of the township. Most of the town is zoned for agricultural and low density residential with a few typically suburban subdivisions. Commercial development is dispersed around the town and there are several large manufacturing, research and assembly plants. While farming has been the backbone of the community, agriculture, horse farms, nurseries and greenhouse operations are becoming more prevalent.

The East Aurora Expressway runs northwest/southeast across the township with Buffalo Creek to the northeast and Cazenovia creek to the southwest. The Town spans the Buffalo Creek Sub-watershed. The northwest corner of the town falls into the Cayuga Creek Sub-watershed and the southwest in the Buffalo River Sub-watershed.

In 2010 the Town of Elma, with the assistance of a Farmland Protection Implementation Grant from the New York State Department of Agriculture and Markets (NYSDAM) and project coordination by the Western New York Land Conservancy, purchased their first permanent conservation easement on a 61 acre property, thereby extinguishing subdivision and development pressures forever on the property. The NYSDAM Farmland Protection Implementation Grants program is an extremely important land protection tool that provides for permanent protection as well as the assurance that farm parcels selected will remain in active farming for the future. Funding from this State grant as well as a contributing portion from the Town of Elma provided for the purchase of development rights.

The following city documents were reviewed for the assessment:

- *Town of Elma Dogs Ordinance (1974)*
- *Town of Elma Filling & Grading Ordinance (2001)*
- *Town of Elma Flood Damage Prevention Ordinance*
- *Town of Elma MS4 Requirements Local Law (2007)*
- *Town of Elma Sewers Ordinance (2005)*
- *Town of Elma Solid Waste Ordinance (1992)*
- *Town of Elma Stormwater Management Local Law (2012)*
- *Town of Elma Subdivision of Land Ordinance (1989)*
- *Town of Elma Zoning Ordinance (1950 – with amendments)*
- *Town of Elma Website (www.elmanewyork.com)*
- *Draft Regional Comprehensive Plan and Draft Generic Environmental Impact Statement (2002) Town of Aurora, Elma, Holland, Wales & Village of East Aurora*

Buffalo Niagara Riverkeeper was not able to obtain a meeting with Town of Elma to discuss local practices and departmental policies. The following assessment is based solely on town codes.

New & Existing Development

According to the town website, preserving Elma's rural character is a high priority. However, it is already quite suburbanized with a mix of rural and suburban development. It is under great development pressures for residential sprawl from Lancaster to the north. It is also under commercial pressure from West Seneca to the west. The Town has codified many BMPs regarding new development, how often they are employed for development review is not known at this time.

Majority of Elma's new development includes the conversion of former agricultural lands to single family residential. Because of this primary development style, town ordinances and development review processes should look to implement low impact design and other standards that protect water quality and living infrastructure.

The town recently amended its commercial zoning and created an Elma Center overlay to improve the quality of development for the Elma center hamlet area. The overlay includes design guidelines to create a pedestrian friendly urban environment. Presently the rate of development has been restricted by the extent of public sewer and water infrastructure in town, which is a tactic the town should maintain as a tool to limit development pressures.

Elma also has a Conservation Board whose duties include advising the Town Board on matters affecting the preservation, development and use of the natural and man-made features in town.

Agriculture & Forestry

Elma is a Right-to-Farm community yet there is little agricultural regulation within their zoning code, such as farm waste management and agricultural best management practices. All agricultural activity is exempt from stormwater management regulations.

Forestry operations are not regulated in town ordinances.

Waterways & Wetlands

Wetlands and waterway protections are only minimally addressed in town ordinances, specifically the stormwater management ordinance (Erie County Model) and flood regulations. No other ordinances offer protections of local waterways and wetlands.

Marinas

Not applicable, as Elma is a land locked community with no navigable waterways.

Roads & Bridges

Not many of Elma's BMPs are codified and it is not known how many may be practiced by the town. Planning documents do note that Elma wants to limit growth through limitations on new roads; this would provide benefits for limiting additional impervious cover in town.

Onsite Wastewater Systems

While Elma has a large portion of town with private septic systems and codes currently reflect some additional oversight of onsite systems. Erie County Health Department also oversees the functionality of onsite septic systems upon property transfer. Any property with access to municipal sewer systems is required to connect.

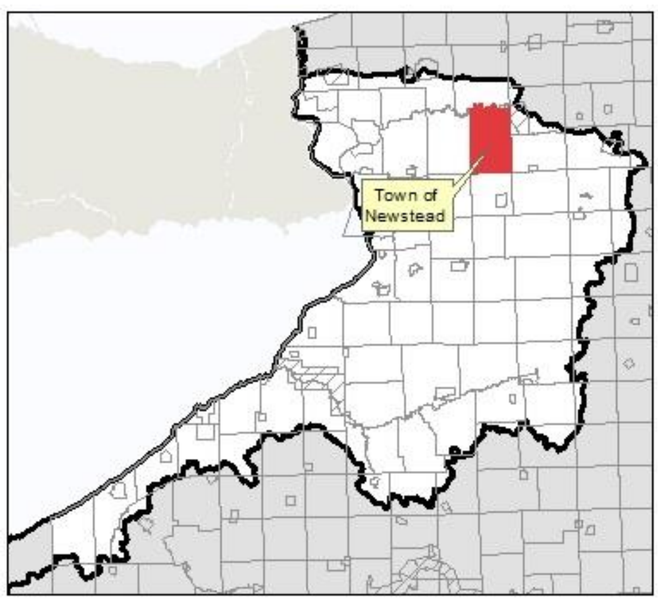
Recommended Future Actions for the Town of Elma

- Develop zoning Conservation District Overlays for Buffalo Creek, Pond Brook, Cazenovia Creek and their tributaries to preserve and protect the creek corridors, implement riparian buffers and habitat protection, not only to protect water quality, but to inhibit sprawl.
- Educate officials and the public with wetland protection programs and best management practices to protect water quality with stronger drainage requirements, and public education about proper maintenance of onsite sanitary waste disposal.
- Complete inventories of natural resources that identify and prioritize them for protection. Priority should be given to the major creek corridors. The creeks contribute to the rural

character of the area, provide open space corridors for wildlife, and are connective features linking the region's living infrastructure.

- Implement site clearing standards, wetland protection regulations, and erosion and sediment control measures.
- Partner with the Agricultural and Farmland Protection Programs (NYSDAM) to conduct workshops about conservation options for rural landowners, and purchasing development rights in priority agricultural areas, which are experiencing the most developmental pressure.
- Incorporate provisions for agricultural operations into stormwater regulations.
- Develop education materials that promote BMPs as a means of promoting farming. They can sell themselves as a pro-active farming Township.
- Train local staff and board members on reviewing developments from a water quality and habitat protection lens.
- Conduct regular inventories of culverts and stormwater infrastructure to identify issues earlier, when they may still be functional but still impact water quality and habitat.
- Incorporate performance standards or stricter regulations into zoning and site plan review ordinances in order to encourage low impact design, green infrastructure, and reduction of impervious cover in private development.

Town of Newstead, NY (Phase 1) Erie County



The Town of Newstead is located in the northeastern corner of Erie County in Western New York. The Town is a rural community with 50% of the area devoted to agriculture. According to the US Census the population in 2010 was 8,594. The town has struggled with its identity and is attempting to maintain its rural agricultural heritage. This agriculture characteristic is the Town's basic heritage going back to its founding in 1823.

The central business district and Town government headquarters are located in the Village of Akron, located in the eastern central part of the Town. The development pressure is moving outward from the neighboring town of Clarence and along Route 5 from the south west. A portion of the Tonawanda Indian Reservation is in the northeastern corner of the Town. The Town is physically split in two by a unique geographical feature, the Onondaga Escarpment.

The Town of Newstead's northern boundary is Tonawanda Creek and it falls within four sub-watersheds; the Middle and Lower Tonawanda Creeks, Murder Creek, and Ellicott creek in the south. Murder Creek falls over the escarpment at Akron Falls, just southeast of the Village of Akron. There are significant state and federal wetlands throughout the town. A large portion of the northern section of Newstead (adjacent to Tonawanda Creek) is located in the 100 year floodplain according to FEMA Flood Insurance Rate Maps.

The following town documents were reviewed for the assessment:

- *Town of Newstead Zoning Ordinance* (1988)
- *Town of Newstead Stormwater Solid Waste Law (1996)*
- *Town of Newstead Right to Farm Law (2008)*
- *Town of Newstead Wastewater Treatment Law (1999)*
- *Town of Newstead Stormwater Management and Erosion Control Law (1996)*
- *FEMA Flood Insurance Rate Maps No. 360251 0001-0030*
- *Town of Newstead Website (www.tonawanda.ny.us)*
- *Town of Newstead and Village of Akron Combined Comprehensive Master Plan (2002)*

A meeting has not been held with Town of Newstead staff to discuss local practices and departmental policies. The assessment is based solely on town codes at this time and resulted in a score of 37 points out of a total of 98. Only 17 Best Management Practices are outlined in the town ordinances.

New & Existing Development

Newstead sees itself as a rural agricultural town but is under pressure for new residential and commercial development. It does have subdivision and zoning ordinances in effect. The majority of land area on the zoning map falls into the rural agriculture zoning district. Very few BMPs have been codified into the zoning ordinance. Without many of the best management practices relative to development codified, the Town of Newstead has limited authority to guide development that is sustainable and protective of water resources.

The Town is now predominately watered thru Erie County Water Authority, with only a few pocket areas still left to be developed with water. This is unfortunate, given the level of sprawl already existent within the County. Direct highway connections to urban employment areas, plus an availability of water and sewer resources, will almost always drive sprawling development patterns.

The structure of Newstead's zoning code will become even more essential as development pressure continues into the future.

The town does have a Conservation Advisory Committee whose role is to advise the Town Board on important natural features and unique biotic communities. The extent of the Committee's influence on town development is not known. Presently, subdivision regulations include provisions to limit impacts on natural features and sensitive environmental conditions. Furthermore, the regulations directly call out for a subdivision lot layout to "avoid adversely affecting groundwater and aquifer recharge; to reduce cut and fill; to avoid unnecessary impervious cover; to prevent flooding;…"

Newstead does employ a Certificate of Occupancy requirement, which allows for follow-up and enforcement actions if developments are not actually built to their permit's standards. More of the watershed's towns should utilize Certificates of Occupancy.

Agriculture & Forestry

Newstead has Right-to-Farm law. Its educational brochure on the website is not about agricultural BMPs, but focuses on the rights that farmers have. Agriculture is supported as a land use in multiple areas of the municipal code. However, several areas of the code either exempt agricultural activities (stormwater management and erosion) or uphold that agriculture activities will not be considered nuisance activities.

Forestry activities are not regulated in Newstead's ordinances.

Waterways, Wetlands and Riparian Area Waterways

Much of the northern part of the township is in Tonawanda Creek's floodplain and there are many wetlands throughout. Newstead's ordinances do not directly protect waterways, wetlands, and riparian lands. There are provisions that reference natural areas, waterways and wetlands, however the extent these are applied to protect water quality in site plan review or subdivision is not known without discussions with the Planning Board, Town Council, and Conservation Advisory Committee. Newstead does employ flood regulations and flags lots that are not suitable for development based on wetland and flooding conditions. The town's website warns citizens to check for floodplains and wetlands prior to buying or planning any development.

Roads, Bridges & Public Rights of Way

Newstead is not currently an MS4 designated community, so it is not held to the higher standards of stormwater and MS4 infrastructure management by New York State at this time. The Town of Newstead owns and maintains approximately 30.8 lane miles of a two lane highway. Roadway widths vary from 18 to 24 feet with 2 to 4 foot wide shoulders. The Town has several roads maintained by Erie County and New York State. They plow several roads for the County in the winter season. The Highway Department helps in the town-wide ditching program. Maintaining ditches is difficult due to lack of easements on private property. Newstead's Highway Department may be implementing a number of Best Management Practices related to road and right-of-way infrastructure even though these practices are not outlined in ordinances.

Onsite Wastewater Treatment Systems

Much of the Town does not have public sewers; however the town has created a small Town Sewer District to promote industry in the township that connects to the Village of Akron wastewater treatment plant. The lack of sewers does assist in controlling development.

Onsite septic systems are not regulated in town ordinances beyond provisions in the Stormwater and Erosion regulations that make it illegal for septic systems to connect/discharge to stormwater systems. Erie County Department of Health does oversee septic system testing and permitting when properties are transferred.

Recommended for Future Actions for the Town of Newstead

- Inventory all natural resources to identify and prioritize them for protection. Priority should be given to the major creek corridors. The creeks contribute to the rural character of the area, provide open space corridors for wildlife, and are connective features linking the region.

- Continue purchasing vacant land and abandoned railroad right-of-ways as a means to preserve sensitive natural areas that support water quality.

- Develop zoning Conservation District Overlays for the creeks and wetlands to preserve and protect the creek corridors, implement riparian buffers and habitat protection, not only to protect water quality, but to inhibit sprawl in these areas.

- Amend zoning regulations or produce a site design guidelines publication to more clearly guide development towards preferred designs (i.e. Low Impact Development, AEM, etc.)

- Educate officials and the public with wetland protection programs and best management practices to protect water quality such as stronger drainage requirements.

- Develop public education materials about proper maintenance of onsite sanitary waste disposal and distribute with town mailings.

- Collaborate with Erie County Soil and Water to identify high erosion and sedimentation areas and implement maintenance and operation plans to limit further erosion.

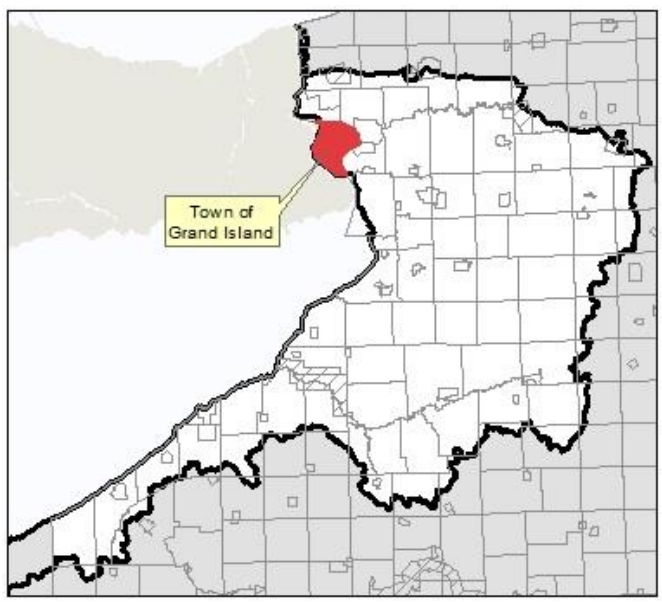
- Strengthen zoning regulations that protect wetlands from development encroachment. Add provisions that implement Best Management Practices.

- Collaborate with the Agricultural and Farmland Protection Program (NYSDAM) such as conducting workshops about conservation options for rural landowners and purchasing development rights in priority agricultural areas which are experiencing the most developmental pressure.

- Promote agricultural Best Management Practices through educational brochures and collaborative workshops with County Soil & Water professionals.

- Develop regulations to address BMP forestry practices, site clearing, and limit vegetation removal along creeks, wetlands, and in floodplains.

Town of Grand Island, NY (Phase 1) Erie County



The town is located entirely on the island of Grand Island in the Niagara River. The Niagara River splits into two parts at the south end of the island and rejoins at the northwest end, about three miles upstream (east) of Niagara Falls. It is largely flat with a few stream systems draining to the northern, eastern and western shoreline where they meet the Niagara River. It's subsurface is primarily clay with very little percolation and a very high water table in some locations. Formerly a rural agricultural community, much of the island has reverted to wetlands as agriculture has lessened considerably. The Town of Grand Island falls entirely within the Niagara River Sub-watershed, and both its northern and southern ends host state parks, Buckhorn Island State Park and Beaver Island State Park respectively.

According to the United States Census Bureau, the town has a total area of 33.3 square miles and a population of 20,374. As a bedroom community between the cities of Buffalo and Niagara Falls, the town is one of the areas of the region whose population is growing and suburban residential development is the primary land use.

The town lies adjacent to the international border between Ontario and the United States though there is no direct bridge or ferry connection from the island to Canada. Paired bridges connect the south end of the island to the Town of Tonawanda, and another pair of bridges connects the northern end to the City of Niagara Falls. The two sets of bridges are connected by a branch of the New York State Thruway.

The in-depth assessment conducted for Grand Island found the town to be very aware of their natural resources and the need to protect them. Many Island residents enjoy water-related recreation, including boating, fishing, kayaking and swimming. Of the 95 BMP categories used in the assessment Grand Island employs 39 directly through local regulations and another 5 through local practices (46% met in total)[11].

The following city documents were reviewed for the assessment:

- *Town of Grand Island Zoning Ordinance*
- *Town of grand Island LWRP,* 2006
- *Town of Grand Island Website (www.grand-island.ny.us)*

In addition to reviewing local documents, a meeting was held with the following Town of Grand Island staff members to discuss local practices and departmental policies:

- Mary Cooke – Town Supervisor
- Ray Billica – Town Council
- John C. Whitney, P.E. – Town Engineer
- Lynn M. Dingey – Assistant Civil Engineer
- James B. Tomkins – Highway Superintendent
- Douglas M. Learman – Building Inspector & Code Enforcement Officer
- Diane Evans – Conservation Advisory Board

New & Existing Development

The Island is ripe for development but it needs to be the right kind and in the right locations. The population is growing. The Township knows it needs to be proactive in directing new growth, and desires additional tools to support water quality and natural area protection. The Island's zoning

[11] Of the 101 total BMPs in the assessment, only 96 are applicable to Grand Island.

codes are currently quite progressive as it is, with regards to protecting water quality. The town Conservation Advisory Board is active and has been provided more authorities and input into development than most watershed municipalities. The Conservation Advisory Board is also becoming more vocal to planning/zoning and other departments on what is most valuable in town. It was noted, however, that additional natural resource inventories are needed in order for the Conservation Advisory Board to effectively outline important natural features when they are threatened by development.

Even though many of the tools exist to guide better development in Grand Island's code, town boards lack some experience in applying these regulations to their full effect. The town would benefit from training and municipal assistance that clarifies their legal rights in regards to development review and enforcement. Many BMPs in this Assessment are part of the Island's site planning process, but are not always applied to the final approved site plan. Town staff also noted that developers are more open to major site plan revisions if they ask for them earlier in process, essentially before they even pull together their plot, site and subdivision plans.

The town also does have a conservation easement program; however it may require revisions to improve its effectiveness and citizen awareness of it. The Town could also be better at protecting trees, such as limits in clear-cutting, removal of old-growth trees, and requiring replacement. Most recently the town relied on the site plan review process to protect old growth forest areas, but found that lacking. The town has made several attempts at passing a tree ordinance, but has not pulled one together yet, mostly due to enforcement concerns.

One of the most significant additions to the Zoning Code is the Enhanced Environment Overlay District (EED) which offers protections to the Town's Significant Coastal Fish and Wildlife Habitats, and other environmentally sensitive areas. By creating this overlay, the Town recognizes different areas are intrinsically suited for different types and intensities of development.

Agriculture & Forestry

There is no active silviculture on the island. Agriculture used to have a heavy presence on the island 50 years ago, but today only one main active farm exists. Anecdotally, much of the agriculture is said to be "placeholder" farming. Land that would be vacant is being farmed (hayed or crop land) and drained so it will not revert to wetland and possibly come under protections. There are no local regulations or educational outreach programs regarding agriculture, aside from what's offered by Erie County Soil and Water and the Natural Resource Conservation Service.

Waterways & Wetlands

The Island hosts the largest amount of Niagara River waterfront land of any community in the watershed, plus a number of smaller tributaries that drain to the Niagara River. The tributaries and Niagara River shoreline provide habitat essential to the ecosystems of the watershed. Most streams are privately or county owned and the Township does nothing to interfere with management of them. Riparian buffer setbacks exist and are based on stream classification and outlined by the town's Engineering Department. The largest setback is a minimum of 80 feet. Waterfront setbacks are applied during site plan review and require maintenance of vegetative areas. Follow-up enforcement of riparian buffer protections has proven difficult for the town, as violations are usually in the rear of a yard and hard to find.

The Town does not ban, but discourages development in the floodplain. Current flood regulations require the lowest floor to be 2 feet above the base flood elevation. Floodplains are addressed by the Enhanced Environmental Overlay as well.

Grand Island has lots of wetlands, most are Federal and identified in the National Wetlands Inventory. In some cases wetlands are used for stormwater management and these authorized uses are pre-screened and approved through the Stormwater Management Officer. Unfortunately the town has found "cheater" stormwater drainage systems discharge into areas wetlands. Development impacts to wetlands are also taken into account in the Enhanced Environmental Overlay.

Marinas

Grand Island has about 25 miles of shoreline and host a number of marinas and private docks. The Town's code only regulates marinas in regards to boat storage (i.e. visibility of boats). They are an allowable use, but the Island defers entirely to state and federal authorities (NYSDEC & ACOE) regarding their permitting, placement and design. The Town has site plan approval of any structures being built, but has no particular requirements incorporating BMPs or shoreline protections for marinas or docks.

Roads & Bridges

Much of the road-related issues affecting water quality are addressed by the Engineering Department, however problems are tackled once discovered. Culvert inspections do not occur regularly. The county does conduct infrastructure maintenance and inspections on their infrastructure and in a few cases will alert the town to issues on town-owned infrastructure.

Town highway staff regularly attends the Cornell Local Roads trainings. The highway superintendent has instituted amendments to their de-icing practices resulting in the reduction of road salt used and the town currently only mows right-of-ways, fertilizers and pesticides are not used on roadside ditches.

Onsite Wastewater Systems

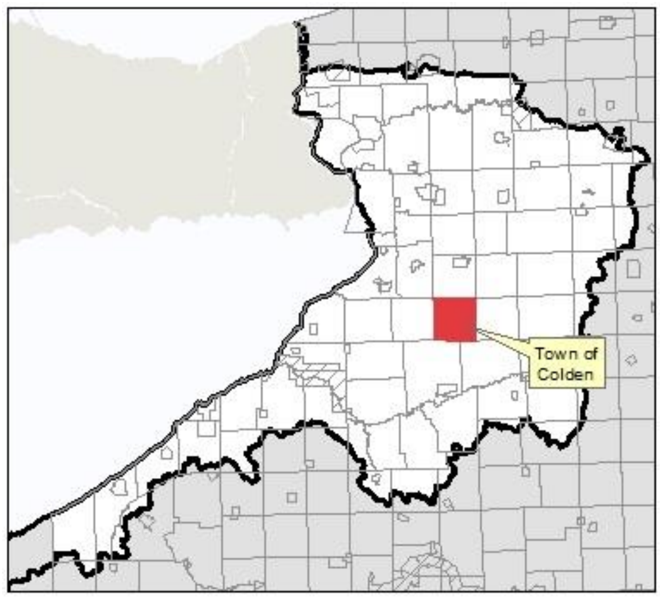
Septic systems are a problem on the island. There are a lot of them. Most of the western half of the island along with smaller areas to the north and southeast are all on septic systems. Many do not work particularly well given the clay substratum of the island. The clay provides no percolation and a sand filter must be built under the septic tank. This type of system sees more overflows and failures. The town is aware of the failures due to the "smell in the summertime". It is known that there are a lot of "cheater" pipes that discharge directly to local creeks and stormwater infrastructure. The town feels that the main problem is that many residents simply do not know how to use and maintain their septic systems. Education can be very valuable approach in solving this problem.

Recommended Future Actions for the Town of Grand Island

- Collaborate with regional organizations and citizens to effectively inventory valued resources that require preservation and protection in development review processes.
- Expand the scope of the Enhanced Environmental Overlay to encompass additional important living infrastructure lands, such as riparian buffers around all creeks and streams, the Niagara River shoreline, all high-functioning wetlands and forest habitats.
- Strengthen protections for riparian buffer vegetation and mature trees in town. Consider the addition of stronger regulatory language governing the management of required buffer areas.
- Investigate opportunities to enhance participation in the town's easement program, including additional incentives.
- Require a local permit for piers or docks located over jurisdictional Town waters.
- Adopt a Clean Marina citizen education program to improve management of private marinas and docking facilities.
- Regulate the design of private docks in accordance with BMPs.
- Train local staff and board members on reviewing developments from a water quality and habitat protection lens.
- Encourage developers to hold initial meetings with town staff and boards prior to submitting applications.
- Amend zoning regulations or produce a site design guidelines publication to more clearly guide development towards preferred designs.

- Collaborate with Erie County Health Department to find and address the illegal septic dumping and educate landowners on property septic operation and maintenance.
- Report illegal septic discharges to the Erie County Health Department.
- Incorporate marina design and maintenance BMPs into the waterfront zoning overlay. Legally the Township has jurisdiction 1100' out into the river and can pursue their regulatory authority.
- Conduct regular inventories of culverts and MS4 infrastructure to identify issues earlier, when they may still be functional but impact water quality and habitat.

Town of Colden, NY (Phase 1) Erie County



The town of Colden is a small rural community located south of the city of Buffalo, with the Towns of Aurora to the north, Holland to the east, Concord/Sardinia to the south and Boston to the West. Colden contains 35.7 square miles. In 2010 it had a population of 3,265, according to the US Census. It is very sparsely populated with only .14 persons/acre.

The town is almost entirely contained within the Cazenovia Creek section of the Buffalo River Sub-watershed. The west branch of the Cazenovia creek runs through the town, as do many smaller streams and tributaries. Colden's topography is made up of hills and valleys associated with the West Branch of Cazenovia Creek, which flows roughly south-north through along the western border of the town. Colden is the most northern section of ski country for Erie County and hosts two ski resorts in town, Buffalo Ski Club and Kissing Bridge. In this Cazenovia Creek valley (Route 240) area the soil is gravelly loam, while on the hills the gravel has a large clay element.

Colden's master plan is quite dated. It was prepared in 1992 as a ten year plan. According to this plan, the town is mostly a "residential dormitory community" with its residents employed elsewhere. It is primarily zoned agricultural (although the soil is very poor for agriculture) with strips of residential and commercial zoning following the north/south roadways in the center and west of the township. A focus of the town is to maintain Colden's picturesque quality while encouraging relevant development. The town recognizes that its natural features are an important component of its rural identity and appeal.

Colden is the home of the Colden Gas Storage Field which is a federally authorized natural gas storage field. The Town approved a six month gas drilling moratorium in 2012 while pursuing a study on the effects of drilling on the environment. After the report they chose to ban High Velocity fracking in the Township. Colden Well Being, a group dedicated to Protecting Our Water Rights (POWR) in Colden is primarily involved in the fracking conversation but is also concerned with other water quality issues.

The following city documents were reviewed for the assessment:

- *Town of Colden Cluster Housing Ordinance*
- *Town of Colden Farming Ordinance*
- *Town of Colden Flood Damage Prevention Ordinance*
- *Town of Colden Master Plan 2002 (1992)*
- *Town of Colden Recycling Ordinance*
- *Town of Colden Streets & Sidewalks Ordinance*
- *Town of Colden Wind Energy Conversion Systems Ordinance*
- *Town of Colden Zoning Ordinance*
- *Gas Drilling in the Town of Colden, report (2013)*
- *Town of Colden Website (www.townofcolden.com)*

Buffalo Niagara Riverkeeper was not able to obtain a meeting with Town of Colden to discuss local practices and departmental policies. The following assessment is based solely on town codes. With just the evaluation of local laws and policies, the Town of Colden scored 30 points out of a total of 100 possible points.

New & Existing Development

Colden, being a small, rural community, doesn't have much new development and is not forecast for growth. Because of this, their zoning does not go to the detail that some of the more built-out communities go to. They do allow for the preservation of natural features. Colden is rural and lacking in significant public infrastructure making large scale development impossible which reinforces large lot development, but also limits development pressures. The plan does recommend that commercial and industrial development take place in the Town's denser hamlet areas and along the Town's main arterial, Route 240. However, this area of town has flooding issues and development occurring in this area should not encroach into the flood plain.

Agriculture & Forestry

Colden makes little mention of forestry in their code or master plan, despite being significantly forested. This may be due to the hilly landscape limiting the ability of forestry operations. While the town is a Right to Farm community, farming is not a major part of Colden's economy due to poor soil conditions and unsuitable topography.

Waterways & Wetlands

Waterways and wetlands are touched upon in the zoning code but could be expanded upon, especially with the amount of tributaries and streams running through the town's borders. Of primary concern is the town's flooding and erosion issues associated with the West Branch of Cazenovia Creek. In some cases stream bank erosion is threatening private property and existing structures near the village area. Adequate setbacks are needed to address highly erodible soils and steep slopes, especially if hilltop development pressures increase for ski-resort vacation homes.

The Town of Colden has few wetlands given the terrain and soil composition. However, additional regulations should be developed to protect wetlands and forested shoreline wetlands especially, as these areas slow down flood waters, reducing erosion impacts. It may benefit the town to identify areas to recreate floodplain that has been lost and shoreline wetlands in order to reduce damage from extreme storm events.

Marinas

Not applicable, as Colden is a land locked community with no navigable waterways.

Roads & Bridges

It is not clear from local laws whether Best Management Practices are followed for roadway design, or highway and bridge maintenance.

Onsite Wastewater Systems

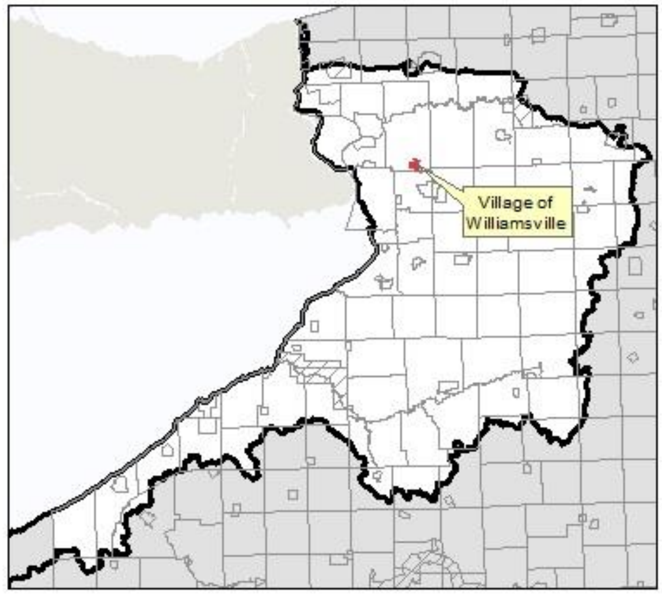
Colden has primarily private septic, but is hoping to make the transition to more public sewer service. It views this transition as important to attracting new development and residents. However, it seems unlikely that the Town will get public sewer service, as the Erie County Division of Sewerage Management is focused on maintaining existing infrastructure and only expanding to new areas if there presents a threat to water quality.

Similar to other municipalities, onsite septic systems are minimally regulated. This is due to many communities relying on the Erie County Department of Health to oversee proper septic operations through the property transfer process.

Recommended Future Actions for the Town of Colden

- Adopt Erie County's model Stormwater Ordinance to reduce stormwater pollution issues during development in town.
- Complete an inventory of natural resources then identify and prioritize them for protection. Priority should be given to the major creek/tributary corridors. The creeks contribute to the rural character of the area, provide open space corridors for wildlife, and are connective features linking the region.
- Develop zoning Conservation District overlays for Cazenovia Creek and tributaries to preserve and protect the creek corridors, implement riparian buffers and habitat protection.
- Encourage greenbelt programs to expand park/open space, large forest tracts and connectivity of living infrastructure, such as floodplains, wetlands, and forested riparian areas.
- Incorporate provisions for agricultural operations into stormwater regulations.
- Incorporate regulations addressing highly erodible soils and steep slopes in town zoning codes to limit erosion and sedimentation issues in town.
- Develop subdivision regulations that encourage clustering or smaller development footprints, limit clear-cutting and create buffers around natural features and interconnected forested areas.
- Establish regulations that limit removal of trees and heavily forested areas.
- Train local staff and board members on reviewing developments from a water quality and habitat protection lens.
- Conduct regular inventories of culverts and stormwater infrastructure to identify issues earlier, when they may still be functional but still impact water quality and habitat.
- Encourage Town staff to attend Cornell Local Roads Training programs.
- Educate officials and the public on wetland protection programs and BMPs to protect water quality with stronger drainage requirements, and public education about proper maintenance of onsite sanitary waste disposal.

Village of Williamsville, NY (Phase 1) Erie County



Williamsville is a small, fully developed, affluent village striving to keep its village sensibility in the midst of suburban sprawl development existing in the surrounding communities. Located in the northeastern quadrant of Erie County, the population was 5,300 at the 2010 census. Williamsville is located mostly within the Town of Amherst, but Creek Road and Creek Heights in the south part of the village are in the town of Cheektowaga. The historic village is mostly built-out with village-style density along Main Street and neighborhoods abutting this main businesses district. Presently, the village is experiencing new larger-scale mixed use developments replacing smaller traditional commercial uses. Its recent planning goals focus on livability and the village has made great efforts to keep Main St (Route 5) walkable for the 2.2 miles between I-290 and Youngs Road.

Williamsville is in the Ellicott Creek Sub-Watershed. At Williamsville's Island Park, Ellicott Creek splits briefly into two channels, one of which contains floodgates. The other channel was historically used to divert water into flumes for powering mills just downstream. Below the floodgates the creek flows rapidly through the village from south to north passing under Route 5. The Onondaga Escarpment runs through the village east-west. Glen Falls marks the place where Ellicott Creek falls over the escarpment in Glen Falls Park. The village is very environmentally aware which is reflected in both its codes and practices.

While the village has a strong focus on historic preservation, it also has a strong environmental sensibility in its comprehensive plan. It has a detailed vision to increase park access and green infrastructure as well as build upon its natural resource, Ellicott Creek. It wants to increase bike infrastructure and off street greenways/recreational trails. The village is small and affluent giving it more opportunities (i.e. tax base) to manage water quality issues.

The Village of Williamsville's Assessment yielded a score of 144 out of a possible 156 total points (91%); 79 out of 82 BMPs are employed through either a local law or practice in the village.

The following city documents were reviewed for the assessment:

- *Village of Williamsville Community Plan & Final Generic Impact Statement (2010)*
- *Village of Williamsville Animals Ordinance (1990)*
- *Village of Williamsville Comprehensive Plan (2009)*
- *Village of Williamsville Garbage, Rubbish & Refuse (2007)*
- *Village of Williamsville Recycling Ordinance (1992)*
- *Village of Williamsville Sewer Use Ordinance (2003)*
- *Village of Williamsville Stormwater Management (2011)*
- *Village of Williamsville Trees Ordinance (2003)*
- *Village of Williamsville Zoning Ordinance (2011)*
- *Village of Williamsville website (www.walkablewilliamsville.com)*

In addition, interviews were held with Ken Kostowniak, the General Crew Chief.

New & Existing Development

Though primarily built out, Williamsville has comprehensively addressed development through their zoning documents and recently updated comprehensive plan. The village is also actively working to address impervious cover, through projects that recover paved right-of-ways and install green infrastructure, including rain gardens, bio-swales and porous pavers. Recently completed projects include the use of porous pavers at Glenn Falls Park, immediately adjacent to Ellicott Creek.

Most recently the village has experienced additional development of larger-scale mixed-use development along the Main Street Business district. The scale of these developments is such that they are increasing the density of the village and the percentage of overall lot coverage. This type of development pressure is expected to increase as the village is gaining in popularity as a live-work-play community. Opportunities exist for the village to better protect water quality in the site plan review process and utilize incentive zoning for these in-fill projects.

The village has also recently addressed its sanitary sewer overflow issues by identifying and correcting inflow and infiltration points within the system (broken manhole pipes). Upon correction, the village no longer has sanitary sewer overflows, unless a flood-stage rain event occurs. Much of the additional common stormwater issues are addressed in the Village's stormwater management ordinances and stormwater pollution prevention plan development/review process.

Agriculture & Forestry

Not applicable, Williamsville has no active commercial farming or silviculture occurring at this time.

Waterways & Wetlands

Williamsville's stormwater management plan (Erie County model) addresses many aspects of waterways and wetlands within the village and the comprehensive plan has a detailed vision for enhancing the village's water resources and protecting them. The village owns a majority of the land along Ellicott Creek, (currently part of their parks system) and is implementing the comprehensive plan item to create a "green highways" along the creek in order to protect it and improve public access.

Zoning regulations currently provide for a thirty (30) foot development buffer from the edge of Ellicott creek, as well as provisions that encourage the protection and maintenance of vegetation along the creek's edge. While a majority of waterfront property owners have backyards that back up to the creek and maintain some vegetation on the shoreline, there are still other private landowners who mow to the water's edge or include small waterfront docks and patios. Parks officials also regularly notice the dumping of yard waste in the creek despite an ordinance making this activity illegal.

Since the village owns Glen Falls Park and Island Park, both of which abut Ellicott Creek, the village has direct opportunities to manage waterfront land with Best Management Practices. This assessment found that the village is employing a variety of BMPs within the parks that benefit the creek, such as maintaining forested riparian buffers, reducing impervious cover, not using fertilizers or pesticides, and even adjusting the flood gates seasonally at Island Park to reduce stagnant waters and thermal issues.

Marinas

Not applicable, as Williamsville is not a waterfront community with navigable waterways.

Roads & Bridges

Several of the major roads within the village are managed by the county. The remaining road infrastructure is managed in a means to reduce stormwater impacts. For example the village has adjusted its road salt application procedures, covered the salt shed, send highway staff to Cornell Local Roads trainings regularly, and follows the Highway Design Manual in road re-design work. The Green Highways program is an example of a potential model program that could be expanded in the region as well. The program reclaims paved right-of-ways for natural green infrastructure with pedestrian friendly amenities, reducing impervious cover and improving filtration opportunities for stormwater.

Onsite Wastewater Systems

There are only a handful of septic systems within one small sub-division. There will be no new systems. Presently the village relies on the county Health Department to address poorly functioning septic systems during the property transfer process.

Recommended Future Actions for the Village of Williamsville

- Improve the vegetative shoreline buffers along Island Park to reduce erosion and provide additional habitat with a denser mixture of native shrubs and trees.
- Document green initiatives and practices initiated by municipal staff into formal program documents and policies in order to retain this departmental knowledge and efforts as staff change-over occurs.
- Develop outreach and educational materials for waterfront landowners that addresses better yard management practices, riparian buffer design, and how best to mitigate shoreline erosion.
- Publicize how dumping yard waste into the creek is an illegal activity and educate citizens on its impacts.
- Strengthen zoning provisions that maintain and restore vegetative buffers in riparian areas, including shorelines, wetlands, floodplains, and special habitats, with preferences for native vegetation.
- Incorporate performance standards or stricter regulations into zoning and site plan review ordinances in order to encourage low impact design, green infrastructure, and reduction of impervious cover in private development.
- Train local boards and officials on low impact development and other green methods of development that protect water quality.
-

The following municipal assessments were completed by the Genesee Fingerlakes Regional Planning Council as part of the *Black and Oatka Creek Watersheds Municipal Law Review*.

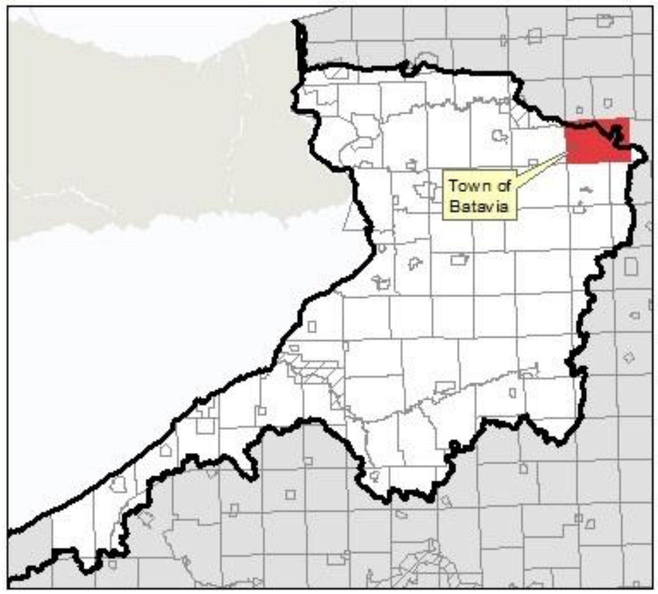
Town of Batavia, NY (Phase 1) — Genesee County

Area of Municipality*	Watershed Area		% of Municipality within Watershed		% of Watershed within Municipality	
	Black	Oatka	Black	Oatka	Black	Oatka
48.43	7.46	0	15.39%	0	3.68%	0

**All area figures in square miles*
**Town area calculations include villages within*

Land Use Documents Reviewed:

- *Town of Batavia Zoning Ordinance. (6/17/98)*
- *Town of Batavia Highways, Vehicles and Traffic Ordinance. (1/20/99)*
- *Mobile Home Ordinance, Town of Batavia (5/18/94)*
- *Town of Batavia Comprehensive Master Plan. (7/6/93)*
- *Town of Batavia Land Subdivision Regulations. (6/15/94)*
- *Town of Batavia Flood Damage Prevention law (1996)*
- *Town of Batavia Town Roadway Specifications (1998)*
- *Dog Control Law of the Town of Batavia. Adopted (1989)*



Approximately 15% of the Town of Batavia falls within the Black Creek watershed. The town has a total area of 48.5 square miles, accounting for over 3% of the total Black Creek watershed area.

As of the Census 2000, the town had a total population of 5,915 persons. The town has 2,334 households and 1,645 families. The average household size is 2.53 persons and the average family size is 2.99 persons. The median age is 39 years. The median income for a household in the town is $38,449. There are 2,447 housing units, housing structures were constructed in the median year 1966, and the median value for an owner-occupied house is $81,400.

According to the *2004 Regional Land Use Monitoring Report*, there were a total of 47 permits issued for new residential units and 12 permits issued for new commercial units between 2003 and 2004 in the Town of Batavia, indicating a significantly high rate of development within the town relative to the municipalities within the two watersheds.

The predominant land cover in the Town of Batavia is pasture/hay, with areas of row crops and small patches of mixed forest interspersed throughout. It is important to note that small portions of the watershed stretch into the City of Batavia, a municipality that has been omitted from this analysis. Land cover in the city is mainly low-intensity residential. It has been noted by local officials, however, that drainage infrastructure within the city transfers significant portions of stormwater from the Black Creek watershed into adjacent watersheds.

Best management practices in erosion and sediment control are well-represented in Batavia's land use regulations. For example, zoning ordinances stipulate that practices in erosion and sediment control should be taken from the NYS Guidelines for Urban Erosion and Sediment Control. Furthermore, stipulations regarding activities in the established Wellhead Protection District are explicit regarding water quality practices and standards. A number of BMPs were also found to be in effect within the town when considering the activities conducted by regional entities such as the county Soil and Water Conservation District and the Cornell Cooperative Extension; personal conversation with the town's highway superintendent revealed BMPs pertaining to highway maintenance as well. While regulations such as SPDES permit compliance and Stormwater Phase II Pre/Post Construction are intended to cover all of New York State, universal enforcement can at times be challenging for relevant authorities. Local regulations can therefore be an important addition to state and federal enforcement and will provide the municipality with the greatest degree of effectiveness when monitored and enforced by local officials.

The Town of Batavia has a relatively high rate of development in comparison to other municipalities within the study area. Strict oversight of site plans and construction activities should be paid by the town as agricultural land uses are converted to residential and commercial uses within the watershed. While specific erosion and sediment control BMPs were found to be present, local officials should strongly consider adopting the NYS model ordinance for stormwater management and erosion and sediment control, as it guarantees uniformity and comprehensiveness.

General attention should also continue to be paid to the maintenance of roadside ditches and other similar systems of stormwater conveyance. Roadside ditches are generally designed to accommodate only the runoff that originates from within the road right-of-way. As other connections are made from private lands, serious complications are likely to occur (specifically, downstream flooding and property damage). Continued evaluation of roadside ditches and connections of private drainage appurtenances (agricultural drainage tiles, sump pumps, field ditches, etc.) is therefore strongly recommended. Furthermore, local officials should consider identifying areas that may be appropriate for the construction of retrofit facilities – such as stormwater retention and detention ponds.

Recommendations for Future Action by Local Officials:

- Consider developing a stormwater management local law that works in conjunction with existing zoning, site plan and/or subdivision ordinances. Such a law would require developers to prepare a Stormwater Pollution Prevention Plan and submit it to the relevant local board as part of the process for new development. For complete information on stormwater and erosion and sediment control programs in NYS, including model local laws and guidance manuals, refer to the NYSDEC Division of Water Stormwater Information Page at http://www.dec.state.ny.us/website/dow/mainpage.htm.

- Revision of the town's comprehensive plan, emphasizing the protection of local water resources and recognizing the importance of watershed planning efforts within the Black Creek watershed and other neighboring watersheds within the municipality.
- Continued ditch maintenance using best management practices, maintaining vegetative buffers near waterbodies, lining sensitive areas with rip rap, and seeding disturbed areas immediately after are recommended practices.
- Consider opportunities to retrofit existing properties with new facilities, such as stormwater detention/retention ponds; also attempt natural conveyance restoration wherever possible.
- Continued education and outreach to area farmers by the Genesee County SWCD and CCE regarding agricultural best management practices and the various federal and state incentive programs available for implementation.
- Support education and outreach (mailings, brochures, etc.) to individuals whose lands are adjacent to Black Creek segments or contain contributing tributaries. Issues including nonpoint source pollution, riparian rights and landowner responsibilities, setbacks, floodplain protection and other stream maintenance BMPs are recommended focus areas.

Assessment Results:

Development	**21 of 44 BMPs, or 48%**	**Forestry and Agriculture**	**8 of 18 BMPs, or 44%**
Existing Development	*7 of 21, or 33%*	*Forestry*	*1 of 10, or 10%*
New Development or Redevelopment	*14 of 23, or 61%*	*Agriculture*	*7 of 8, or 88%*
Waterways/Wetlands	**8 of 15 BMPs, or 53%**	**Recreation**	**0 BMPs found**
Modified Waterways	*7 of 9, or 78%*	*Docks and Launches*	*0*
Wetlands/Riparian Areas	*1 of 6, or 17%*	*Golf Courses*	*0*
Roads and Bridges	**24 of 29 BMPs, or 83%**	**Onsite Wastewater Treatment Systems**	
Existing	*6 of 6, or 100%*	**3 of 7 BMPs, or 43%**	
New	*9 of 13, or 69%*	*Table summarizes the number of BMPs found to be present within the municipality. A listing of these BMPs can be found in Appendix F. Unabridged results for each municipality can be found on the project website.*	
All	*9 of 10, or 90%*		

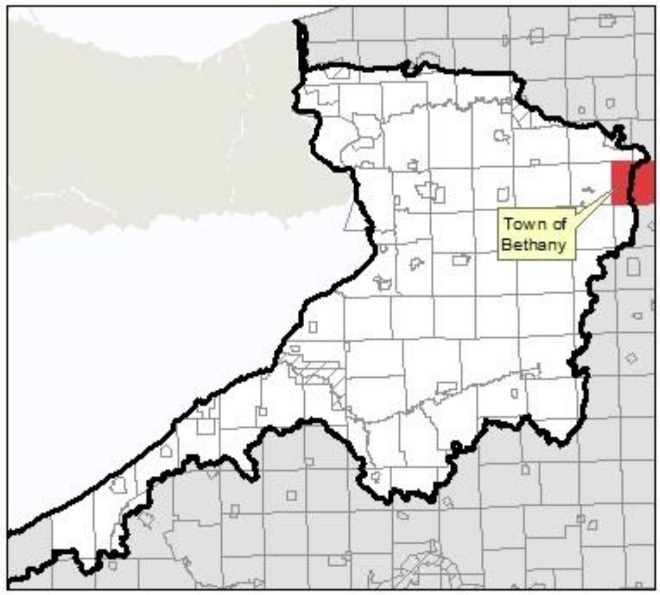
Town of Bethany, NY (Phase 1) — Genesee County

Area of Municipality*	Watershed Area		% of Municipality within Watershed		% of Watershed within Municipality	
	Black	Oatka	Black	Oatka	Black	Oatka
36.12	**30.29**	**.23**	**93.72%**	**.70%**	**14.96%**	**.11%**

**All area figures in square miles*
**Town area calculations include villages within*

Land Use Documents Reviewed:

- *Town of Bethany Comprehensive Plan (1996)*
- *Town of Bethany Comprehensive Emergency Management Plan (2002)*
- *Town of Bethany Zoning Law (2004)*
- *Town of Bethany Stormwater Management and Erosion Control Law (1994)*
- *Town of Bethany Flood Damage Prevention Law (1989)*



The Town of Bethany has a total area of 36.1 square miles, with portions of it spanning both the Black and Oatka Creek watersheds. While the headwaters of the Black Creek begin in Middlebury to the south, the creek becomes well established as it enters Bethany in the area of the Genesee County Park and Forest, a public area of 444 acres which lies at the town's southern border.

The Town of Bethany has a population of 1,760 persons. There are 636 households and 499 families residing in Bethany with an average household size of 2.77 persons and an average family size of 3.10 persons. The median age is 38 years. The median income for a household is $45,450, and the median income for a family is $50,234. The median year a structure was built in the town is 1954 and the median value of an owner-occupied housing unit is $82,600.

According to the *2004 Regional Land Use Monitoring Report*, there were a total of 14 permits issued for new residential units and 0 permits issued for new commercial units between 2002 and 2003 in Bethany, indicating a low rate of development within the town relative to the municipalities within the two watersheds.

Land cover in the Town of Bethany is rather diverse. Significant stands of mixed forest line the southern half of the Black Creek riparian corridor; these stands give way to pasture/hay in the northern half of the town. Outside of the central riparian corridor, land cover is predominately pasture/hay with significant patches of row crops. Land cover within the Bethany/Oatka Creek watershed area mirrors similar patterns as observed in the Black Creek watershed.

Town officials have noted that the majority of sediment and erosion problems occurring within the town are associated with agricultural practices rather than development. Aside from encouraging participation in voluntary federal and state incentive programs, there is little that municipal governments can do to regulate specific agricultural activities.

A comprehensive review of Bethany's land use ordinances revealed a host of important best management practices relevant to stormwater and sediment control. The town's comprehensive plan sets clear goals for the preservation of the town's rural character and the abatement of environmental degradation resulting from new development. Bethany's *Stormwater Management and Erosion Control Law* accounts for most of the BMPs found. The law requires erosion control plans to be developed and submitted to the responsible board for review and requires specific BMPs in erosion and sediment control to be present on disturbed sites, such as vegetative retention, various structural facilities (both temporary and permanent), as well as hazardous waste source controls. While the law covers many of the important areas relevant to erosion and sediment control, it does not meet the standards that regulated MS4s will be held to in 2008. Town officials may therefore want to consider reviewing the state model (as described on Appendix M of this report) in order to ensure comprehensiveness of scope of the local stormwater and erosion control law.

A number of BMPs were also found to be in effect within the town when considering the activities conducted by regional entities such as the county SWCD and the CCE. While regulations such as SPDES permit compliance and Stormwater Phase II Pre/Post Construction are intended to cover all of New York State, universal enforcement can at times be challenging for relevant authorities. Local regulations can therefore be an important addition to state and federal enforcement and will provide the municipality with the greatest degree of effectiveness when monitored and enforced by local officials.

Recommendations for Future Action by Local Officials:

- Consider modifying current local laws to be in conformance with the *Sample NYS Local Law for Stormwater Management and Erosion and Sediment Control*. By doing so, local officials will be providing uniformity and comprehensiveness regarding stormwater management and enforcement. For complete information on stormwater and erosion and sediment control programs NYS, including model local laws and guidance manuals, refer to the NYSDEC Division of Water Stormwater Information page at: http://www.dec.state.ny.us/website/dow/mainpage.htm.
- During the next scheduled revision of the town's comprehensive plan, emphasize the protection of local water resources and recognize the importance of watershed planning efforts within the Black and Oatka Creek watersheds

- Continued ditch maintenance using best management practices, maintaining vegetative buffers near waterbodies, lining sensitive areas with rip rap, and seeding disturbed areas immediately after are recommended practices.
- Consider opportunities to retrofit existing properties with new facilities, such as stormwater detention/retention ponds; also attempt natural conveyance restoration wherever possible.
- Continued education and outreach to area farmers by the Genesee County SWCD and CCE regarding agricultural best management practices and the various federal and state incentive programs available for implementation.
- Support education and outreach (mailings, brochures, etc.) to individuals whose lands are adjacent to Oatka Creek and Black Creek segments or contain contributing tributaries. Issues including non-point source pollution, riparian rights and landowner responsibilities, setbacks, floodplain protection, and other stream maintenance BMPs are recommended focus areas.

Assessment Results:

Development	**24 of 44 BMPs, or 55%**	**Forestry and Agriculture**	**8 of 18 BMPs, or 44%**
Existing Development	*10 of 21, or 48%*	*Forestry*	*1 of 10, or 10%*
New Development or Redevelopment	*14 of 23, or 61%*	*Agriculture*	*7 of 8, or 88%*
Waterways/Wetlands	**10 of 15 BMPs, or 67%**	**Recreation**	**0 BMPs found**
Modified Waterways	*8 of 9, or 89%*	*Docks and Launches*	*0*
Wetlands/Riparian Areas	*2 of 6, or 33%*	*Golf Courses*	*0*
Roads and Bridges*	**11 of 29 BMPs, or 38%**	**Onsite Wastewater Treatment Systems**	
Existing	*1 of 6, or 17%*	**2 of 7 BMPs, or 29%**	
New	*6 of 13, or 46%*	*Table summarizes the number of BMPs found to be present within the municipality. A listing of these BMPs can be found in Appendix F. Unabridged results for each municipality can be found on the project website.*	
All	*4 of 10, or 10%*		

Roy Hersee, Town of Bethany Highway Superintendent could not be reached for comment; section therefore is incomplete.

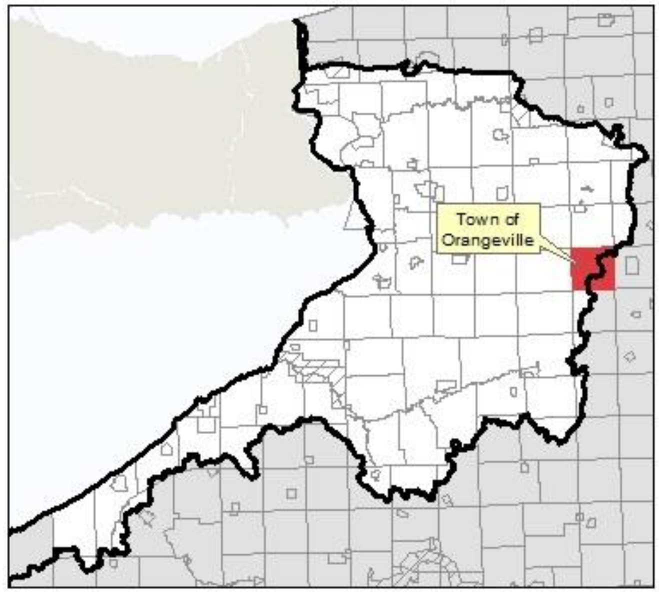
Town of Orangeville, NY (Phase 1) Wyoming County

Area of Municipality*	Watershed Area		% of Municipality within Watershed		% of Watershed within Municipality	
	Black	Oatka	Black	Oatka	Black	Oatka
35.67	**0**	**7.29**	**0**	**20.44%**	**0**	**3.39%**

**All area figures in square miles*
**Town area calculations include villages within*

Land Use Documents Reviewed:

- *Town of Orangeville Zoning Ordinance (1964)*
- *Amendments related to building permits and agricultural districts (1979)*



Approximately 3.4% of the total area of the Oatka Creek watershed lies within the eastern portion of the Town of Orangeville. The town has an area of 35.7 square miles, 0.25% of which is water.

Orangeville has a total population of 1,300 and possesses 602 housing units according to the 2000 US Census. The median year a structure was built in Orangeville is 1971, and the median value for an owner-occupied housing unit is $82,600. There are 485 households and 358 families residing in the town; the average household size is 2.68 persons and the average family size is 3.07 persons. The median age is 37 years and median income for a household in the town is $45,208.

According to the *2004 Regional Land Use Monitoring Report*, there were a total of 36 permits issued for new residential units and 0 permits issued for new commercial units between 2002 and 2004 in Orangeville, indicating a high rate of development within the town relative to the municipalities within the two watersheds.

A comprehensive assessment of the Town of Orangeville's land use regulations revealed no ordinances or regulations specific to erosion and sediment control. The Town's highway superintendent is, however, amply aware of drainage issues throughout the town and has personally overseen the installation of several mitigation projects approved by FEMA related to flash-flooding and stormwater control (specifically, culvert re-sizing and "drop-box" or check dam installation). Continued evaluation as to the effectiveness of these structures and regular maintenance will be crucial to avoiding problems in the future.

There were a number of BMPs found to be in effect throughout the town when considering the activities conducted by regional entities such as the county SWCD and the CCE; personal conversation with the town's highway superintendent revealed information in this regard as well. While regulations such as SPDES permit compliance and Stormwater Phase II Pre/Post Construction are intended to cover all of New York State, universal enforcement can at times be challenging for relevant authorities. Local regulations can therefore be an important addition to state and federal enforcement and will provide the municipality with the greatest degree of effectiveness when monitored and enforced by local officials.

The predominate land cover in the Orangeville portion of the Oatka Creek watershed is hay/pasture, with a modest amount of mixed forest along with a small amount of land used for row crop production. This portion of the watershed is characterized by very steep slopes with deep gullies, resulting in high-velocity surges in stormwater runoff during rain and thaw events. Two Oatka Creek tributaries – Stony Creek and Relyea Creek – are the primary drainage channels here. While both appear to be well-forested, their contributing tributaries appear to be somewhat unprotected and are likely to receive and contribute significant volumes of water from roadside ditches and drainage tiles originating in private farmland.

Considering the relatively high degree of new construction that has been occurring in the Town of Orangeville over the past several years, it may be prudent for town officials to consider enacting a stormwater management local law, as the risks of erosion resulting from construction activities are likely to increase if these building trends persist. This is of particular importance when considering the relative age of Orangeville's current land use regulations, which currently lack provisions related to erosion and sediment control.

General attention should also continue to be paid to the maintenance of roadside ditches and other similar systems of stormwater conveyance. Roadside ditches are typically designed to accommodate only the runoff that originates from within the road right-of-way. As other connections are made from private lands, serious complications are likely to occur (specifically, downstream flooding and property damage). Continued evaluation of roadside ditches and connections from private drainage appurtenances (agricultural drainage tiles, sump pumps, other ditches from private lands, etc.) is therefore strongly recommended.

Recommendations for Future Action by Local Officials:

- Designate a local official (preferably a member of the town board) to represent the town at future Oatka Creek Watershed Committee meetings. Meetings are held on a monthly basis during the 3rd Monday of each month at the LeRoy Village Hall.
- Consider developing a stormwater management local law that works in conjunction with existing zoning, site plan and/or subdivision ordinances. Such a law would require developers to prepare a Stormwater Pollution Prevention Plan and submit it to the relevant local board as part of the process for new development. For complete information on stormwater and erosion and sediment control programs in NYS, including model local laws and guidance manuals, refer to the NYSDEC Division of Water Stormwater Information Page at http://www.dec.state.ny.us/website/dow/mainpage.htm.

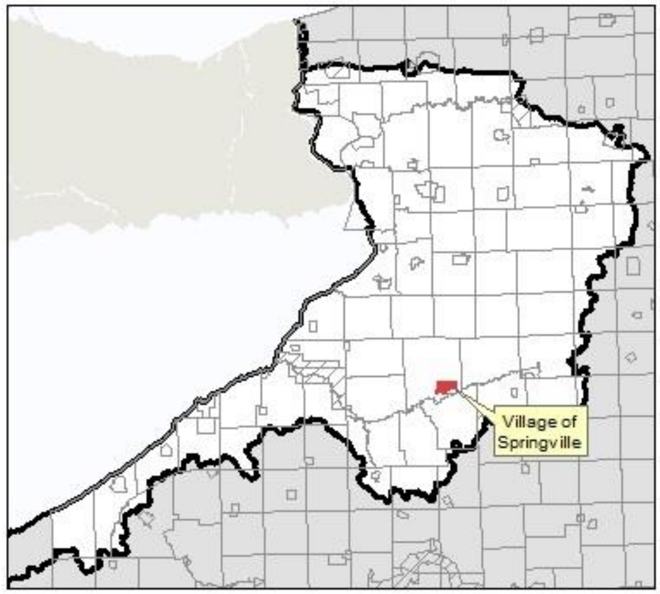
- Drafting of a comprehensive plan, emphasizing the protection of local water resources and recognizing the importance of watershed planning efforts within the Oatka Creek watershed and other neighboring watersheds within the municipality.
- It is highly recommended that check dams be constructed and/or maintained in steep slope areas which have considerable potential to produce high-velocity runoff.
- Continued ditch maintenance using best management practices, maintaining vegetative buffers near waterbodies, lining sensitive areas with rip rap, and seeding disturbed areas immediately is also recommended.
- Consider developing environmental protection overlay zones for significant tributaries and steep slope areas, prohibiting the erection of new structures within at least 50 feet of environmentally sensitive areas.
- Continued education and outreach to area farmers by the Wyoming County SWCD and CCE regarding agricultural best management practices and the various federal and state incentive programs available for implementation.
- Support education and outreach (mailings, brochures, etc.) to individuals whose lands are adjacent to Oatka Creek segments or contain contributing tributaries. Issues including nonpoint source pollution, riparian rights and landowner responsibilities, setbacks, floodplain protection and other stream maintenance BMPs are recommended focus areas.

Assessment Results:

Development	**12 of 44 BMPs, or 27%**	**Forestry and Agriculture**	**7 of 18 BMPs, or 39%**
Existing Development	*8 of 21, or 38%*	*Forestry*	*1 of 10, or 10%*
New Development or Redevelopment	*4 of 23, or 17%*	*Agriculture*	*6 of 8, or 75%*
Waterways/Wetlands	**7 of 15 BMPs, or 47%**	**Recreation**	**0 BMPs found**
Modified Waterways	*6 of 9, or 67%*	*Docks and Launches*	*0*
Wetlands/Riparian Areas	*1 of 6, or 17%*	*Golf Courses*	*0*
Roads and Bridges	**22 of 29 BMPs, or 76%**	**Onsite Wastewater Treatment Systems**	
Existing	*5 of 6, or 83%*	**2 of 7 BMPs, or 29%**	
New	*8 of 13, or 62%*	*Table summarizes the number of BMPs found to be present within the municipality. A listing of these BMPs can be found in Appendix F. Unabridged results for each municipality can be found on the project website.*	
All	*9 of 10, or 90%*		

The following municipal assessments were completed as part of Phase 2 of the Regional Niagara River/ Lake Erie Watershed Management Plan Project.

Village of Springville, NY (Phase 2) Erie County



The Village of Springville is a small rural village located near Cattaraugus Creek within the Town of Concord. Spring Brook, a tributary to Cattaraugus Creek, flows through its boundaries. According to the 2010 Census Springville had a population of 4,296 within its 3.65 square miles.

By the late nineteenth century, Springville had several factories, mills, a foundry, and a machine shop. It has maintained a historic downtown business district despite the shift from industrial to service–sector jobs over the years. The village area is mostly built-up and does not offer much area for future development, however there are a few vacant parcels and some potential brownfield remediation sites.

The in-depth assessment conducted for Springville found the village to be moving in a proactive direction, especially in terms of stormwater management actions. It has undertaken many green infrastructure practices such as installing rain gardens along Franklin and Factory Streets, even though it is not required to do so by law, since it is not a regulated Municipal Storm Sewer System in an urbanized area. Of the 87 Best Management Practices (BMPs) categories used in the assessment, Springville employs 32 directly through local and state regulations and another 34 through local practices (76% met in total)[12].

The following town documents were reviewed for the assessment:

- *Village of Springville Zoning Ordinance* (2009)
    - *Village of Springville Floodplain Overlay District (1997)*
    - *Village of Springville Wellhead Protection Overlay District (2002)*
- *Village of Springville Water, Sanitary Sewer, Electric and Storm Sewer Systems Ordinance (May 2016)*
- *Village of Springville Subdivision of Land Ordinance (1997)*

[12] Of the 151 total BMPs in the assessment, only 87 are applicable to Springville.

- *Village of Springville Parking Lots Ordinance (1979)*
- *Village of Springville Comprehensive Plan (May 2015)*
- *Village of Springville Website* (http://www.villageofspringvilleny.com/)

Meetings were held with the following Village of Springville staff:

Kenneth Kostowniak – Department of Public Works
Michael Kaleta – Code Enforcement Officer
Elizabeth Melock – Village Administrator
Robert Moriarty – Village Trustee
Robert Muhlbauer – Village Planning Board
Sue Owen – Village Zoning Board

New & Existing Development

While the majority of land uses in Springville are residential, the village is defined by a traditional Main Street (Route 39) bisecting it from east to west, and an auto-centric commercial strip running north-south on the west end of the village (S. Cascade Drive). The majority of public services for both Springville and the Town of Concord are located within the village.

The village still has large parcels of mostly undeveloped land, some of which are vacant. The practice in the village is to approve items that go above and beyond code if the design is well done and has been shown effective, but the village should consider the potential of these large lots, as well as that of significant redevelopment in already developed lots. By improving design and massing guidelines throughout the village, Springville can protect the watershed as well as its own resources and character for the long term.

The village should also protect its waterways by creating consistent setbacks across all riparian areas, especially for future redevelopment. While NYS codes and floodplain ordinances are followed with no additional setback or riparian buffers required since areas along streams and natural areas are already developed, educating residents and landowners about best management practices when living next to a creek may reduce detrimental runoff.

In an effort to allow for more sustainable buildings that reduce water consumption and stormwater runoff, the Village Board may want to create specific provisions to minimizing the creation of impervious surfaces or requiring permeable pavement, and encouraging village-owned properties to go above state building codes. The Village Board may have to pass a law to allow village buildings to exceed NYS building code.

Agriculture & Forestry

Springville does not have many active commercial farming or silviculture sites at this time, but is part of Erie County's Southeast Agricultural District. Belscher Farm is located on the edge of the village on N. Central Avenue and is mostly located within the Town of Concord. Dygert Farm, the former site of the Erie County Fair, on Elk Street, is now a horse farm. The village does not regulate practices on these farms. It is recommended that the village encourage farms seeking an agriculture assessment to participate in Agricultural Environmental Management in order to protect water quality, especially due to the proximity to Cattaraugus Creek.

In an effort to protect its tree cover and village character, Springville intends to conduct a tree survey and develop a Tree Ordinance. Improved tree cover increases stormwater retention within the roots and leaves of trees, reduces water temperature along streams, and enhances fish habitat, as well as improving quality of life for residents by providing shade and air quality benefits.

Waterways & Wetlands

Spring Brook crosses the Village of Springville in a generally north-south axis. The NYS Department of Environmental Conservation (NYSDEC) classifies Spring Brook as Class C waters which are suitable for secondary contact recreation and supports fish survival and may be suitable for fish propagation. It is also classified as "T", which identifies trout in the stream and "TS" which identifies trout spawning.

This waterway is protected by the NYSDEC; any alterations to its banks require a NYSDEC permit. Additionally, the Village of Springville's recent update to their village code included further protections for waterways by prohibiting discharges to natural outlets. However, the village should consider requiring additional buffers or provisions around the brook to protect it, such as maintaining or improving the riparian system, and educating waterfront landowners on bets management practices.

There are a small number of wetlands in the National Registry within the village. According to the 2015 Comprehensive Plan, the wetlands are delineated on a case by case basis as development is undertaken. Efforts should be lead from within Springville to protect and maintain these important resources.

Marinas

Not applicable, Springville does not have any current nor planned marinas.

Roads & Bridges

Of the approximately 25 miles of roadways in Springville, almost 15 miles belong to the village with the rest primarily a combination of county and state roads. The village roads are mostly collectors to the state and county roads.

Road maintenance practices can play a role in the pollution of waterways. Rock salt, sediment, paving, moving fill, and automotive fluids can all negatively impact water quality within municipal limits. The Springville Highway Department applies many of the Best Management Practices (BMPs) in the assessment in the maintenance of their roadways, including a good training program for highway personnel. However, it has not codified or otherwise formalized any of them other than NYS DOT design and guidance documents, which leaves good, locally relevant practices subject to being abandoned as tenures and funding change.

Springville also has completed rain gardens along some streets and the village's Zoning Code encourages the use of shared driveways due to space constraints. Both measures are a smart use of resources that improve water quality and reduce impervious surfaces. Encouraging the use of permeable pavement and limiting lot coverage where practical will also go a long way to reducing stormwater runoff within the village.

Onsite Wastewater Systems

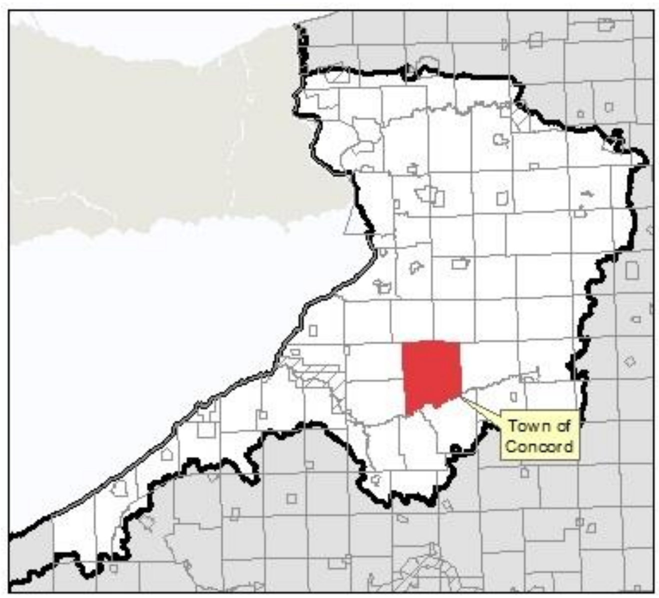
Springville follows the NYSDEC's regulations regarding onsite wastewater treatment, and depends on the Erie County Department of Health for inspections at property transfers. However, most of Springville is served by the village's sewer system. The Village Code requires connections to public sewers when available and prohibits privies, septic tanks, and cesspools. They also hold all generators of industrial waste "responsible for the removal of contaminants present in quantities that might create problems in the Village collection system, the Village wastewater treatment plant, or the outside environment."

Recommended Future Actions for the Village of Springville

- Develop zoning provisions that maintain and restore vegetative buffers in riparian areas, including shorelines, wetlands, floodplains, and special habitats, with preferences for native vegetation. Create regulations to oversee appropriate riparian site design along Spring Brook.
- Ensure proper maintenance and upkeep of private stormwater management systems by adopting codes that strengthen enforcement authority (i.e. establishing fines for violations).
- Create zoning provisions that limit the creation of impervious surfaces and encourage the use of green stormwater infrastructure (i.e. lot coverage, porous materials).

- Conduct waterfront property owner outreach and education on limiting stream bank erosion and improving stability through maintaining naturalized shorelines and riparian vegetation. Consider promoting the use of programs such as NYSDEC's Trees for Tribs program.
- Evaluate wetlands for their capacity as local non-point source pollution control (stormwater) infrastructure to better inform relocation or mitigation actions.
- Encourage highway maintenance staff to continue participating in Cornell Local Roads trainings and document existing BMPs that go above and beyond NYS standards.
- Pass a law encouraging village-owned properties to go beyond the NYS building code to allow for reduced water consumption and reduced stormwater runoff.
- Encourage properties seeking agricultural value assessment to participate in Agriculture Environmental Management.
- Develop a Tree Survey and/or Natural Resource Inventory as part of an Open Space Conservation Plan to protect habitat, water quality, and quality of life within the village.

Town of Concord, NY (Phase 2) Erie County



The Town of Concord is a rural town in southern Erie County with Cattaraugus Creek making up the southern border. Collins and North Collins form the western border and Sardinia forms the eastern border. Boston and Colden can be found to the north. The Village of Springville is entirely within the borders of Concord. According to the 2010 Census, Concord had a population of 8,494 within its 70.1 square miles. It is the largest town, in terms of square miles, within Erie County.

There are several large open spaces in the Town that offer a variety of recreational opportunities. Zoar Valley is a state-owned multiple-use-area located along Cattaraugus Creek. Erie County operates Sprague Brook Park and Scoby Dam Park. Kissing Bridge is a privately-owned ski resort. There are also several town-owned parks and two privately-owned golf courses.

Concord is home to several large retail operations along the Route 219 corridor, as well as a few large manufacturing plants. Much of the commercial and industrial development has taken place within the Village of Springville borders, in part due to existing sewer and water infrastructure.

The in-depth assessment conducted for Concord found the town routinely applies many of the Best Management Practices (BMPs), especially in terms of road maintenance. Of the 91 BMPs used in the assessment, Concord employs 28 directly through local and state regulations and another 33 through local practices (67% met in total)[13].

The following town documents were reviewed for the assessment:

- *Town of Concord Zoning Ordinance* (*2005*)
- *Town of Concord Sewers Ordinance (February 1993)*
- *Town of Concord Animals Ordinance (2006)*
- *Town of Concord Flood Damage Prevention Ordinance (1987)*
- *Town of Concord Parks and Recreation Areas Ordinance (1993)*
- *Town of Concord Refuse Disposal Ordinance (1997)*
- *Town of Concord Water Ordinance (March 1999)*
- *Town of Concord Subdivision of Land Ordinance (1997)*
- *Town of Concord Streets and Sidewalks Ordinance (2005)*
- *Town of Concord and Village of Springville Joint Comprehensive Plan (August 1999)*
- *Town of Concord Website (http://www.townofconcordny.com/)*

A meeting was held with the following Town of Concord staff:

Gary A. Eppolito – Town Supervisor
Dennis M. Dains – Highway Superintendent
Kenneth D. Zittel – Councilman

New & Existing Development

Concord is a largely rural town with the majority of its commercial and civic activity, except for agriculture and mining, within the Village of Springville. As is common for rural communities, large scale development is unusual, with most developments coming in the form of individual residences. There are some hamlets dispersed through the town, as well as some attractions such as Zoar Valley Park, Scoby Dam, Sprague Brook, and Kissing Bridge Ski Resort.

[13] Of the 151 total BMPs in the assessment, only 91 are applicable to Concord.

Almost 42% of the town, including the Village of Springville area, has slopes above 8%, which have been known to cause severe erosion. The town, in an effort to allow development but acknowledging challenging conditions, has retained the authority to require additional measures regarding sewers beyond state or county regulations.

Due to experiences with prior developments, the town has a subdivision ordinance that prioritizes the existing resources on the site.

Concord employs numerous BMPs, but has not formalized them. In order for Concord to grow in a way that protects its natural resources and the watershed, the town may want to identify and implement those practices into regulations that concentrate development in appropriate areas. Significant redevelopment should also be held to these standards.

Agriculture & Forestry

Concord is a Right to Farm community; approximately 38,000 acres of Concord and the Village of Springville are included as part of NYS's Agricultural District program in the Southeast Agricultural District. Agriculture in the town includes dairy and animal farming with some crop farming. Most of Concord's valuable agricultural soils are concentrated on the east and west sides of the town. It is recommended that the town encourage farms seeking an agriculture assessment to participate in Agricultural Environmental Management in order to protect water quality, especially due to the proximity to Cattaraugus Creek.

Tree cover throughout the town is extensive, but there are no logging or managed forests within Concord. While the town has established regulations for the commercial extraction of mineral resources in addition to those regulated by the state, there is no similar protections or development standards for other natural resources.

Waterways & Wetlands

Concord is split between four of the designated sub-basins of the Niagara River/Lake Erie Watershed. Two flow in a northerly direction toward Eighteenmile Creek and Cazenovia Creek into the Buffalo River. The other two sub-basins flow south into Cattaraugus Creek.

Spring Brook, Cattaraugus Creek, the western branch of Cazenovia Creek, and Eighteenmile Creek are Concord's main waterways. These waterways are protected by the NYSDEC; any alterations to their banks require a NYSDEC permit.

The NYS Department of Environmental Conservation (NYSDEC) classifies Spring Brook as Class C waters which are suitable for secondary contact recreation and supports fish survival and may be suitable for fish propagation. It is also classified as "T", which identifies trout in the stream and "TS" which identifies trout spawning. Cazenovia and Cattaraugus Creeks are both designated Class "B", indicating they are appropriate for primary and secondary contact recreation and fishing, to include wildlife propagation. Eighteenmile Creek is designated as "AT", which indicates the water's suitability for drinking and cooking.

The majority of wetlands are in the southern half of the town. According to the 1999 Joint Comprehensive Plan, the wetlands are delineated on a case by case basis as development is undertaken.

NYS codes and floodplain ordinances are followed with no additional set-back or riparian buffers required. Studies have shown that even a 10 foot buffer can help to stabilize banks and shade waterways for fish habitat while a preferred 100-foot vegetated buffer can reduce sediment and nutrient loading to waterways.

Marinas

Not applicable, Concord does not have any current nor planned marinas.

Roads & Bridges

Two main roads, perpendicular to each other, cross Concord: US Route 219 and State Route 39. The majority of the remaining roadways are county-owned roads. The Concord Highway Department maintains the Town roads and applies many Best Management Practices (BMPs), including explicit reference to NYS DOT design and guidance documents as well as requiring regular training for employees. It is recommended that Concord implement regulation to use native species in new landscaping along roadways and to treat runoff. Consider adding BMPs from NYSDEC's *Stormwater Management Gap Analysis Workbook for Local Officials*.

Onsite Wastewater Systems

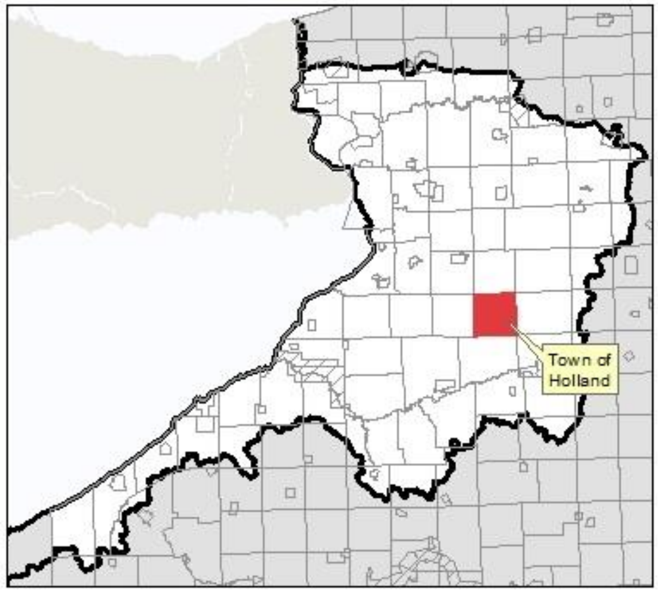
There are only two small areas and the Village of Springville within the Town of Concord that have sanitary sewer systems. The majority of the town uses septic systems, and follow NYSDEC or Erie County Department of Health regulations regarding onsite wastewater treatment. Concord requires continued maintenance of the septic systems and requires connection to the sewer systems if they become available to a property.

Recommended Future Actions for the Town of Concord

- The town may want to explicitly allow for creative or technologically-advanced solutions throughout Concord, which may encourage developers to come to the town with the best available solution from the beginning.
- Require trees above specific radii to be accounted for in site plan review submissions.
- Develop zoning provisions that maintain and/or restore vegetative buffers in riparian areas, including shorelines, wetlands, floodplains, and special habitats, with preferences for native vegetation. Create consistent setbacks across all riparian areas to pertain to future redevelopment.
- In addition to existing setback guidelines, Concord should consider local regulations to protect wells and surface water sources from manure and other substances detrimental to water quality.
- Require disturbed soils be stabilized as soon as possible, even with temporary vegetation and mulching, and minimize the use of cut and fill operations.
- Improve zoning provisions to include limits on the creation of impervious surfaces and encourage the use of green stormwater infrastructure (i.e. lot coverage, porous materials).
- Consider requiring new development to maintain pre-development stormwater runoff rates, even for lots smaller than 1 acre.
- Consider enacting limits on roads and driveway grades more responsive to the town's topography and soils.
- Conduct property owner outreach and education on limiting stream bank erosion and improving stability through maintaining naturalized shorelines and riparian vegetation. Consider promoting the use of programs such as NYS Department of Environmental Conservation's Trees for Tribs program.
- Consider encouraging properties seeking agriculture value assessment to participate in Agriculture Environmental Management.

Town of Holland, NY (Phase 2) Erie County

Holland is a rural town of 35.8 square miles located in southeastern Erie County and known for its scenic valley. Settlers initially developed the northern portion of the Town known as "Humphrey Valley" in the early 19th century. The town is bordered by Java in Wyoming County to the east, the Town of Colden to the west, the Town of Wales to the North, and the Town of Sardinia to the south. In 2010, the population was 3,401 according to the U.S. Census.



Holland is split between the Buffalo Creek and Buffalo River (including Cazenovia Creek) sub-watersheds with all drainage eventually emptying to the City of Buffalo. The economy of Holland includes several large farms, light industry, and a NASCAR-sanctioned racetrack. NY Route 16 runs through the town center. This corridor boasts both the Holland business district and prime agricultural soils.

The in-depth assessment conducted for Holland found the town relies heavily on the Special Use permit process to apply best management practices (BMPs). Of the 103 BMP categories used in the assessment, Holland employs 31 directly through local and state regulations and another 30 through local practices (61% met in total)[14].

The following town documents were reviewed for the assessment:

- *Town of Holland Zoning Ordinance (2013)*
- *Town of Holland Solid Waste Ordinance (2010)*
- *Town of Holland Dogs Ordinance (2010)*
- *Town of Holland Water Ordinance (1992)*
- *Town of Holland Flood Damage Prevention Ordinance (2008)*
- *Town of Holland Subdivision of Land Ordinance (2004)*
- *Town of Holland Streets and Sidewalks Ordinance (2004)*
- *Town of Holland Trees Ordinance (2000)*
- *Town of Holland Open Development Area Ordinance (2004)*
- *Regional Comprehensive Plan (Towns of Aurora, Elma, Holland, and Wales, and Village of East Aurora) (2004)*
- *Town of Holland Master Plan Update (1994)*
- *Town of Holland Website (http://www.townofhollandny.com/)*

A meeting was held with the following Town of Holland staff:

Marty Regan – Holland Planning Board

[14] Of the 151 total BMPs in the assessment, only 103 are applicable to Holland.

Michael Hayden – Water Operator
Patrick Joyce – Highway Superintendent/Facilities Manager
Karen Kline – Councilmember

New & Existing Development

NYS codes and floodplain ordinances are followed with no additional set back or riparian buffers required. The town has prepared for potential development with Planned Unit Development, Planned Business Development, and Cluster Residential Development ordinances. Holland also has, commendably, a specific ordinance on trees, requiring the preservation and protection of trees on public and private property in efforts to reduce flooding, water pollution, and preserve the town's ecological, economic, and aesthetic environments. This ordinance includes section §111-9 *Standards for a tree preservation plan* in the case of site changes requiring site or subdivision plan approval under the Zoning law.

In addition, Holland explicitly limits the building coverage of a lot, but just as other municipalities, does not limit the overall amount of impervious surface coverage per lot.

Agriculture & Forestry

Holland is a Right to Farm community, and the majority of the municipality is included in Erie County's Southeast Agricultural District. As of the 1994 Master Plan, 68% of the Town was part of the Agricultural District and 30% of the town's land was actively farmed. Additional language should be added to the Town Code to protect health and safety by, for example, instituting setbacks from waterways and drinking sources to avoid contamination from animal and agricultural wastes.

The Master Plan also reported 56% of the town as forested or vacant. While the town's Trees Ordinance protects these forested lands from clear cutting during development or from major losses by removing diseased trees, other best management practices could be introduced. Examples include employing natural topography and contour for design of roads, and considering potential water quality impacts when selecting silviculture systems (yarding system, site preparation, pesticide employment, etc.).

Waterways & Wetlands

The valleys of Cazenovia and Hunters Creeks run north-south through Holland and are flanked by ridges and hills. Cazenovia Creek in Holland is listed as mostly Class B, indicating a best usage for swimming and other recreation, and fishing. The classification by the NYS Department of Environmental Conservation (NYSDEC) changes to C (T) south of the town hamlet, identifying waters which are suitable for secondary contact recreation, and fish survival; the "T" specifies trout in the stream. Hunters Creek is a Class B waterway. A Fish and Wildlife Protection of Waters Permit is required to physically disturb the bed or banks of any stream with a classification standard of C (T) or higher.

Only a collectively small area of wetlands has been identified in Holland, mostly in the southeast corner of the municipality.

Marinas

Not applicable, Holland does not have any current nor planned marinas.

Roads & Bridges

Like other municipalities contacted for this document, Holland applies many BMPs, but has not codified many of them. The town's Trees Ordinance aids in the protection of vegetation in disturbed sites, including the right of way.

It is recommended that Holland document BMPs in writing, in order to maintain water quality in the town and prevent emerging threats, such as invasive species and erosion, from negatively impacting the town. The town only requires long term sedimentation control & maintenance for utility scale energy systems, and should incorporate this language throughout the code for significant development and redevelopment, to include roads.

Onsite Wastewater Systems

Holland follows the NYSDEC's regulations regarding onsite wastewater treatment and relies on the County's Department of Health for regulation. However, as of the 2004 Regional Comprehensive Plan, the monthly average fecal coliform concentrations exceeding NYS standards for Class B streams (namely, Cazenovia Creek) were attributed to failing or leaking septic tanks from residential and rural-residential uses.

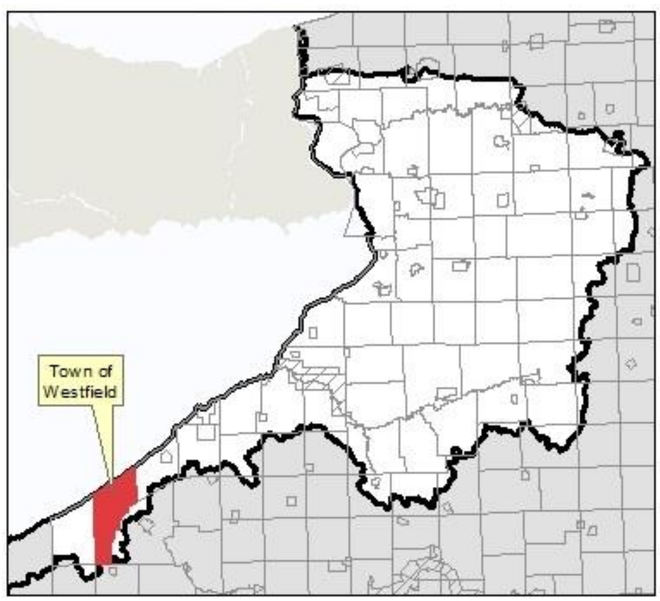
It is recommended that Holland employ BMPs such as requiring "regular inspections of OWTS at a frequency adequate to determine failure and undertake required maintenance" and provide educational materials to homeowners regarding OWTS maintenance and repairs.

Recommended Future Actions for the Town of Holland

- Special Use Permits that are constantly requested should be built into the Town Code, leaving the Special Use Permit process for unique or otherwise unusual situations.

- Develop zoning provisions that maintain and restore vegetative buffers in riparian areas, including shorelines, wetlands, floodplains, and special habitats, with preference for native vegetation.
- Ensure proper maintenance and upkeep of private stormwater management systems by adopting codes that strengthen enforcement authority (i.e. establishing fines for violations).
- Create zoning provisions that limit the creation of impervious surfaces and encourage the use of green stormwater infrastructure (i.e. lot coverage, porous materials).
- Include significant redevelopment in stormwater runoff control structures requirements.
- Document existing BMPs that go above and beyond NYS standards.
- Require both temporary and long term sedimentation control & maintenance.
- Include language throughout the code regarding proper handling and removal of construction wastes.
- Compost pile regulations should be part of the *Regulations Which Apply to All Districts.*
- Requiring a high percentage of indigenous plants during development or significant redevelopment should be part of the *Regulations Which Apply to All Districts.*

Town of Westfield, NY (Phase 2) Chautauqua County



The Town of Westfield is a rural coastal town in Chautauqua County with the Town of Ripley to the southwest and Town of Portland to the northeast. Chautauqua Creek forms the border between the Town of Westfield and the Town of Chautauqua and outlets at Lake Erie. There are also several other small creeks within the borders of the Town. The Village of Westfield is located wholly within the boundaries of the Town. Interstate I-90, which heads northeast to Buffalo and southwest to Pennsylvania, also runs through Westfield. According to the 2010 Census, Westfield had a population of 3,224 within its 844 square miles.

Westfield is known for Barcelona Harbor, the shallow draft recreational harbor that also serves as a Harbor of Refuge, located just northeast of the mouth of Chautauqua Creek. It is protected by east and west breakwaters totaling 1,730 feet.

Westfield is home to several commercial operations along the Route 20 corridor. Much of the commercial and industrial development has taken place within the Town of Westfield's main street. Known as the "Grape Juice Capital of the World," Westfield still devotes much of its agriculture to grapes.

The in-depth assessment conducted for Westfield found the town to be moving in a proactive direction, particularly by preparing for development and technological changes ahead of peer municipalities.

The in-depth assessment conducted for Westfield found the Town applies many of the Best Management Practices (BMPs). Of the 89 BMPs used in the assessment, Westfield employs 31 directly through local and state regulations and another 56 through local practices (77% met in total)[15]. The Assessment of Westfield yielded a score of 143 out of 230 possible points.

The following town documents were reviewed for the assessment:

- *Town & Village of Westfield Comprehensive Plan (1997)*
- *Town of Westfield Website (http://www.townofwestfield.org)*
- *Town of Westfield Animals Ordinance (2006)*
- *Town of Westfield Flood Damage Prevention Ordinance (1989)*
- *Town of Westfield Highways Ordinance (2007)*
- *Town of Westfield Littering Ordinance (1962)*
- *Town of Westfield Parks and Recreation Areas Ordinance (1989)*
- *Town of Westfield Sewers Ordinance (1991)*
- *Town of Westfield Solid Waste Ordinance (1990)*
- *Town of Westfield Streets and Sidewalks Ordinance (2003)*
- *Town of Westfield Subdivision of Land Ordinance (2006)*
- *Town of Westfield Water Ordinance (2005)*
- *Town of Westfield Zoning Ordinance (2013)*
- The Westfield – Chautauqua Greenway
- *Westfield-Ripley Lakefront Opportunity Plan (2008)*

[15] Of the 151 total BMPs in the assessment, only 116 are applicable to Westfield.

A meeting was held with the following Town of Westfield staff:

Martha Bills – Town Supervisor
Joel Seachrist – Town Attorney
David Babcock – Highway Superintendent
Bonnie Rae Strickland – Assessor, Building Inspector, and Code Enforcement

New & Existing Development

Westfield has prepared itself to handle residential, manufacturing, or light industrial developments that may occur in the future, by including general development standards in their code. They have addressed potential issues such as the proliferation of solar power and residential development through ordinances and encouraging cluster development. Although the town does not yet have manufacturing uses, Westfield has preemptively designated zones for manufacturing, with best management practices built in to development and site expectations. Additionally the Town Code explicitly allows for self-imposed restrictions in §151-13(B)(7) and provides training for contractors when the code is substantially updated.

However, while the town's code establishes general standards for some types of developments, the code does not address any expectations from commercial developments, whether large (such as superstores) or small (such as gas stations and fast food establishments).

The Town of Westfield actively protects trees and natural features. Some examples include the explicit expectation that proposed lots will be redrawn to retain significant features such as outcroppings, and establishing a maintenance easement for streams in addition to NYSDEC buffer regulations.

Agriculture & Forestry

Activities such as agriculture and forestry do take place within the town of Westfield on privately owned land; however, the town does not regulate these activities. The Village of Westfield owns the forested area that surrounds the water reservoir within the town limits, but the town does not have any jurisdiction over the land-management. Agricultural Environmental Management Plans are suggested, but cannot be required.

Silviculture practices by private land-owners are, inasmuch as the town is aware of, advanced and meant for long-term resource management.

Waterways & Wetlands

The town has taken measures in two waterways in order to protect surrounding areas from high speed, flash floods. In addition, Unites States Army Corps of Engineers has built a fish ladder to protect and restore fish habitat on Chautauqua Creek. Westfield has also taken measures to purchase waterfront property for conservation, protection, and public access. Overall, the town is taking active measures to provide active and passive recreational activities, while providing a limited role for natural preservation.

Marinas

The marina in the Town of Westfield is privately owned, but Barcelona Harbor & Pier is owned by the town. Westfield has improved the beach and pier by implementing maintenance and waste control measures. In addition, the town seeks to educate locals and visitors by offering educational materials on the pier. Improvements in the area include the implementation of pervious paver parking surfaces.

Roads & Bridges

The Town of Westfield seeks to maintain existing infrastructure in accordance with the NYSDOT design and guideline standards. During the repaving, resurfacing, or regular maintenance process, it is the town's practice to re-use existing materials, retain trees, and reduce sedimentation and runoff. In addition the practice of the town is to stabilize soils as soon as possible after they are disturbed. Stormwater conveyances in Westfield are through stormwater ditches, and are regularly maintained through annual mowing and re-seeding. High risk areas have been identified in the Pre-Hazard Mitigation Plan, and are being addressed by the town. The Town is proactive in requiring larger culverts when drainage calculations indicate they are necessary.

Onsite Wastewater Systems

There is a small community within the Town of Westfield that has an operating sewer system. The majority of the town operates on septic systems. Town code requires regular maintenance. In addition, Chautauqua County regulates property transfer inspections which include a review of the septic system by the Health Department.

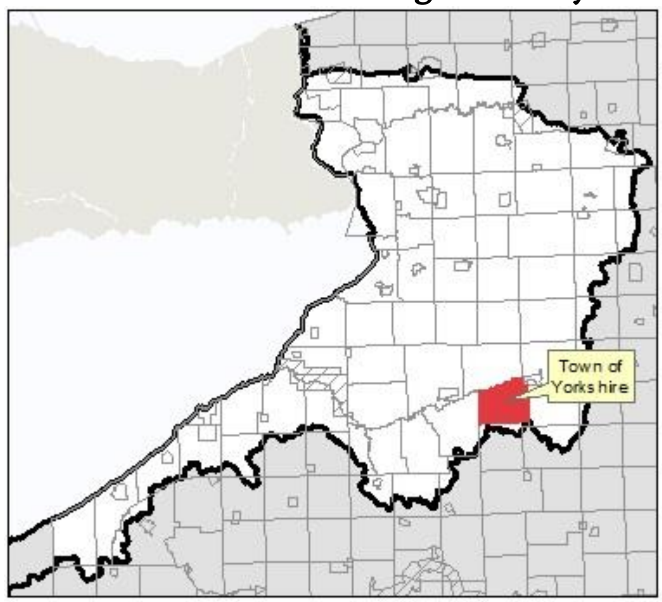
Recommended Future Actions for the Town of Westfield

- Additional measures must be taken for owners to realize the impacts of letting pet (such as dogs) and other animal (such as cow and horse) wastes enter water bodies or drinking water sources. Signage along waterways and educational materials to homeowners with wells may go a long way, since few will read the town code. Signage discouraging the feeding of wild animals may also be useful in parks.

- The Town of Westfield may want to update their code to explicitly indicate that an entire property be included in stormwater analysis/calculation for non-residential development on a lot of less than 1 acre, which is not covered by State regulations.
- Westfield may want to incorporate the same language regarding retaining trees, erosion control, and other best management practices found in the streets construction standards and sewer pipe installation standards throughout the code.
- Additionally, the town may want to incorporate language addressing soil types and topography when addressing erosion control (not just preserve interesting rock outcroppings).
- The code does not indicate the expectation that runoff rates should remain similar to pre-construction levels. Additionally, the collective/compounding effects of individual developments are not considered.
- While the town includes such expectations on their permits, it may be beneficial to include language regarding the use of temporary vegetation and mulching to protect exposed and critical areas from erosion during development as part of the construction standards listed in the Code. Restoration of surfaces within six months listed in §151-13B(5)(f) could also be applied throughout similar circumstances within the code.
- While the Town Code requires developers to survey any trees above 8” in diameter, the town should also ask for a cutting plan, wherein a developer would indicate which trees they intend to eliminate.
- Town would benefit in the long term by requiring certain BMPs regarding forestry. At this time, the Code does not indicate a requirement for permits if a significantly forested lot were to be clear cut. Towns must anticipate potential concerns, such as development pressures form large-scale development, whether manufacturing, commercial, or residential.
- Add a maximum lot coverage regulation in zoning code and/or require a percentage of lot remain as a permeable surface.
- The town may want to consider encouraging native plants in landscaping plans to improve water quality and reduce runoff.
- Setbacks should be added to compost piles or bins to protect surface water and drinking water sources from contaminants or other materials.
- Include language that requires vegetated buffer zones to control stormwater, nutrients, and sediment runoff from entering the waterways.
- In addition to updating the Commercial Zone regulations to include development and/or design standards, the town may want to designate a maximum parking limit (instead of a minimum) to reduce impervious surface area.
- Consider treating the stormwater from the non-permeable parking areas and roads before releasing it into Lake Erie.

- Prohibit fish parts or remains at Barcelona Harbor from going into the lake by providing a fish cleaning station with educational materials and possibly fish composting onsite.
- Post signage at Barcelona Harbor indicating allowed activities, to inform users and prevent non-allowed activities such as boat repair and maintenance.
- Design a spill contingency plan for Barcelona Harbor. While liquids are not stored in the harbor, all motorized vehicles present a spill risk.

Town of Yorkshire, NY (Phase 2) Cattaraugus County



Yorkshire, New York is a small rural town located in the northeastern section of Cattaraugus County along Cattaraugus Creek. The Village of Delevan sits in the eastern section of the Town of Yorkshire. According to the 2010 U.S. Census report, the Town of Yorkshire had a population of 1,259 residents within its 35.2 square mile area.

Yorkshire has successfully maintained its small town rural character since the founding of the town, deriving from the Holland Land Company. The town's economy relies on agricultural, dairy, and milling uses while focusing a small commercial business district at the intersection of two state routes (NY 39 & NY 16).

Yorkshire recently updated the town website, which includes scanned files of the town's local laws. As has been noted with other municipalities, they have not looked to be proactive in their regulations for future potential land-use. However, in their efforts to protect the natural and rural character of the town for future generations, Yorkshire has included cluster development initiatives into their local laws.

The desktop assessment conducted for Yorkshire found the town applies a few of the Best Management Practices (BMPs). Of the 101 BMPs used in the assessment, Yorkshire employs 12 through local practices (12% met in total)[16]. The Assessment of Yorkshire yielded a score of 20 out of 202 possible points. It is likely that the town practices many more of the BMPs, but they are not set forth in writing.

[16] Of the 151 total BMPs in the assessment, only 101 are applicable to Yorkshire.

The following town documents were reviewed for the assessment:

- *Town of Yorkshire Local Law No. 1*
    - *Town of Yorkshire Dog Control Program (2010)*
    - *Town of Yorkshire Administration & Enforcement of NYS Uniform Fire Prevention And Building Code (2006)*
    - *Town of Yorkshire Flood Damage Prevention*
    - *Town of Yorkshire Land Division Regulations (1993)*
- *Town of Yorkshire Local Law No. 2*
    - *Town of Yorkshire Snow and Ice Conditions of Highways (1979)*
    - *Town of Yorkshire Disposal of Hazardous Waste (1983)*
    - *Town of Yorkshire Solid Waste Disposal Law (1991)*
    - *Town of Yorkshire Cross Connection Control for Town Water System (1992)*
    - *Town of Yorkshire Public Improvements Permit (1993)*
    - *Town of Yorkshire Zoning Law (2001)*
    - *Town of Yorkshire Zoning Law Amendment (2015)*
    - *Town of Yorkshire Hydrofracking (2013)*
- *Town of Yorkshire Local Law No. 3*
- *The Yorkshire Vision Comprehensive Plan (1995)*
- *Town of Yorkshire & Village of Delevan Website (http://yorkshireny.org/)*
- *Town of Yorkshire Water Quality Report*
    - *District 1 2013*
    - *District 2 2013*
    - *District 1 2014*
    - *District 2 2014*
- *Town of Yorkshire Zoning Map*
- *Village of Delevan Water Quality Report 2014*

New & Existing Development

The Town of Yorkshire actively protects trees and natural features, an example of which is the standards for Master Planned Development zones including utilizing topography and site features to best advantage. Additionally, the Town of Yorkshire explicitly requires, through its Zoning Law, that designs shall assure the runoff after development does not exceed that existing at the time of plan submission.

Agriculture & Forestry

Materials reviewed did not address forestry. Agricultural uses are exempt from the Town's Stormwater Management & Erosion Control and Site Plan Review regulations.

Waterways & Wetlands

The Town of Yorkshire waterways include Cattaraugus Creek, Stony Creek, Elton Creek, McKinstry Creek, Elton Creek, Gooseneck Creek, and the Lime Lake Outlet; most of which are considered Class C (best usage is fishing). The Town also has numerous wetlands along its southern and eastern areas.

The Town includes maintenance of altered watercourses to assure that flood-carrying capacity is not diminished, but does not provide the same regulation for all other watercourses. Large-scale in-stream sedimentation areas and debris should be cleared from natural watercourses that pose a threat to flooding, while still maintaining natural aquatic habitat areas.

Marinas

Not applicable, Yorkshire does not have any current nor planned marinas.

Roads & Bridges

As of the Yorkshire 1995 Comprehensive Plan, there are approximately 43 miles of Town roads. While the Town code requires the layout to be conducive to connectivity, there is no mention of construction or maintenance expectations.

Onsite Wastewater Systems

Yorkshire relies on septic systems for sewage disposal. The town's code defers to the Cattaraugus County Health Department and New York States Department of Environmental Conservation standards on septic systems.

Recommended Future Actions for the Town of Yorkshire

- Additional measures should be taken for owners to realize the impacts of letting pet (such as dogs) and other animal (such as cow and horse) wastes enter water bodies or drinking water sources.
- Setbacks should be added to protect surface water and drinking water sources from compost piles or bins.
- Add a maximum lot coverage regulation in zoning code and/or require a percentage of lot remain as a permeable surface.
- Require entire property (existing as well as proposed) to be included in stormwater analysis/calculation.
- The town may want to consider encouraging native plants in landscaping plans.

- Include language that requires vegetated buffer zones to control stormwater, nutrients, wastes, and sediment runoff from entering the waterways.
- Conduct permitting, licensing, certification, and nonregulatory non-point source pollution activities in a manner that protects wetland functions.
- Require best management practices during construction and significant reconstruction of roadways within the town.
- Institute setbacks from waterways for septic systems
- Include a regular maintenance requirement for onsite wastewater treatment systems.
- The Town of Yorkshire would benefit in the long term by formally adopting BMPs such as those included in the Practices and Ordinances Assessment Form. Towns must anticipate potential future concerns, such as resource protection, development pressures (whether manufacturing, commercial, or residential), and improving technologies (renewable energy, broadband utility, etc.).

Model Regulations & Resources

Listed below are model ordinances and zoning regulations from various localities within New York State that strengthen local protections on water resources from the impacts of development. The models were either drafted by or recognized as effective legislation through County Planning Departments, other New York State watershed management organizations, or the *Protecting Water Resources through Local Controls and Practices* guide. All of the models ordinances are provided in the Appendix.

Site Plan Review Process **Appendix F**

Town of Ithaca, Site Plan Review and Approval Procedures
Model Site Plan Review Local Law for Cattaraugus County, New York

Subdivision **Appendix G**

Town of Middlesex Subdivision Regulations
Model Subdivision Regulations, Dutchess County Planning Department, New York
City of Saratoga Springs Conservation Subdivision Regulations

Open Space/Conservation **Appendix H**

Town of Ithaca, Conservation Zones (includes provisions for steep slopes, cluster subdivision, vegetative riparian buffers, sensitive habitats, wildlife corridors, timber harvesting, and scenic views).
Town of Livonia, Land Conservation Regulations

Onsite Wastewater Ordinance **Appendix I**

Ontario County Planning Department Onsite Wastewater System Model Law
Chautauqua County Department of Health Mandatory Inspection Program for Onsite Wastewater Treatment Systems in Lakeshore Areas Model Law

Flood Regulations **Appendix J**

FEMA model floodplain regulation

Wetlands **Appendix K**

Village of Trumansburg Wetland Conservation Overlay District
Town of Pawling Freshwater Wetlands and Watercourse Protection

Riparian Buffer/Shoreline **Appendix L**

Tompkins County Model Stream Buffer Ordinance, Riparian Protection Agreement & Riparian Buffer Easement.
Town of Ithaca, Stream Setback Ordinance
Town of Geneseo, Erosion & Sediment Control with Riparian Protections (Non-MS4 Community).
Village of Trumansburg Stream Buffer Conservation Overlay District (simplified version of Tompkins County Model Stream Buffer Ordinance)

Stormwater Management and Sediment and Erosion Control **Appendix M**

Sample Local Law for Stormwater Management and Erosion & Sediment Control, NYSDEC
Town of Geneseo, Erosion & Sediment Control with Riparian Protections (Non-MS4 Community).

Steep Slopes	**Appendix N**
Town of Livonia Land Conservation Regulations	
Town of Cortlandt Steep Slopes Ordinance	

Junk Yard Ordinance	**Appendix O**
Model Junkyard Ordinance, James Coon Local Government Technical Series	
Town of Groveland Junk Storage Model Law	

Logging/Silviculture Practices	**Appendix P**
Canandaigua Watershed Council Timber Harvesting Law	

Marinas/Boat Launches/Docks	**Appendix Q**
Lake George Park Commission, Docks, Wharfs, Moorings and Marinas Regulations	
Town of Ulysses, Lakeshore District Regulations	

Additional Organizations and Agencies involved in Watershed Planning & Protection

As a final element of the Assessment of Laws and Practices, an inventory was conducted of all the additional organizations involved in water resources management beyond the municipal level. The following is a summary of the local, state, federal, and international agencies, whose staff, programs, activities, and regulatory authority influence watershed health directly[17]. Non-profit organizations with an environmental focus central to the intent of this plan are also outlined, as their initiatives often fill the gaps of governmental programs and policies, as well as provide “boots-on-the-ground” to implement many local initiatives.

Local Organizations & Agencies

County Water Quality Coordinating Committees (WQCC)

Water quality committees were formed to develop and implement county non-point source water quality strategies. Committee members generally represent municipalities; local, state and federal agencies; and outdoor recreation and environmental organizations. The Committees identify water quality problems, prioritize needed actions, seek funding for projects, coordinate programming and

[17]Organizations and Agencies were partially researched through the Genesee/Finger Lakes Regional Planning Council guide: *Protecting Water Resources through Local Controls and Practices: An Assessment Manual for New York Municipalities.*

recommend policy to protect and improve water resources in their respective county and its watersheds.

- Allegany County Water Quality Coordinating Committee
- Cattaraugus County Water Quality Council
- Chautauqua County Water Quality Task Force
- Erie County Water Quality Committee
- Genesee County Water Quality Coordinating Committee
- Niagara County Water Quality Coordinating Committee
- Wyoming County Water Resources Coordinating Committee
- Orleans County Water Quality Coordinating Committee

NYS Soil and Water Conservation Districts (SWCD)

New York State created the Soil and Water Conservation Committee in 1940 along with its subsequent districts as part of the NYS Soil and Water Conservation Law. There are eight districts in the watershed based on county boundaries, Allegany County SWCD, Cattaraugus County SWCD, Chautauqua County SWCD, Erie County SWCD, Genesee County SWCD, Niagara County SWCD, Orleans County SWCD, and Wyoming County SWCD. Soil and Water districts play an important role in the monitoring and assessment of public and private water and soil quality, and in the design and implementation of conservation plans and practices. They also are involved in watershed, recreation and natural resource planning; management, stewardship, public education and outreach activities. Some key program areas include:

- NYS Ag Non-Point Source Abatement and Control Program
- Agricultural Environmental Management (AEM) Program, Coordination & Outreach
- Comprehensive Nutrient Management Planning (CNMP)
- Mining & Mined Lands Reclamation Planning
- Stream bank Stabilization & Streamside Conservation
- Watershed Planning, Education & Water Quality Monitoring
- Conservation Technical Assistance for Municipalities
- Agricultural Conservation Reserve Enhancement Program (CREP)
- Native Tree & Shrub Seedling Program & Hydro Seeding
- Fish Stocking & Pond Design Assistance

County Health Departments

County Health Departments manage and enforce the New York State Sanitary Code regulations including the construction, repair, expansion, and replacement of onsite sewage disposal systems, and both public and private drinking water supplies. The departments also ensure compliance for existing systems through property transfer certifications, and periodic water quality monitoring of public/private drinking water systems. Drinking water systems found in violation with EPA's Safe Drinking Water Act are required to address the contaminant and conduct on-going monitoring till the system is no longer in violation. Erie, Niagara, and Genesee County Health Departments also regularly monitor public beaches during the summer season to determine if the water quality poses a health risk.

County Planning Boards & Departments

County planning boards review local land development projects and certain land use actions that may have county-wide or intermunicipal impacts. These municipal referrals are required by Article 12B, Section 239 of NYS General Municipal Law. County planning departments generally serve as staff to their county planning boards, or in the absence of a planning board serve similar functions, perform other county planning functions, and often provide technical assistance to local municipalities on a wide variety of planning initiatives. They may also assist with economic and community development activities. Presently the County Planning Departments are involved in the following watershed and water quality committees and projects, not necessarily within the Niagara River/Lake Erie Watershed:

<u>Allegany County Department of Planning</u>

- Allegany County Hazard Mitigation Plan
- Genesee River Wilds
- Soil & Water Conservation District Board
- Agriculture & Farmland Protection Board Participation

<u>Cattaraugus County Economic Development, Planning, and Tourism</u>

- Cattaraugus County Soil and Water Conservation District Participation
- Cattaraugus County Water Quality Council
- Cattaraugus County Agriculture & Farmland Protection Board Participation
- Southern Tier West Watershed Coalition

<u>Chautauqua County Planning and Economic Development</u>

- Northern Chautauqua County Intermunicipal Local Waterfront Revitalization Program (LWRP)
- Lake Erie Management Commission
- Agriculture & Farmland Protection Board
- Environmental Management Council
- Chautauqua County Soil and Water Conservation District
- Chautauqua Watershed Conservancy
- Chautauqua County Water Quality Task Force
- Chautauqua County Sports Fishery Advisory Board

- Lake Erie Watershed Protection Alliance
- Bear Lake Association and Watershed Management Plan
- Cassadaga Lakes Association and Watershed Management Plan
- Findley Lake Association and Watershed Management Plan
- Chautauqua Lake Association and Local Waterfront Revitalization Plan
- Chautauqua Lake Watershed Management Plan
- Macrophyte Management Strategy for Chautauqua Lake
- Chautauqua Lake and Watershed Management Alliance
- Conewango Watershed Commission
- Conewango Creek Watershed Association
- Roger Tory Peterson Institute
- Jamestown Audubon Center

Erie County Department of Environment & Planning

- Erie County Water Quality Committee Management
- WNY Stormwater Coalition Joint-Management
- Lake Erie Watershed Protection Alliance (LEWPA) Participation
- Tonawanda Creek Watershed Committee Participation
- Municipal Separate Storm Sewer Mapping Project
- Initiatives for a Smart Economy – Habitat Restoration & Water Infrastructure Investment
- Rush Creek Interceptor Project
- Lackawanna Wastewater Treatment Plant Elimination Project
- Brownfields Remediation (INS Junkyard)
- Environmental Management Council
- Agriculture & Farmland Protection Board Participation

Genesee County Planning

- Water System Hookup Administrative Review Committee Participation
- Soil & Water Conservation District Water Quality Coordinating Committee Participation
- Tonawanda Creek Watershed Committee Participation
- Black Creek Watershed Coalition Watershed Management Planning Assistance
- Oatka Creek Watershed Committee Watershed Management Planning Assistance
- Genesee County Water Resources Agency Assistance
- Smart Growth Planning
- Agriculture & Farmland Protection Board Participation
- Genesee/Finger Lakes Regional Planning Council (G/FLRPC)

Niagara County Economic Development

- Niagara County Soil and Water Conservation District Participation

- One Region Forward Project Participation
- Brownfield Remediation
- WNY Stormwater Coalition Joint-Management by Public Works Department
- Agriculture & Farmland Protection Board Participation

Orleans County Planning & Development

- Joint Local Waterfront Revitalization Program (LWRP)
- Agriculture & Farmland Protection Board Participation

Wyoming County Planning and Development

- Tonawanda Creek Watershed Committee Participation
- Buffalo Creek Watershed Planning
- Black Creek Watershed Coalition Watershed Management Planning Assistance
- Oatka Creek Watershed Committee Watershed Management Planning Assistance
- Water Resources Committee
- Wyoming County Water Resource Agency
- Wyoming County Soil & Water Conservation District
- Agriculture & Farmland Protection Board Participation
- National Resources Conservation Service Assistance
- Erie-Wyoming County Joint Board of Conservation Districts

County Environmental Management Councils (EMC)

Erie, Niagara and Chautauqua Counties have EMC's that advise county government on local environmental concerns and act as a liaison between communities and county government. EMC projects often take the form of studies that provide recommended courses of action for decision makers. Councils are established as part of Article 47 of New York State's Environmental Conservation Law and membership includes representatives from cities, towns and villages within each county, as well as regional environmental organizations.

Local & County Utilities, Authorities & Districts

There are a number of municipal and county authorities, districts and departments that supply drinking water and/or provide sewage collection and treatment to their customers.

- Buffalo Sewer Authority: Serves all or parts of the City of Buffalo and the Towns of Alden, Cheektowaga, Elma, Lancaster, Orchard Park, Tonawanda, West Seneca, and the Villages of Depew, Lancaster, and Sloan.
- Erie County Sewer Districts (1-6, 8): Serves the City of Lackawanna, Towns of Alden, Amherst, Aurora, Brant, Boston, Clarence, Cheektowaga, Collins, Eden, Evans, Hamburg, Holland, Lancaster, Orchard Park, West Seneca, and Villages of Angola, Blasdell, Farnham, Hamburg, Depew, East Aurora, Lancaster, North Collins, and Orchard Park.

- Niagara County Sewer Districts: Serves all or parts of the Towns of Wheatfield, Pendleton, Cambria, Lewiston, Lockport, and Niagara.
- Erie County Water Authority: Serves all or parts of the City of Tonawanda, Towns of Alden, Amherst, Aurora, Boston, Brant, Cheektowaga, Clarence, Colden, Eden, Elma, Evans, Hamburg, Lackawanna, Lancaster, Marilla, Newstead, Orchard Park, West Seneca, the Villages of Angola, Blasdell, Depew, East Aurora, Farnham, Hamburg, Lancaster, Orchard Park, Sloan, and Williamsville in Erie County. The ECWA also provides service to the Cattaraugus Indian Reservation, with some services to portions of Hanover in Chautauqua County and Perrysburg in Cattaraugus County.
- Niagara County Water District: Serves the Towns of Cambria, Hartland, Lewiston, Lockport, Niagara, Newfane, Pendleton, Porter, Royalton, Somerset, Wheatfield, Wilson, and the Villages of Barker, Lewiston, Middleport, Wilson, and Youngstown.
- Niagara Falls Water Board: Serves the City of Niagara Falls and some outlying areas.
- Municipal Water Authorities, Districts, & Departments: Cities of Batavia, Buffalo, Dunkirk, Lockport, Niagara Falls, North Tonawanda, and the Towns of Alabama, Ashford, Batavia, Brant, Chautauqua, Colden, Concord, Dunkirk, Ellicottville, Grand Island, Hanover, Holland, Java, Machias, Otto, Perrysburg, Pomfret, Portland, Ripley, Rushford, Sardinia, Shelby, Tonawanda, Warsaw, Westfield, and Yorkshire, and Villages of Akron, Alden, Alexander, Arcade, Attica, Brocton, Cattaraugus, Delevan, Fredonia, Kenmore, North Collins, Silver Creek, Springville, and Westfield.
- Genesee County Water Resources Agency (GCWRA): Serves as a supporting agency for planning, design, and decision making purposes for county water systems.
- Wyoming Water Agency: Newly formed agency supports municipal public water works by consolidating purchasing and testing needs, and cross-training plant operators to address staffing issues.

Seneca, Tuscarora, and Tonawanda Indian Nations

The Tuscarora Indian Nation and Reservation of about 5,700 acres is located in the Lewiston, Niagara County area. The Nation's governing body, the Council of Chiefs, has a government-to-government relationship with the United States government. The Tonawanda Indian Nation and Reservation of 7,549 acres is located in Erie, Niagara and Genesee Counties, within the townships of Newstead Royalton, and Alabama. The Seneca Nation of Indians Cattaraugus Reservation (also known as the Cattaraugus Indian Territories) of 21,618 acres is located in Erie, Chautauqua, and Cattaraugus counties, bestriding Cattaraugus Creek.

The Nations are members of the Haudenosaunee Environmental Task Force (HETF) whose mission is to help Haudenosaunee Nations in their efforts to conserve, preserve, protect, and restore their environmental, natural, and cultural resources; to promote the health and survival of the sacred web of life for future generations; and to fulfill their responsibilities to the natural world as their Creator instructed without jeopardizing peace, sovereignty, or treaty obligations. The HETF is administering a grant from the USEPA to assist the Cayuga, Tuscarora and Tonawanda Seneca Nations as they develop environmental programs.

WNY Stormwater Coalition

Forty municipalities in Erie and Niagara Counties have joined together for the purpose of developing a stormwater management program to protect community waterways. These MS4 communities share resources and work in partnership to comply with EPA Phase II storm water requirements. Operators of small municipal separate storm water systems (MS4) are required to implement six minimum control measures and integrate review of required stormwater plans into land use regulation. The goal of the Coalition is to facilitate regional collaboration that identifies water resources and develops programs to reduce the negative impacts of storm water pollution.

Niagara River Greenway Commission

The Commission was established out of legislation adopted in 2004 as part of the New York Power Authority (NYPA) relicensing agreement for its Niagara River Hydro facilities and included a funding resource to support the Commission's efforts. Since the relicensing, the Commission has developed and adopted the Niagara River Greenway Plan to guides the creation of a Niagara River Greenway Trail, along with other improvements to waterfront public space, habitat, and cultural assets. Regional projects seeking Greenway funding are reviewed by the Commission for consistency with the Plan's vision and priorities. Standing Committees then determine if funding requests are approved. To date, the Standing Committees ha funded approximately 94 projects with over $46 Million in Greenway money.

Tonawanda Creek Watershed Committee

This committee is a multi-county alliance of local, county, tribal, and regional officials as well as interested landowners and other stakeholders located within Wyoming, Genesee, Erie, and Niagara Counties. Their mission is to protect, conserve, and restore the quality of Tonawanda Creek and its watershed by planning and managing its ecosystem resources for a sustainable future that enhances the vitality of watershed communities. Current efforts include distributing the Map Guide to the Tonawanda Creek, marking storm drains, stream cleanups, and expanding committee participation.

Genesee/Finger Lakes Regional Planning Council (G/FLRPC)

Genesee and Wyoming Counties are members of the G/FLRPC which is a public organization that fosters coordination among neighboring counties and provides a regional approach to shared issues. The participating county governments have joined together voluntarily to address common economic and social concerns through regional programs and activities. Primary G/FLRPC functions include regional and water resources planning; regional economic development; strategic planning; program and grant development; a regional data, technology, and resource center; and technical assistance to member counties and their municipalities.

Lake Erie Management Commission (LEMC)

The LEMC was created by the Chautauqua County Legislature to be a unified voice for the concerns of the communities in the Lake Erie watershed of the County. The mission is to seek funding for projects that will promote the quality and sustainability of the Chautauqua County Lake Erie watershed and waterways, as well as the quality of life for residents and visitors. Issues addressed include education and outreach, harbor dredging, infrastructure maintenance, and pollution prevention.

Lake Erie Watershed Protection Alliance (LEWPA)

LEWPA is an intermunicipal watershed organization, whose mission is to foster collaboration and partnerships to address regional water quality and quantity concerns within the Lake Erie Watershed, specifically the counties of Erie, Cattaraugus, and Chautauqua in New York State. LEWPA aims to conduct watershed management planning, flood resiliency planning, reduce non-point source pollution, enhance water related recreation activities, natural habitat planning, and educational activities to foster community stewardship.

WNY Crop Management Association

The Western New York Crop Management Association works with farmers across the region to increase their efficiency of crop input management and to bolster their environmental responsibility. Membership in the association has grown to include over 400 farms, comprising over 250,000 acres of consulted crop land across Allegany, Erie, Chautauqua, Cattaraugus, Genesee, Livingston, Monroe, Niagara, Ontario, Orleans, Steuben, Wayne, Wyoming, and Yates Counties.

State Organizations & Agencies

NYS Department of State (NYSDOS), Office of Planning and Development

This Office is involved in a wide variety of programs and initiatives that help revitalize, promote and protect communities and waterfronts. Over the past twenty years, the Office has worked with hundreds of local governments and communities to prepare Local Waterfront Revitalization

Programs (LWRPs) and Harbor Management Plans (HMPs). The Office also provides technical and financial assistance for plans and projects that have expanded public access, revitalized urban waterfronts, restored habitat, improved water quality, and strengthened local economies.

Among other activities the Office implements the Federal Coastal Zone Management Act and the State's Waterfront Revitalization of Coastal Areas and Inland Waterways Act; implements and administers the NYS Coastal Nonpoint Pollution Control Program; provides planning and technical assistance for redevelopment of brownfields, abandoned buildings and deteriorated urban waterfronts; and protects water quality through inter-municipal watershed planning.

NYS Department of Environmental Conservation (NYSDEC)

The NYS Department of Environmental Conservation exists to, "conserve, improve, and protect New York State's natural resources and environment, and control water, land and air pollution, in order to enhance the health, safety and welfare of the people of the state and their overall economic and social well-being." The NYSDEC has numerous departments and divisions, some of which are described below.

<u>NYSDEC Division of Environmental Permits</u>

This NYSDEC Division reviews projects that require NYSDEC permits, conducts environmental assessments under the State Environmental Quality Review Act (SEQRA), and reviews energy projects. SEQRA requires all state and local governments and agencies to assess the environmental impacts and significance of all discretionary actions they undertake. These agencies must assess the environmental significance of all such actions that they may approve, fund or directly undertake. They also work with business/industry to reduce waste generation.

<u>NYSDEC Division of Water</u>

This NYSDEC Division protects and conserves the water resources of New York State through a wide range of programs and activities. Water quality standards contain the classification system for New York State surface and ground waters. The standards and guidance values for surface water and groundwater quality and groundwater effluent limitations are included in these regulations, including the State Pollution Discharge Elimination System (SPDES).

The New York State Protection of Waters Regulatory Program is the implementing structure behind Article 15 of the NYS Environmental Conservation Law. All waters of the state are provided a class and standard designation based on existing or expected best usage of each waterway or segment.

The Protection of Waters Regulatory Program regulates five different categories of activities:

- Disturbance of bed or banks of a protected stream or other watercourse.
- Construction, reconstruction or repair of dams and other impoundment structures.
- Construction, reconstruction or expansion of docking and mooring facilities.
- Excavation or placement of fill in navigable waters and their adjacent and contiguous wetlands.
- Water quality certification for placing fill or undertaking activities resulting in a discharge of waters of the United States.

The NYSDEC has classified regulated freshwater wetlands according to their respective function, values and benefits. Wetlands may be Class I, II, III or IV. Class I wetlands are the most valuable and are subject to the most stringent standards. A wetland must be 12.4 acres or larger for protection under the Freshwater Wetlands Act. Smaller wetlands may be protected when the NYSDEC Commissioner determines they have unusual local importance in providing one or more wetland functions. The wetland buffer zone, an adjacent area that extends 100 feet from the wetland boundary, may also be regulated.

The NYSDEC Priority Waterbodies List (PWL) is required by Section 303(d) of the Clean Water Act and is a section of the 305(b) Water Quality Report made by NYSDEC to the United States Environmental Protection Agency (USEPA). The PWL identifies waters that have one or more uses that are not fully supported or are threatened by conditions or practices that could lead to declining water quality. The PWL is used as a basis for water program management.

The NYSDEC has been delegated by the federal government to carry out U.S. EPA's National Pollution Discharge Elimination System (NPDES) program. The program's goal is to limit pollution of the nation's lakes, streams and rivers by runoff from construction sites and developed areas using a SPDES permit (State Pollutant Discharge Elimination System). New York State has issued two non-industrial Stormwater Management General Permits under SPDES, one for construction site operators and one for regulated localities.

State Pollution Discharge Elimination System (SPDES) permits are also required for Concentrated Animal Feeding Operations (CAFO's). A CAFO is an agricultural operation that confines a large number of livestock in a barn or feed lot for a specific period of time. The CAFO regulations define the animal number thresholds that constitute medium and large scale CAFOs, specific effluent management guidelines for those operations, and record keeping requirements. The Agricultural Environmental Management (AEM) program has been used to help farms comply with CAFO regulations.

NYSDEC Division of Fish, Wildlife and Marine Resources
This NYSDEC Division protects fish, wildlife and habitats; issues licenses and educates anglers, hunters and trappers; and maintains boat launches and fishing access sites.

NYSDEC Division of Lands and Forests
This NYSDEC Division manages more than four million acres of state owned land and conservation easements including the Adirondack and Catskill forest preserves and state forests. The Division also administers the Saratoga Tree Nursery and programs for forest health, urban and community forestry, forest products use, and provides assistance to private forest land owners.

NYS Environmental Facilities Corporation (EFC)

The NYS Environmental Facilities Corporation (EFC) provides funding and technical assistance to municipal and private entities to comply with environmental regulations, and for capital projects that improve environmental protections. Their focus involves projects associated with water and sewer infrastructure, air emissions, energy consumption, and general natural resource management. The EFC oversees a variety of grant and loan programs, including the Clean Water State Revolving Loan Fund (CWSRF), the Green Innovation Grant Program (GIGP), the Drinking Water State Revolving Loan Fund (DWSRF), Clean Vessel Assistance Program, Small Business Environmental Assistance Program, and Industrial Finance Program. The CWSRF and DWSRF provides low-interest rate financing to municipalities to construct improvement projects for sewers, drinking water and wastewater treatment facilities, while the GIGP provides funding for green infrastructure/technologies to improve water quality and stormwater management. The remaining programs offer regulatory compliance assistance for private businesses.

NYS Department of Agriculture and Markets

The Agricultural Environmental Management (AEM) Program helps farmers meet economic challenges and address environmental concerns while complying with regulatory requirements. AEM is a state-wide, voluntary, incentive-based program designed to help farmers better understand how their on-farm activities impact the environment. The program is designed to guide farmers through the regulatory framework, provide funding for on-farm improvements and encourage farmers to adopt methods that can effectively address issues such as non-point source water quality concerns and other agriculture environmental issues. All NYS counties are required to develop a five-year strategic plan to guide AEM activities in priority areas of concern. Plans are required to emphasize the watershed approach to environmental management. The Department of Agriculture and Markets also implements the Agricultural Nonpoint Source Abatement and Control Program, which provides funds for nonpoint source abatement and control projects that plan or implement Agricultural Best Management Practices on New York State farms. These projects will help to reduce, abate, control and prevent nonpoint source pollution originating from agricultural sources.

NYS Canal Corporation

The system of the four historic canals (Erie, Champlain, Oswego, and Cayuga-Seneca) in New York are operated and maintained by the NYS Canal Corporation, a subsidiary of the NYS Thruway Authority. The canal system links the Hudson River with Lake Champlain, Lake Ontario, Cayuga Lake, Seneca Lake, and Lake Erie via the Niagara River. The Regional Niagara River/Lake Erie Watershed Management Plan hosts the Erie and Black Rock Canals. Pursuant to the NYS Law (21 NYCRR Sub-chapter D, Parts 150-156), all activities on the Erie Canal are regulated by the New York State Canal Corporation. Certain Statewide boating regulations are in force along the Erie Canal, including speed limitations, vessel waste treatment and disposal restrictions, and design and construction requirements for residential/non-commercial docks, decks, platforms and boat launches/ramps.

NYS Health Department, Bureau of Water Supply Protection

The Department's Drinking Water Program, in cooperation with county health departments, regulates the operation, design, and quality of public water supplies and commercial bottled water suppliers; assures water sources are adequately protected; provides financial assistance to public water suppliers; reviews and approves plans for proposed realty subdivisions; and sets standards for individual water supplies and individual wastewater systems.

Federal Organizations & Agencies

Army Corps of Engineers (ACE), U.S. Department of Defense

The US Army Corps of Engineers (USACE) undertakes civil works projects, and is involved with water resource management activities such as: coastal and flood protection, disaster preparedness and response, environmental protection and restoration, providing community water supplies, managing outdoor recreation areas, regulatory oversight of navigable waters and wetlands, navigational dredging, and generating hydropower. As mentioned below, they are also responsible for permitting fill activities under Section 404 of the Clean Water Act.

US Environmental Protection Agency (EPA)

The mission of the EPA is to protect human health and the environment. Developing and enforcing environmental regulations, providing financial assistance, performing environmental research, sponsoring and promoting partnerships and programs, monitoring hazardous materials, and reporting related information to the public are several of the EPA's many duties.

While the EPA is the primary federal body enforcing regulations such as the Endangered Species Act, the Clean Air Act, and the Clean Water Act, enforcement of most of these regulations is generally delegated to the New York State Department of Environmental Conservation (NYSDEC). The EPA provides significant sources of funding to be used by the responsible state agencies for enforcement and implementation of federal laws and regulations.

The Clean Water Act requires states to classify waters according to their best uses and to adopt water quality standards that support those uses. Section 404 of the Clean Water Act requires that anyone interested in depositing dredged or fill material into waters of the United States, including wetlands, must receive authorization for such activities. The U.S. Army Corps of Engineers (USACE) has been assigned responsibility for administering the Section 404 permitting process.

As authorized by the Clean Water Act, the National Pollutant Discharge Elimination System (NPDES) permit program controls water pollution by regulating point sources such as pipes or ditches that discharge pollutants into waters of the United States. Individual homes that are connected to a municipal system, use a septic system, or do not have a surface discharge do not need a NPDES permit. However, industrial, municipal, and other facilities must obtain permits if their discharges go directly to surface waters. In most states, including New York, the NPDES permit program is administered by the state environmental agency. Thus, the NYS Department of Environmental Conservation administers the State Pollutant Discharge Elimination System (SPDES).

The Safe Drinking Water Act protects public health by regulating the nation's public drinking water supply. The law requires many actions that help protect public health and drinking water, including rivers, lakes, reservoirs, springs, ground water wells, and other sources.

In conjunction with other international and state agencies, the EPA has developed the Lakewide Action and Management Plan (LAMP) as a framework for integrating the restoration and monitoring practices that have been taking place throughout the Great Lakes for decades. Each of the five Great Lakes has its own LAMP. Agencies in charge of developing and implementing LAMP strategies include the United States Environmental Protection Agency (Region II), Environment Canada, the

New York State Department of Environmental Conservation, and the Ontario Ministry of the Environment (collectively referred to as "the Four Parties").

U.S. Department of Agriculture, Natural Resource Conservation Service (NRCS)

The Natural Resource Conservation Service (NRCS) is a U.S. Department of Agriculture (USDA) agency that assists land owners with conserving soil, water and other natural resources. Services include Agricultural Conservation Plans, the Conservation Reserve Program, the Wetlands Reserve Program, preparation of Comprehensive Nutrient Management Plans, and technical assistance to farmers on water quality and erosion control issues.

The Resource Conservation and Development (RC&D) program is one that helps communities improve their economies through the wise use of natural resources. The purpose of the RC&D program is to improve the capability of state, tribal and local units of government and local nonprofit organizations in rural areas to plan, develop and carry out programs for resource conservation and development. The NRCS provides administrative support for the RC&D program including office space and staff.

Fish and Wildlife Service (FWS), U.S. Department of the Interior

The U.S. Fish and Wildlife Service (USFWS) mission is to conserve, protect and enhance fish, wildlife and plants, and their habitats. The USFWS helps protect a healthy environment for people, fish and wildlife; and helps Americans conserve and enjoy outdoor resources. Major responsibilities address migratory birds, endangered species, certain marine mammals, and freshwater and anadromous fish. The USFWS has jurisdiction over listings for terrestrial and native freshwater species. Under the Endangered Species Act the USFWS determines critical habitat for the maintenance and recovery of endangered species and requires that the impacts of human activities on species and habitat be assessed. USFWS also conducts the National Wetlands Inventory (NWI) used to provide biologists and others with information on the distribution and type of U.S. wetlands to aid in conservation efforts.

National Parks Service (NPS), U.S. Department of the Interior

The NPS preserves the natural and cultural resources and values of the national park system. NPS cooperates with partners to extend the benefits of natural and cultural resource conservation, and outdoor recreation. Sites administered by the National Park Service in the Regional Niagara River/Lake Erie Watershed Management Plan include the Niagara Falls National Heritage Area, Theodore Roosevelt Inaugural National Historic Site (in Buffalo), and the Erie Canal Heritage Corridor. The Niagara Falls National Heritage Area is a 13-mile-long corridor along the Niagara River from the City of Niagara Falls to Lake Ontario in the Town of Porter. The Erie Canalway National

Heritage Corridor covers 524 miles in Upstate New York and includes four navigable waterways: the Erie, Champlain, Oswego and Cayuga-Seneca Canals.

United States Geologic Survey (USGS)

The USGS offers an extensive array of services and data related to hydrologic research and development, wildlife and fisheries management, invasive species, geographic information systems, mapping, coastal management and watershed planning. Services include stream flow, flood and high flow, drought, groundwater, earthquake, mineral, and water resources information.

United States Coast Guard, Buffalo

The Coast Guard's Buffalo Station includes departments for Prevention, Logistics and Response. Departmental responsibilities include search and rescue, homeland security, waterways management, and navigational aids, law enforcement, facility and vessel inspections, marine casualty investigations, engineering (naval and facilities), finance/supply, and logistical support/mutual aid for Coast Guard Stations from Buffalo to Massena, NY and Lorain, OH.

International Organizations & Agencies

International Joint Commission (IJC)

The IJC is an independent, bi-national organization established by the Boundary Waters Treaty of 1909. Its purpose is to help prevent and resolve disputes relating to the use and quality of boundary waters and to advise Canada and the United States on related issues. IJC specific duties involve:

- Reviewing the operation and effectiveness of the Great Lakes Water Quality Agreement;
- Assessment and evaluation of the criteria used for regulating water levels in Lake Ontario and the St. Lawrence River;
- Maintaining the general process in which Remedial Action Plans and Lakewide Management Plans should proceed in order to restore the Beneficial Use Impairments of the Great Lakes; and,
- Supporting the establishment of ecosystem-focused watershed boards, in accordance with a 1998 request from the U.S. and Canadian governments.

Great Lakes Commission (GLC)

The Commission is a bi-national agency that promotes the orderly, integrated and comprehensive development, use and conservation of water and related natural resources of the Great Lakes basin and St. Lawrence River. Its members include the eight Great Lakes states (New York, Pennsylvania, Ohio, Indiana, Michigan, Illinois, Wisconsin, and Minnesota) with associate member status for the

Canadian provinces of Ontario and Québec. Each jurisdiction appoints a delegation of three to five members comprised of senior agency officials, legislators and/or appointees of the State governor or Provincial premier.

The GLC researches, compiles, and reports a wide variety of information relative to the health and condition of the Great Lakes. Communicating relevant Great Lakes issues to members of congress, coordinating regional monitoring and restoration strategies, and strengthening partnerships among federal, state and local agencies are some of the roles and responsibilities addressed by the GLC.

Environmental Organizations

Buffalo Niagara RIVERKEEPER® (Riverkeeper)

Riverkeeper is a not-for-profit organization that uses legal, scientific, planning, design, policy and advocacy tools to protect and defend WNY's fresh water resources. Riverkeeper's overall organizational goal is to protect and restore WNY's water resources while improving safe and healthy access to our waterways. Founded in 1989, Riverkeeper partners with community organizations, government, business representatives, and preservationists to develop a shared agenda for restoring our waterways and to secure the resources needed to achieve that vision. Program goals and strategies include: improving community awareness of the Great Lakes and the Regional Niagara River/Lake Erie Watershed Management Plan, restoring waterway health through watershed planning and action, improving public water access through greenway planning and action, and improving stewardship of community water resources, including habitat.

Buffalo Audubon Society (BAS)

The BAS is a non-profit organization that promotes appreciation and enjoyment of the natural world through education and stewardship in Western New York. Their 384 acre Beaver Meadow Audubon Center in Java, Wyoming County hosts their nature education programming. In total, the BAS maintains six nature preserves with over 900 acres.

Sierra Club, Niagara Chapter

Since 1892, the Sierra Club is a grass roots environmental organization that has been working to protect communities, wild places and the planet. The Niagara Chapter represents members in Cattaraugus, Chautauqua, Erie, Genesee, Niagara and Wyoming counties. The Niagara Chapter is actively involved in issues surrounding climate change issues, wetlands, forest management, hydro-fracking, hazardous waste, and planning initiatives including the Niagara River Greenway and the Niagara Relicensing Environmental Coalition.

Western New York Land Conservancy (Land Conservancy)

The Land Conservancy is a private, non-profit land trust dedicated to preserving the regions irreplaceable natural places, farms, forestlands and open spaces to protect wildlife habitat, recreation areas, and unique scenic resources. Over 6,000 acres of land are now protected through measures such as donation or purchase, and donation or sale of conservation easements (permanent deed restrictions that prevent harmful land uses).

Great Lakes United (GLU)

For 30 years, GLU was a coalition focused on ensuring a healthy and vibrant future for the Great Lakes and Saint Lawrence River ecosystem. GLU initiatives included addressing legacy pollution and emerging chemicals of concern; improving water quality via international programs, promoting water conservation, and improving regulations to limit invasive aquatic plants and animals. The organization is now defunct.

The Nature Conservancy (TNC), Central & Western New York Chapter

The TNC's mission is to preserve the plants, animals and natural communities that represent the diversity of life by protecting the lands and waters they need to survive. Their Central & Western NY Chapter works in eight priority conservation landscapes. They have protected nearly 100,000 acres of central and western NY landscapes.

Additional Organizations*

There are a number of smaller environmental organizations, sportsmen's clubs, educational and research organizations, community groups and non-profit organizations not outlined previously that are involved with a wide variety of environmental concerns within the Regional Niagara River/Lake Erie Watershed Management Plan, including:

Buffalo State College-Great Lakes Center
Center for Sustainable Communities and Civic Engagement at Daemen College
Chautauqua County Federation of Sportsmen
Citizens Campaign for the Environment
Clean Air Coalition of WNY
Clean Communities of WNY
Coalition on West Valley Nuclear Wastes
Community Foundation of Greater Buffalo
Cornell Cooperative Extension (Erie & Niagara Counties)
Erie County Federation of Sportmen's Clubs, Inc.
Friends of Broderick Park
Friends of Times Beach Nature Preserve
Grant-Amherst Business Association
GreenWorks Buffalo Niagara
GObike Buffalo
GROW WNY
Highland Community Revitalization Committee
John R. Oishei Foundation
Keep WNY Beautiful
League of Women Voters of Buffalo/Niagara
Massachusetts Avenue Project
Nature Sanctuary Society of WNY, Inc.

Niagara River Anglers Association
NY Sustainable Agriculture
Old First Ward Community Center
Olmsted Parks Conservancy
PUSH Buffalo
Residents for Responsible Government
ReTree WNY
Seneca Babcock Environmental Subcommittee
SUNY Buffalo State - Great Lakes Center
Tifft Nature Preserve
Valley Community Center
WNY Drilling Defense
WNY Environmental Alliance
WNY Marine Trades Association
WNY Trout Unlimited

**This is not meant to be a complete list, but rather a snapshot of the sheer number of organizations with various levels of involvement in this important work.*

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Chapter 7: Watershed Projects Inventory

It is essential to understand what work has already been completed, planned, or is underway to identify actions needed to protect and restore the watershed. Provided in Table 7.3 is an alphabetical inventory of watershed-related projects that have been recently completed, are currently underway, or are in the planning stages as of 2017. Compiling this list assists in cross-disciplinary communication and provides context for the existing conditions and influential factors affecting the Niagara River/Lake Erie Watershed. The projects are listed according to their sub-watershed location. For ease of searching the projects, the table can be viewed and sorted differently online[1].

The inventory provides an outline of federal projects (i.e. US Army Corp of Engineers), state projects (i.e. NYSDEC), county projects (i.e. Soil & Water, Sewer Districts), and some large-scale local projects. It should be noted that the following chart is a preliminary assessment and does not attempt to capture all of the potential water-influencing projects within the watershed. For example, there are many smaller local projects underway at the municipal-level that are not fully documented in this inventory.

Table 7.1 Total Watershed Projects by Category

Category	Number of Projects
Habitat Restoration	57
Data Collection & Research	33
Non-Point Source Pollution	17
Infrastructure Support	12
Water Quality	11
Navigational Dredging	10
Flood Control	9
Toxics Reduction	9
Outreach & Education	5
Erosion	3

A total of 150 projects were identified in the inventory. To highlight the major progress areas in the watershed, the captured projects are categorized to represent the main goal or issue the project aims to address. In Table 7.1 these 10 categories are identified along with the number of projects that fall within these categories. Some projects fell into more than one category and are counted in each. Habitat restoration and data collection & research projects represent the two largest project categories found in the watershed. This may be explained by Buffalo State College's Great Lakes Center, which is located in the watershed and where much of the research focusing on Lake Erie is completed. It is essential to maintain a balance between data collection & research, and implementation projects, because water quality improvement (through habitat restoration, erosion control, non-point pollution mitigation, etc.) is vital for improving and protecting the state of our watershed. However, as invasive species, emerging pollutants, and other manmade modifications become increasingly prevalent in the Niagara River and Lake Erie ecosystems, continued research is integral for informing future projects.

[1] www.erie.gov/wmp

Table 7.2 Total Projects by Subwatershed

Subwatershed	Number of Projects
Niagara River	59
Buffalo River	43
Lake Erie	16
Smoke(s) Creek	12
Canadaway Creek	11
Chautauqua Creek	7
Cattaraugus Creek	6
Ellicott Creek	6
Big Sister Creek	6
Lower Tonawanda Creek	6
Cayuga Creek	6
Middle Tonawanda Creek	4
Walnut Creek	4
Buffalo Creek	4
Headwaters Cattaraugus Creek	4
Upper Tonawanda Creek	3
Murder Creek	2
Eighteenmile Creek	2

Table 7.2 shows the number of projects from the list taking place in each sub-watershed. Some projects are taking place in more than one sub-watershed and are counted in each. The Niagara River and Buffalo River sub-watersheds have the most projects underway by far. This is due to the numerous impairment contributors and other high priority issues in these two designated Areas of Concern. Many of the Lake Erie projects are data collection & research projects that assess the water quality and habitat quality of the lake itself. Smoke(s) Creek and Canadaway Creek sub-watersheds are also highly industrialized, flowing through the cities of Lackawanna and Dunkirk respectively, where creeks have been channelized, buried, or otherwise manipulated for industrial and commercial development. This is similar to what has occurred in Buffalo. The highest number of projects are therefore occurring in the most industrialized and urbanized sub-watersheds of the Niagara River/Lake Erie Watershed to restore waterways to a more natural state.

Table 7.3 Niagara River/ Lake Erie Watershed Projects Inventory

Project Title	Project Description	Sub-watershed	Organization/Agency	Project Funding Level	Cost	Time-frame	Category	Status
Agri-Chemical Handling Facility	Implemented BMPs for an Agri-chemical Handling Facility within the Bergholz Creek area.	Niagara River	Niagara County SWCD	Federal	$38,000	2014	Toxics Reduction	Completed
Anticipating Future Chemical Threats to the Great Lakes	This project identified persistent and bioaccumulative contaminants that chemical monitoring and surveillance programs should analyze when testing fish, air and sediments in the Great Lakes. The project focused on possible impurities, by-products, and degradation products/metabolites of commercial chemicals.	Lake Erie	SRC, Inc.	Federal	$64,912	2010-2012	Data Collection & Research	Completed
Aquatic Invasive Species Prevention & Monitoring in the Eastern Great Lakes Basin	This project involved both research, planning, and design of field demonstrations of technologies for eradicating invasive aquatic plants that are adversely impacting the quality and diversity of wetlands in the Great Lakes. Laboratory investigations of innovative technologies were advanced with an emphasis on those that can control Phragmites. In addition, this project conducted preliminary design of field demonstrations of various technologies for Phragmites control at multiple sites within the Great Lakes basin, including sites at selected Areas of Concern. FY10 funds were used to continue investigations at Cornell University of new insect biological control strategies as a long-term, sustainable management method against Phragmites australis, an invasive plant that threatens native wetland habitats. The work includes: 1) development of test procedures and conditions for host-specificity studies and data collection on host specificity of promising insect agents (4 shoot-boring moth species); 2) development of laboratory and greenhouse mass-rearing procedures; and 3) assessing the extent of hybridization between the native and introduced genotypes of (No Suggestions).	Lake Erie	The Nature Conservancy	Federal	$315,059	Not Available	Data Collection & Research	Completed
Aquatic Invasive Species Risk Assessment Program	This project will continue an aquatic invasive species risk assessment program to develop and implement a rapid screening process to assess the risk of establishment and significant, negative impacts of species: 1) imported and traded within the Great Lakes Basin and 2)That may benefit from Great Lakes habitat restoration and enhancement under the Great Lakes Restoration Initiative (As requested by other Federal, and Regional [e.g., Great Lakes Fishery Commission], State, Tribal, and local governments, industries, and nongovernmental organizations).	Lake Erie	US Fish & Wildlife	Federal	~ $ 94,000 per year	Annual	Data Collection & Research	Ongoing
Athol Springs Seawall Protection, Hamburg NY	Complete design and implementation planning for the seawall along Route 5 at Athol Springs area of Hamburg, NY. The seawall is deteriorating and lake storms significantly impair driving ability along Route 5.	Smoke(s) Creek	US Army Corps of Engineers, NYS DOT , Town of Hamburg	Federal	$3 million	2018-2020	Infrastructure Support	Underway
Avian Habitat Restoration at Joseph Davis State Park (NY)	This project restored approximately 35 acres of shrub habitat in need of restoration, making it a highly productive habitat for native pollinators, breeding birds, and migrating birds reliant on fruits from native shrubs. Buffalo Audubon Society and partners restored and enhanced 85 acres of critical bird habitat at Joseph Davis State Park along the Upper Niagara River Corridor. Through invasive species control and seeding and planting of native vegetation, the project will benefit priority bird species by improving forested wetland, scrub-shrub wetland and shrub/scrub early successional habitats throughout the park. This work will address habitat-related Beneficial Use Impairments and contribute to the delisting of the Niagara River Area of Concern by helping to reverse the loss of bird habitat.	Niagara River	Buffalo Audubon Society	Local/Federal	$200,000, $360,031	2010-2011	Habitat Restoration	Completed

Barcelona Breakwater Rehabilitation - Federally Authorized O&M	USACE Harbor of Refuge on Great lakes Navigational System - Repair of failed breakwater sheet pile cell and mitigation of resultant shoaling	Chautauqua Creek	US Army Corps of Engineers, Chautauqua County & Town of Westfield	Federal/Local	$750,000	2017	Navigational Dredging	Underway
Barcelona Harbor Dredging - Federally Authorized O&M	USACE Harbor of Refuge on Great Lakes Navigational System - Mitigation of shoaling caused by 2015 breakwater failure in Federal and Recreational channels	Chautauqua Creek	US Army Corps of Engineers, Chautauqua County & Town of Westfield	Federal/Local	$500,000	TBD	Navigational Dredging	Planning
Be Green in the Great Lakes	The Be Green in the Great Lakes project focused on outreach and education for the general public and land care businesses regarding alternatives to conventional synthetic pesticides and fertilizers. Four training sessions were held in August 2013 in the Great Lakes watershed. Educational brochures and web content were produced. See the Be Green in the Great Lakes Project and Pest Management Tips webpages for more information.	Lake Erie	NYSDEC	Federal	$315,223	2010-2013	Outreach & Education	Completed
Beach Forecasting Model and Weather Station Network	This project established weather station networks with real-time internet data retrieval at five northeast Lake Erie beaches and associated streams. These networks will be validated by water quality sampling results and will make existing preemptive beach closure procedures more accurate and precise. This will allow beach managers to protect human health by making more informed decisions.	Big Sister Creek, Smoke(s) Creek	Erie County Health Department	Federal	$91,440	2010	Data Collection & Research	Completed
Beaver Island State Park Habitat Restoration	Habitat restoration project to maximize the biodiversity of the park and to provide a richer recreational experience for the public. Lagoon Dredged & returned to marsh area.	Niagara River	NYS office of Parks, Recreation & Historic Preservation	State	Not Available	2010-11	Habitat Restoration	Completed
Bell Slip	As part of a brownfield remediation project, the Niagara Frontier Transportation Authority constructed a shallow-water fish habitat within the Buffalo Outer Harbor bay area known as the Bell Slip. The habitat is conducive to spawning for local species.	Buffalo River	NYSDEC, Niagara Frontier Transportation Authority	State	Not Available	2006 - 2008	Habitat Restoration	Completed
Bergholz Creek Cover Crop	Provide cover crop to reduce erosion in the Bergholz Creek area.	Niagara River	Niagara County SWCD	Federal	$88,000	2015-2019	Non-point Source Pollution	Underway
Bergholz Creek Segment Analysis	This project conducted in-depth analyses of Bergholz Creek to better understand hydrodynamics and sediment loading.	Niagara River	Niagara County SWCD	County	$22,000	2014	Data Collection & Research	Completed
Big Sister Creek Feasibility Study	This project will explore options for green infrastructure or a constructed wetland to treat stormwater and creek volume before it reaches Bennett Beach.	Big Sister Creek	Erie County Department of Environment & Planning/ NY Sea Grant	State	$25,000	2017-2018	Non-point Source Pollution	Underway
Biomonitoring of Great Lakes Populations	The Agency for Toxic Substances and Disease Registry established programs with Minnesota, Michigan and New York health departments to measure environmental toxin levels in people (measuring toxins in blood & urine samples) who live in the Great Lakes basin to see if there is a higher amount of toxins in people with greater exposure to toxins, such as people who eat Great Lakes fish. This information will guide actions that the state health departments take to protect people.	Lake Erie	Department of Health & Human Services - Agency for Toxic Substances & Disease Registry	Federal	$2.2 million	Not Available	Data Collection & Research	Not Available
Black Rock Canal Improvements	Green infrastructure, sediment/contaminant removal & technology improvements within the Black Rock Canal.	Niagara River	US Army Corp of Engineers	Federal	$250,000	2012	Non-point Source Pollution & Habitat Restoration	Completed
Blue Tower Turning Basin	1700 linear feet of in-water habitat restoration and minor riparian buffers at Buffalo Motor & Generator Corporation.	Buffalo River	Buffalo Niagara Riverkeeper	Federal	$1,000,000	2017-2018	Habitat Restoration	Underway

Broderick Park Habitat Restoration & Seawall Repair	Study to restore habitat and fish passage at Broderick Park in Buffalo, with special consideration to the deteriorated seawall. Project focused on passage of the Emerald Shiner, a species important to the food web of Lake Erie. This project led to the initiation of the Niagara River Shiner Study.	Niagara River	US Army Corp of Engineers	Federal	$130,000	2014	Infrastructure Support & Habitat Restoration	Completed
Buckhorn State Park Habitat Restoration	Protection of an important bird nesting & breeding area within the park. Includes Osprey poles installed and marsh & dredging of marsh area.	Niagara River	NYS office of Parks, Recreation & Historic Preservation	State	Not Available	2010	Habitat Restoration	Completed
Buffalo Color Peninsula	2645 linear feet of shoreline and riparian restoration.	Buffalo River	Buffalo Niagara Riverkeeper	Federal	$1,500,000	2017-2018	Habitat Restoration	Underway
Buffalo Harbor Maintenance Dredging	Maintenance dredging occurs every other year, subject to availability of funding. Dredging is planned for summer 2017 and dredged material will be used beneficially for aquatic ecosystem restoration at Unity Island.	Buffalo River	US Army Corp of Engineers	Federal	TBD	Every other year	Navigational Dredging	Funded
Buffalo Motor and Generator Corporation	The project includes upland and shoreline restoration on the property owned by Buffalo Motor and Generator as well as in the adjacent river channel. In total there will be 460 linear feet of in-water habitat restoration. The site is located along the right descending bank of the Buffalo River, across the River from RiverWorks.	Buffalo River	Buffalo Niagara Riverkeeper	Federal	$450,000	2017-2018	Habitat Restoration	Underway
Buffalo Outer Harbor	The United States Army Corp of Engineers (USACE) is studying the feasibility of various alternatives to restore aquatic habitat along the shoreline of Lake Erie within the Buffalo Harbor area in Buffalo, NY.	Buffalo River	US Army Corps of Engineers	Federal	$50,000	2010	Habitat Restoration	Completed
Buffalo River & Harbor Enhanced Navigational Dredging	Buffalo Harbor is a Federal navigation channel within the Buffalo River Area of Concern. The project involved the removal of approximately 450,000 cubic yards of contaminated sediments from the navigation channel in order to support the elimination of the dredging restriction Beneficial Use Impairment and delisting of the Area of Concern. The project also involved significant repairs and improvements to the Dike 4 Confined Disposal Facility to support its use for disposal of contaminated sediments from outside the navigation channel dredged as part of a Legacy Act project. FY10 funds were used to initiate construction of repairs and enhancements to the Dike #4 Confined Disposal Facility and to initiate dredging.	Buffalo River	US Army Corps of Engineers	Federal	$50,000	Not Available	Navigational Dredging	Not Available
Buffalo River AOC Habitat Restoration - RiverBend Phase I	The RiverBend Habitat Restoration Project included the engineering and design, and implementation of habitat restoration along the Buffalo River, on the site of the former Republic Steel and Donner Hanna Coke facility, and is accessed via South Park Ave. The project is part of the greater RiverBend industrial park master plan, which is located within the South Buffalo Brownfield redevelopment area.	Buffalo River	Buffalo Niagara Riverkeeper	Federal	$657,245	2014	Habitat Restoration	Completed
Buffalo River AOC Habitat Restoration - RiverBend Phase II	This project further supports the Buffalo River Remedial Action Plan to address stream water quality monitoring, river bottom sediments, inactive hazardous waste sites, municipal and industrial wastewater treatment facilities, combined sewer overflows, and fish and wildlife habitat issues in the Buffalo River Area of Concern. In particular, data will be collected on the degradation and loss of fish and wildlife habitat, the degradation of microscopic plant and animal populations, and the presence of excess levels of nutrients and algae.	Buffalo River	US Department of Commerce & NOAA	Federal	$167,000	2013-2017	Habitat Restoration	Underway
Buffalo River Bailey Peninsula and Red Jacket Park	Shoreline and riparian habitat restoration in the Buffalo River Area of Concern This site will restore approximately 3,765 linear feet of shoreline as part of the management actions for delisting of the Buffalo River as an Area of Concern.	Buffalo River	Erie County Department of Environment & Planning	Federal	$1,300,000	2014-2019	Habitat Restoration	Underway

Buffalo River NFTA 61 Smith Street	Shoreline and riparian habitat restoration in the Buffalo River Area of Concern This site will restore approximately 1,080 linear feet of shoreline as part of the management actions required for delisting of the Buffalo River as an Area of Concern.	Buffalo River	Erie County Department of Environment & Planning	Federal	$831,000	2015-2019	Habitat Restoration	Underway
Buffalo River Restoration & Habitat Restoration (Phase 2)	Legacy Act dredging and disposal of (non-navigation channel) contaminated sediments from the Buffalo River Area of Concern, including capping of the Union Ship Canal sediments. Following dredging and capping elements, the project will backfill into specific areas of the Buffalo River Area of Concern and Union Ship canal to restore in-water habitat environments (Regional Sediment Management).	Buffalo River	US Army Corp of Engineers	Federal	$44 million	2013-2015	Navigational Dredging	Completed
Buffalo River Sediment Remediation & Habitat Restoration (Phase 1)	Buffalo Harbor is a Federal navigation channel within the Buffalo River Area of Concern. The project involved the removal of approximately 450,000 cubic yards of contaminated sediments from the navigation channel in order to support the elimination of the dredging restriction Beneficial Use Impairment and delisting of the Area of Concern. The project also involved significant repairs and improvements to the Dike 4 Confined Disposal Facility to support its use for disposal of contaminated sediments from outside the navigation channel dredged as part of a Legacy Act project. FY10 funds were used to initiate construction of repairs and enhancements to the Dike #4 Confined Disposal Facility and to initiate dredging.	Buffalo River	US Army Corp of Engineers/Great Lake Legacy Act	Federal	$9 million	2012	Navigational Dredging	Completed
Buffalo River Sediment Transport Model	The project developed a Sediment Transport Model for the Buffalo River to assist state and local agencies with the planning and implementation of measures for soil conservation and non-point source pollution prevention.	Buffalo River	US Army Corps of Engineers	Federal	Not Available	Not Available	Erosion Control & Non-point Source Pollution	Completed
Buffalo River Seneca Bluffs	Shoreline and riparian habitat restoration in the Buffalo River Area of Concern This site will restore approximately 3,000 linear feet of shoreline as part of the management actions required for delisting of the Buffalo River as an Area of Concern.	Buffalo River	US Army Corps. of Engineers, Erie County Department of Environment & Planning	Federal	$2,300,000	2015-2020	Habitat Restoration	Underway
Buffalo River Submerged Aquatic Vegetation	In-River submerged aquatic vegetation restoration at three sites that together will restore approximately 2,300 linear feet of shoreline as part of the management actions for delisting of the Buffalo River.	Buffalo River	US Army Corps. of Engineers, Erie County Department of Environment & Planning	Federal	$1,870,000	2015-2017	Habitat Restoration	Underway
Buffalo River Submerged Aquatic Vegetation Alternative Sites	Submerged Aquatic Vegetation work proposed at 3 alternative sites for 2300 linear feet of habitat restoration along the Buffalo River.	Buffalo River	Erie County	Federal	$1,870,000	Not Available	Habitat Restoration	Underway
Buffalo River Watershed Study (Final Watershed Assessment)	An initial watershed assessment was completed in 2012. Phase 2 would have consisted of a multi-agency strategic plan for recommending and implementing measures to address the problems within the watershed, but was not pursued due to lack of a project sponsor.	Buffalo Creek, Buffalo River & Cayuga Creek	US Army Corp of Engineers	Federal	$92,000	2012	Data Collection & Research	Completed
Buffalo River Wetlands Restoration at Seneca Bluffs	Removal of invasive species, planting & landscaping restoration, improved facilities.	Buffalo River	Buffalo Niagara Riverkeeper, Erie County Department of Environment & Planning	Federal	$200,000	2013	Habitat Restoration	Completed
Buttermilk Falls North Otto Road Stream Stabilization	The Cattaraugus County DPW and Cattaraugus County Soil & Water Conservation District determine emergency streambank projects around the county every year and budget funds to correct these issues to improve water quality, flood control, non-point source pollution and infrastructure protection. This project armored the Warterman Brook stream bank with rock riprap to protect the road shoulder and repair existing rock. This will prevent further erosion and sediment loading.	Cattaraugus Creek	Cattaraugus County DPW & Cattaraugus County SWCD	County	$23,342	2014	Erosion Control	Completed

Canadaway Creek Restoration, Pomfret, Chautauqua County, New York	Restore three sections of Canadaway Creek to reduce sediment loading, restore aquatic habitat and restore aquatic organism passage. Approximately 0.3 miles of stream will be restored.	Canadaway Creek	US Fish & Wildlife	Federal	$154,000	2015-2017	Habitat Restoration	Underway
Cattaraugus Creek Harbor - Federally Authorized O&M	USACE Harbor of Refuge on Great Lakes Navigational System - Mitigation of shoaling caused by deferred maintenance in Federal and Recreational channels, maintenance of breakwater structures.	Cattaraugus Creek	US Army Corps of Engineers, Chautauqua County & Town of Hanover	Federal/State/Local	$795,000	TBD	Flood Control/Navigational Dredging	Unfunded
Cattaraugus Creek Harbor Flood Mitigation Study	Feasibility Study for flood mitigation at Sunset Bay and dredging the mouth of Cattaraugus Creek.	Cattaraugus Creek	US Army Corps of Engineers, Chautauqua County & Town of Hanover	Federal/Local	$200,000	2018	Flood Control	Included in 2016 WRDA Bill
Cattaraugus Creek Round 21 Ag BMP Implementation Project	Participating farms in the Cattarugus Creek watershed received funding to implement BMP's to reduce agriculture runoff and nutrient management.	Headwaters Cattaraugus Creek	Cattaraugus County SWCD & Wyoming County SWCD	State/County	$848,633	2015 - 2019	Non-point Source Pollution	Underway
Cattaraugus Creek/Clear Lake Drinking Water Source Protection Project	The project implemented conservation and management practices on seven farms to protect water quality in area streams that are source water for Clear Lake Reservoir and lake Erie.	Cattaraugus and Headwaters Cattaraugus Creeks	Erie and Cattaraugus Soil & Water Conservation Districts	State/Local	Not Available	Not Available	Non-point Source Pollution	Completed
Cazenovia Creek, Ice Control Structure, West Seneca, NY	Repair the Ice Control Structure located on Cazenovia Creek in West Seneca. The structure provides an ice retention barrier to reduce downstream flooding.	Buffalo River	US Army Corps of Engineers, NYS DEC, and Town of West Seneca	Federal/State/Local	$650,000	2017	Infrastructure Support	Completed
Chadwick Bay Regional Water Supply Program - Phase 1	Implementation of a regional water supply and distribution system that consolidates separate municipal water supply and distribution systems that serve 42,000 people.	Cattaraugus, Chautauqua, and Walnut Creeks	Chautauqua County and municipalities that border Lake Erie	State/Local	$32.35 million	2016-2018	Infrastructure Support	Underway
Characterization of the Niagara River Larval Fish Community	The U.S. Fish and Wildlife Service Lower Great Lakes Fish and Wildlife Conservation Office sampled juvenile and larval fish using a variety of methods in several habitat types (wetlands, backwater and open flow areas) in the Niagara River from May-September 2011. Sampling methods included drift nets, ichthyoplankton nets, light traps, minnow traps, trawling and larval seines. Species diversity information will help guide management decisions on the Niagara River.	Niagara River	US Fish & Wildlife	Federal	$47,000	2010 - 2011	Data Collection & Research	Completed
Chautauqua County Fairgrounds Drainage	Mitigate localized flooding and nutrient loading from fairgrounds runoff to Lake Erie tributary.	Canadaway Creek	Chautauqua County Fair Association	Local	$300,000	TBD	Infrastructure Support	Planning
Chautauqua County Septic Inspections (within 250 feet of Lake Erie shoreline)	County-wide initiative to identify and bring inadequate septic systems into compliance. Other bodies of water included are Chautauqua, Findley, Bear, and Cassadaga lakes.	Cattaraugus, Chautauqua, and Walnut Creeks	Chautauqua County	Local	$100,000 annually	Ongoing	Infrastructure Support	Ongoing
Chautauqua Creek Fish Passageway, Chautauqua County, Westfield, NY	Utilized in-stream construction to allow fish to pass the three barriers.1) Raised pool level at downstream railroad bridge; 2) Raised pool level at the middle barrier that was damaged by the storm; and 3) Created an engineered riffle at the upper barrier damaged by the storm to allow passage over the village water supply dam. Boulders were pinned at each location to ensure that the project does not fail during hugh flows.	Chautauqua Creek	US Fish & Wildlife	Federal	$270,000	2014-2016	Habitat Restoration	Completed

Chautauqua Creek Oxbow Forest Preserve Improvement Project	The Chautauqua Watershed Conversancy undertook this project as part of a larger series of public access improvements at this Preserve. Eight checkdams and a large rock outfall were installed along Lyons Road in the Town of Chautauqua as part of the erosion control project. An approximately 2500 square foot rain garden was also installed to reduce runoff that was severely eroding the steep slopes of the Chautauqua Creek Gorge. Aside from reducing erosion, these efforts will help prevent degraded water quality in Chautauqua Creek, a tributary of Lake Erie, trout stream, and drinking water supply of the Town of Westfield. Finally, over 300 individual plants from more than 30 native species were planted, which will benefit the local ecosystem by enhancing floral biodiversity and replacing lost ecological connections that stem from losses in diversity. This project was supported with funding from the New York State Conservation Partnership Program (NYSCPP) and New York's Environmental Protection Fund. The NYSCPP is administered by the Land Trust Alliance, in coordination with NYS Department of Environmental Conservation.	Chautauqua Creek	Chautauqua Watershed Conservancy	Local/State	15,619	2015-2016	Water Quality, Erosion Control, Habitat Restoration	Completed
Clear Creek Stream Habitat Restoration and Fish Passage Project, Cattaraugus County, Freedom, NY	The project stabilized stream banks, reduced sediment inputs, and restored sediment transport to re-establish stream and floodplain function along Clear Creek, and provide fish passage over the sheet pile grade control structure. The project restored 0.3 miles of stream and re-opened 6 miles of stream to fish passage.	Headwaters Cattaraugus Creek	US Fish & Wildlife	Federal	$146,000	2010-2012	Habitat Restoration	Completed
Common Tern Nesting HIP	Common terns, which are a protected species in NYS, have been nesting on breakwalls along the Buffalo Harbor and Niagara River, and their nesting has been monitored nearly every year since 1986. A decline in nesting success was noted and attributed to deterioration of the nesting areas (concrete weathering) and competition by gulls and cormorants. Although there has been colony nesting maintenance for several years, this project marked a more dramatic increased improvement the nesting areas by adding a greater quantity substrate, brood boxes and perimeter fencing. Chick rearing success was monitored every ten days throughout the season and mink predators were removed. This HIP has improved tern nesting success compared to years with less intensive efforts.	Niagara River	New York Power Authority	Local	$1,076,000	2008-2013	Habitat Restoration	Completed
Concord Wastewater Infrastructure Project	Consolidation of Kissing Bridge and Crane Ridge subdivisions' waste water treatment plants	Buffalo River	Town of Concord	State	$50,000	2014-2017	Water Quality	Underway
Connoisarauley Creek County Road 12 Stream Stabilization	The Cattaraugus County DPW and Cattaraugus County Soil & Water Conservation District determine emergency streambank projects around the county every year and budget funds to correct these issues to improve water quality, flood control, non-point source pollution and infrastructure protection. This project armored the stream bank with rock riprap to protect the road shoulder and repair existing rock. This will prevent further erosion and sediment loading.	Cattaraugus Creek	Cattaraugus County DPW & Cattaraugus County SWCD	County	$20,445	2015	Erosion Control	Completed
Contaminated Sediment Strategic Plan	Identified strategic opportunities for the USACE to collaborate with EPA's Legacy Act and other programs to remove contaminated sediments from the U.S. Great Lakes Area Of Concerns (AOCs) having federal navigation channels.	Buffalo River, Niagara River	US Army Corp of Engineers	Federal	$756,000	2010-2015	Toxics Reduction	Completed

Crooked Brook Aquatic Habitat Restoration, Dunkirk, Chautauqua County, NY	Restored two sections of Crooked Brook to reduce sediment loading and improve water quality. In addition, the project improved aquatic habitat within the stream. Bendway weirs and bank armoring were used in several locations to divert the main force of the stream flow back to the center of the channel. Resting pools were added between weirs to aid fish migration. In addition, at one location, engineered rock riffles were used to maintain grade and prevent head cutting of the streambed.	Canadaway Creek	US Fish & Wildlife	Federal	$77,000	2015-2016	Habitat Restoration	Completed
Crow Creek Fish Barrier Removal	An improperly installed culvert which prevents native brook trout movement will be removed and replaced. A preliminary assessment revealed that the culvert was clogged and 56 brook trout were below the barrier, whereas only three were upstream. The barrier will be replaced with a wide arch pipe culvert which will provide 1.9 of stream miles of aquatic connectivity. Post construction monitoring and community assessment will determine if improvements in passage and water quality occurred as a result, while also ensuring that unexpected bankside erosion did not occur. Improvement to the quality of water in the Attica Reservoir is also anticipated as a direct result of this project. Resident brook trout were sampled for genetic analysis to determine if they are a native strain (i.e.. not stocked in origin).	Tonawanda (Upper) Creek	Buffalo Niagara Riverkeeper, US Fish and Wildlife Service, Wyoming County SWCD, WNY Trout Unlimited	Local/State/Federal	$175,986	2016-2018	Habitat Restoration	Underway
Dunkirk Harbor - Federally Authorized O&M	USACE Harbor of Refuge on Great Lakes Navigational System - Mitigation of shoaling caused by deferred maintenance in Federal and Recreational channels, maintenance of breakwater structures.	Canadaway Creek	US Army Corps of Engineers, Chautauqua County & City of Dunkirk	Federal/Local	$1.35 million	TBD	Navigational Dredging	Unfunded
Dunkirk Harbor Improvements	USACE Harbor of Refuge on Great Lakes Navigational System - Mitigation of design deficiencies to mitigate wave reflection & multiplication.	Canadaway Creek	US Army Corps of Engineers, Chautauqua County & City of Dunkirk	Federal/Local	TBD	TBD	Infrastructure Support	Planning
Dunkirk Segmented Breakwater	Install Segmented Breakwater east of Dunkirk Harbor to protect beach and seawall.	Canadaway Creek	US Army Corps of Engineers, Chautauqua County & City of Dunkirk	Federal/Local	TBD	TBD	Infrastructure Support	Planning
Ellicott Creek, Lehn Springs (Williamsville, NY)	Study for the Determination of Federal Interest on erosion and flooding problems from the Lehn Springs Area of Glen Falls Park in Williamsville and impacting Ellicott Creek. Project was not initiated due to lack of funding.	Ellicott Creek	US Army Corps of Engineers	Federal/Local	Not currently funded	TBD	Flood Control	Pending
Emerald Shiner Project in the Upper Niagara River	This project is a comprehensive study of the life history and habitat utilization of the native emerald shiner (*Notropis atherinoides*) in the upper Niagara River and their importance in sustaining sport fish and piscivorous bird species (in particular the common tern, *Sterna hirundo*) that depend on this resource. This project focuses on restoration and enhancement of fish and wildlife resources by analyzing threats to migration and the status of key habitats, helping restore threatened species, conserving migratory birds, and educating the public. In addition, this project addresses the delisting criteria of the Niagara Remedial Action Plan (RAP) for Fish Habitat and for Fish Communities.	Niagara River	Buffalo State College	Local	$766,448	2014-2017	Data Collection & Research	Underway

Enhanced Fish Consumption Advisory in Buffalo Niagara Region	Current advisories were revised to improve information uptake in high-risk communities. Local community and refugee outreach groups collaborated in translating and distributing non-traditional outreach materials. This project filled a significant gap in understanding fish consumption patterns of subsistence anglers to inform future education and policy efforts.	Buffalo River, Niagara River, Lake Erie	Buffalo Niagara Riverkeeper	Federal	$224,997	2010	Outreach & Education	Completed
Evaluating Ponto-Caspian Fish Species for Risk of Great Lakes Invasion	This project identified "high-risk" fish species from the Ponto-Caspian region of Russia. Information obtained from this investigation will be used to evaluate the effectiveness of ballast water regulations against invasive species from the Ponto-Caspian. Informational materials were developed to support early detection and monitoring initiatives in the Great Lakes.	Lake Erie	Buffalo State College	Federal	$111,264	2010-2011	Data Collection & Research	Completed
Evaluation of Niagara River Corridor Benthic Habitat With Side Scan Sonar and GIS Modeling	The U.S. Fish and Wildlife Service Lower Great Lakes Office is classifying substrate in the Niagara River to help restore lake trout and lake sturgeon habitat. Side scan sonar mapping and GIS techniques, coupled with field validation and underwater video, will be used to evaluate habitat. They will assess 22 miles of habitat in the upper river, 8 miles of habitat in the lower river, and 12 square miles of the Niagara bar. Information will be used to prioritize habitat protection.	Niagara River	US Fish & Wildlife	Federal	~ $ 58,000 per year	Annual	Data Collection & Research	Ongoing
Evans Town Park Beach Project	Installation of Green Infrastructure measures to improve water quality at the Town Beach (public).The Fern Brook Creek runs along the northwest side of the park and drains into Lake Erie and is a discharge point for stormwater drainage for Town Park. The design plan integrates rain gardens and bio-retention swales to infiltrate stormwater from roofs, paved surfaces and recreational courts before reaching the beach to further permeate daily stormwater.	Big Sister Creek	Town of Evans	Federal	$172,125	Not Available	Non-point Source Pollution	Underway
Fish Attraction Structures	Four structures were placed in the upper Niagara River with the intention of improving fish habitat. These structures were installed in 2008 and are being monitored periodically until 2018. As reported in the 2012 monitoring, there has been some structural loss, and accumulation of silt and Dreissena mussels; however overall the structures were in good to fair shape. The primary fish species to utilize these structures (through direct diving observation) are round goby and smallmouth bass, followed by carp, muskie and largemouth bass. The monitoring report (available online) discusses suggestions for future fish structures, based off the experiences from this project.	Niagara River	New York Power Authority	Local	$310,000	2008, Monitoring periodically until 2018	Habitat Restoration	Completed
Fish Monitoring and Surveillance	This project will assess trends and identify emerging and legacy contaminants (identified in the Great Lakes Water Quality Agreement) at levels previously impossible to detect by monitoring fish from each of the five Great Lakes. Additionally, in collaboration with other state, federal, and international agencies, the project will assess transfer of contaminants from the water column through the food chain, expand the existing Great Lakes Fish Monitoring Surveillance Program (GLFMSP) analyte list to include important emerging contaminants, and provide better information for decision-makers regarding the health of the Great Lakes ecosystem.	Lake Erie	Clarkson University	Federal	$2.75 million	2010-	Data Collection & Research	Ongoing
Flood Control Projects	Various projects are listed to address flooding issues throughout the Niagara River/Lake Erie Watershed. http://www.dec.ny.gov/lands/62265.html	Entire Niagara River/Lake Erie Watershed	NYSDEC	State	Varies	Varies	Flood control	Completed

Forest Lawn Upper Wetland	This project is intended to improve water quality and mitigate flooding impacts of Scajaquada Creek in Forest Lawn Cemetery, through the implementation of wetland, wet meadows and riparian forest surrounding a spring fed pond. It will consist of many native plantings, which will enhance habitat for multiple species of ducks, as well as indicator salamander species. It will also include beneficial human uses, such as pedestrian foot paths, scenic landscape, and meandering pathways through the wetland and meadow.	Niagara River	Buffalo Niagara Riverkeeper, Forest Lawn Cemetery, Buffalo Sewer Authority, Ducks Unlimited	Local	$1,080,000	2016-2018	Habitat Restoration, Flood Control, Water Quality	Underway
Fox Valley Road Slope/Stream Stabilization Project/Buttermilk Creek, West Valley, NY	The project addressed a severe bank slide on Buttermilk Creek that was contributing tons of sediment with every rain event. The bank was reshaped, the toe was armored with heavy rock and the site was hydroseeded to restore and	Headwaters Cattaraugus Creek	Cattaraugus County SWCD	State/Local	$27,500	2017	Erosion Control	Completed
Frog Island Restoration	The Frog Island Habitat Improvement Project (HIP) is a shallow, roughly 5-acre area that is currently devoid of vegetation. Historically this island was over mined for gravel, and wave action likely eroded what little remained, Located in the shallows between Motor and Strawberry Islands, this HIP involves the creation of emergent wetland and submerged aquatic vegetation (SAV) habitat in a portion of the river that at one time supported wetlands. This project involves using hard structures surrounding the island to absorb and dissipate wave energy. The purpose is to create better habitat and structure for native vegetation, fishes and waterfowl.	Niagara River	New York Power Authority	Local	$4,200,000	2013-2016	Habitat Restoration	Completed
Gallagher Beach Feasibility Study	Study for the Determination of Federal Interest in making improvements to Gallagher Beach for the purposes of storm damage reduction and shoreline protection. Beach is currently used to launch boats and smaller watercraft, public has a desire to see improvements at the beach, including sand replenishment.	Buffalo River	US Army Corps of Engineers	Federal	Not currently funded	TBD	Infrastructure Support	Unfunded by Congress
Gowin Gulf Road Emergency Stream Stabilization Project	This was an emergency stream stabilization project that was on a tributary to the South Branch of the Cattaraugus Creek in the Town of New Albion. After a few significant rain events the stream eroded to the point where it took a section of the road shoulder on Gowin Gulf Road. This project stabilized a total of 350 linear	Cattaraugus Creek	Cattaraugus County SWCD	State/Local	$32,553	2017	Erosion Control	Completed
Grand Isle Ferry Landing	New York State Department of Environmental Conservation acquired a 1 acre parcel within the Niagara River AOC. This parcel is one of the last undeveloped sections of shoreline that provides natural habitat for native fish, wildlife, and plant species.	Niagara River	NYSDEC	Federal/State	$26,500	2011	Habitat Restoration	Completed
Green Infrastructure along E. Spring Street in Williamsville	The Village of Williamsville completed a Green Infrastructure project on East Spring Street including road construction with permeable pavement and rain gardens to capture runoff prior to discharging to Ellicott Creek in Glenn Park with funding from NYSDEC WQIP, NYS Environmental Facilities Corps GIGP, and other sources as part of larger project.	Ellicott Creek	Village of Williamsville	State	$3 million	2014-2016	Non-point Source Pollution	Completed
Green Infrastructure along S. Long Street in Williamsville	Green Infrastructure with porous pavement and rain gardens is planned for S. Long Street to capture runoff prior to discharging to Ellicott Creek. Funding is from NYS Environmental Facilities Corporation GIGP.	Ellicott Creek	Village of Williamsville	State	$1.5 million	2017-2019	Non-point Source Pollution	Underway
Guterl Steel Investigation, Lockport NY	Investigation includes a full remedial investigation, feasibility study, proposed plan and Record of Decision for the former Guterl Steel facility in Lockport, NY. The 70 acre site includes elevated levels of radionuclides. The Guterl Steel Site is currently in the feasibility study phase. The document is currently scheduled to be complete in FY18.	Tonawanda (Lower) Creek	US Army Corps of Engineers, US Congress	Federal	$10.9 million	2010-	Toxics Reduction	Ongoing

Habitat Use and Movement of Lake Trout in the Niagara River and Niagara Bar	The objective of this Great Lakes Restoration Initiative project is to identify specific habitat use and movement of radio and acoustic tagged lake trout that could help identify potential spawning habitat in the Niagara River and on the Niagara Bar.	Niagara River	US Fish & Wildlife	Federal	~ $65,000 per year	Annual	Data Collection & Research	Ongoing
Hazelwood Real Time Controlled In Line Storage Structure	Installation of a real time controlled chamber to temporarily store flows in the existing sewer.	Niagara River	City of Buffalo Sewer Authority	State/Local	$2 million	2017-2018	Water Quality	Underway
Household Toxics Reduction through Consumer Education Pilot	This project reduced toxic contamination of the Great Lakes from household cleaning products. It supported workshops promoting the use of nontoxic products and sustainable practices in communities throughout the Rochester Embayment, Niagara River, Eighteenmile Creek, and St. Lawrence River-Massena Area of Concern watersheds.	Niagara River	Rochester Institute of Technology	Federal	$104,192	2011-2014	Outreach & Education	Completed
Identification of Lake Sturgeon Spawning Habitat in the Lower Niagara River	The U.S.. Fish and Wildlife Service Lower Great Lakes Fish and Wildlife Conservation Office has been radio tagging and acoustic tagging adult lake sturgeon since 2011 to identify habitat use. These data will be used in conjunction with substrate mapping data to identify spawning habitat and prioritize management actions.	Niagara River	US Fish & Wildlife	Federal	~ $46,000 per year	2010 - 2018	Data Collection & Research	Underway
Improving the Early Detection of Pronto-Caspian Fishes in the Great Lakes	SUNY- Buffalo State College assessed the invasive potential for high-risk Ponto-Caspian fish from European shipping ports. Great Lakes ports were also assessed to identify high-risk locations and time periods that are a strong habitat match for these high-risk invasive fish. This data will be used to focus surveillance and early detection efforts for invasive Ponto-Caspian fish likely to adapt to the waters of the Great Lakes.	Lake Erie	Buffalo State College	Federal	$99,756	2012-2016	Data Collection & Research	Completed
Installation of real time controlled in-line storage structure on Smith Street Drain	Installation of overflow control structure with static weir and actuated dewatering valves to allow combined sewer to be stored upstream of the structure and rerouted to the South Interceptor for conveyance to the plant.	Buffalo River	City of Buffalo Sewer Authority	State/Local	$4,000,000	2016-2017	Water Quality	Underway
Investigating Lake Sturgeon in Lower Niagara River	SUNY- Buffalo State College and US FWS will study the distribution, abundance and diversity of benthic forage resources in the lower Niagara River and their relation to lake sturgeon habitat use and feeding ecology. This information is essential for developing management and conservation action plans, and supporting the sustainable recreational use of the Niagara River.	Niagara River	Buffalo State College	Ecological Greenway Fund	$296,218	2014-	Data Collection & Research	Ongoing
Lake Erie Beach Planning Study	NYSDEC Division of Water- Planning Study to implement green infrastructure at Lake Erie Beach (public) in order to reduce the volume of contaminated runoff to near shore waters. The beach is approximately 450 feet long. The Beach has experienced beach closings due to unacceptable bacteria tests in the past few years. Proposed projects include removal of impervious surfaces, and installation of bioinfiltration/bioretention areas and rain gardens, designed to treat, slow, divert or capture runoff to reduce pollutant concentrations that drain into the beach and nearshore areas (discharge from Muddy Creek).	Big Sister Creek	Town of Evans	State	$75,000	2016-2017	Non-point Source Pollution	Underway
Lake Sturgeon Assessment in the Niagara River	This project will assess the status of lake sturgeon populations in the Lower Niagara River and Niagara Bar and upper Niagara River. Lake sturgeon are captured, aged, and tagged (using PIT tags and radio transmitters). Mark-recapture analysis will be used to estimate abundance, survival and developing habitat preference models. This is a collaborative project between the U.S.. Fish and Wildlife Service Lower Great Lakes Fish & Wildlife Conservation Office and the Northeast Fishery Center.	Niagara River	US Fish & Wildlife	Federal	~ $65,000 per year	2010-2018	Data Collection & Research	Underway

Linde	1870 linear feet of shoreline work proposed on northeast shoreline of Katherine Street.	Buffalo River	US Environmental Protection Agency	Federal	$2,600,000	Not Available	Habitat Restoration	Planning
Little River Harbor Dredging, Niagara Falls, NY	Periodic dredging is needed to maintain the recreational harbor of Little River in Niagara Falls, NY. The Harbor was last dredged in 1988.	Niagara River	US Army Corps of Engineers	Federal	Not currently funded	TBD	Navigational Dredging	On hold
Living Shorelines Program	As part of the Niagara River Riparian Restoration Phase 2 Program, Buffalo Niagara Riverkeeper is identifying areas of severe erosion along the Niagara River and its tributaries, to select and implement 4 riparian restoration projects at selected sites. The program aims to restore both hardened and degraded shoreline areas to their natural, resilient, and self-repairing form which will better support a sustainable, protective and higher-functioning ecosystem. Restoration practices include innovative bioengineering techniques utilizing natural materials, native plant species, and gradual slopes to protect from erosion and create function natural living infrastructure systems.	Niagara River	Buffalo Niagara Riverkeeper	Local (Niagara River Greenway)	$1,299,430	2013-2018	Habitat Restoration	Underway
Lower Great Lakes Barrier Assessment and Brook Trout Assessment	This project will develop a GIS based database of road crossings that includes information on fish passability and importance to brook trout populations. In addition, it will prioritize fish passage restoration projects in the Great Lakes watershed. This is a multiple year project. Work will include the Great Lakes watershed portion of western and central New York.	Lake Erie	US Fish & Wildlife	Federal	~ $25,000 per year	Annual	Data Collection & Research	Ongoing
Lower Great Lakes Lower Trophic Monitoring Program	The U.S.. Fish and Wildlife Service Lower Great Lakes Fish and Wildlife Conservation Office and partners will monitor and evaluate key lower trophic variables (phosphorus, chlorophyll a, secchi depth and zooplankton density and biomass) that characterize overall ecosystem change spatially, temporally and by habitat types. Collections will occur at 18 stations in Lake Erie and 12 stations in Lake Ontario from May through October. This project is conducted in partnership with State and Federal agencies and universities around Lake Erie and Lake Ontario.	Lake Erie	US Fish & Wildlife	Federal	~$50,000 per year	Annual	Data Collection & Research	Ongoing
Motor Island Wetland Restoration	This HIP consisted of excavation of a pier, implementation of breakwalls and protective berms surrounding the island, and native wetland restoration plantings on Motor Island (north of Strawberry Island). Other features included ice scouring preventions, enhancement of existing shallow pool areas, herbivory deterrents on new plants, and installation of submerged aquatic vegetation. Motor Island is important habitat for many spawning fish and resident and migratory birds, but has been susceptible to erosion ever since it was over-mined in the mid 21st century.	Niagara River	New York Power Authority	Local	$1,920,000	2012-2014	Habitat Restoration	Completed
MS4 Gap Analysis and Mapping Project	This project will perform a gap analysis to identify barriers to green infrastructure in building and zoning codes. It will also upgrade storm system maps to include municipal facilities and post-construction stormwater management practices.	MS4 Communities within Erie & Niagara Counties	NYS DEC, Erie County Department of Environment & Planning, Western New York Stormwater Coalition	State/Local	$517,405	2017-2019	Data Collection & Research	Underway
Murder Creek Bank Stabilization	Murder Creek Bank Stabilization funded by the NYSDEC Water Quality Improvement Program led by the Town of Newstead.	Murder Creek	Town of Newstead	State	$212,000	2010	Non-point Source Pollution	Completed

Muskellunge Telemetry Study	This acoustic telemetry project will track muskellunge in the Buffalo Harbor and Niagara River for 5-7 years. Although musky presence is well-documented in these regions, there is little information regarding the movement of muskellunge throughout these two systems between captures. This project will directly inform researchers about the migration and movement of adult muskies, and therefore elucidate where habitat restoration efforts would be the most beneficial for this prized apex predator. It is expected that enough data will be gathered in the first two years to create GIS maps identifying critical areas for habitat improvement projects, as musky are quite dependent on vegetation and shallow areas for successful spawning.	Buffalo River, Niagara River	Niagara Musky Association, NYSDEC, GLATOS, Gomez and Sullivan Engineers	Local/State	$113,000	2016-2021 or 2023 (dependent on transmitter battery life)	Data Collection & Research	Underway
New York Teachers Get WET for the Great Lakes	This grant supported two five-day academies and 14 "Get WET for the Great Lakes" institutes at which teachers were provided with content and methods for conducting watershed education experiences relating to the Buffalo River, Niagara River, Eighteenmile Creek, and Rochester Embayment Areas of Concern in New York State. The project targeted teachers from underserved schools and empowered teachers and students to protect fresh water resources through direct stewardship activities in their Areas of Concern. Following the training, teachers received support to help them integrate Great Lakes information into their curricula.	Buffalo River, Niagara River	Buffalo Niagara Riverkeeper	Federal	$168,982	2011	Outreach & Education	Completed
Niagara Falls, NY Wastewater Treatment Facility Improvements	Design and construction for upgrades to Niagara Falls, NY's Wastewater Treatment Facility. The plant has reached its 30 year useful life and requires upgrades and replacement to avoid system failure.	Niagara River	US Army Corps of Engineers, Niagara Falls Water Board	Federal/Local	$5 million	TBD	Infrastructure Support	Unfunded by Congress
Niagara Gorge & Rim Restoration and Enhancement	The project will treat invasive species and plant additional native plants at Devil's Hole Gorge State Park, a 125 acre parcel of high quality riparian habitat. Four separate landscapes will be targeted throughout the park, ranging from talus forest to native grassland tracts. Invasive species will be treated with spot herbicides where necessary to prevent non-target effects.	Niagara River	WNY Land Conservancy	Local	$996,000	2017-2019	Habitat Restoration	Underway
Niagara Gorge Rim Restoration Plan	Development of an ecological restoration plan for the Niagara Gorge Rim.	Niagara River	Wild Ones Niagara/Niagara River Greenway Commission	Local	TBD	TBD	Habitat Restoration	Planning
Niagara River AOC Ecosystem Restoration, Great Lakes Fishery and Ecosystem Restoration	The study consisted of a conceptual design for possible ecosystem restoration of fish and wildlife habitats, including islands and wetlands along the US shoreline of the Niagara River. Plans and concepts were shared with project partners and used as the basis for detailed design at project sites including East River Marsh, Buckhorn State Park, Burnt Ship Creek, Grass Island and Spicer Creek.	Niagara River	US Army Corps of Engineers, Buffalo Niagara Riverkeeper, NYS DEC, NYS Parks, Niagara River Greenway Commission	Federal/State/Local	–	TBD	Habitat Restoration	Unfunded by Congress
Niagara River Bird & Herptile Population Project	The purpose of this project is to evaluate delisting criteria related to birds and herptiles for the Degradation of Fish and Wildlife Populations Beneficial Use Impairment. Depending on the approach detailed in the work plan, the study will likely include reconnaissance and preliminary field work during 2013. This is the first phase of a multi-year BUI evaluation project.	Niagara River	US Fish & Wildlife	Federal	$407,400	2014-2018	Data Collection & Research	Underway
Niagara River Ecosystem Restoration	The study will include a reconnaissance analysis for possible ecosystem restoration (reconstruction of fish and wildlife habitats, including islands and wetlands) along the US shoreline of the Niagara River.	Niagara River	US Army Corps of Engineers, Buffalo Niagara Riverkeeper, NYS DEC, Niagara River Greenway Commission	Federal/State/Local	$100,000	TBD	Habitat Restoration	Unfunded by Congress

Niagara River Habitat Restoration Strategy	Niagara River Habitat Conservation Strategy identified the most critical biodiversity features of the Niagara River Watershed and its major sub-basins, evaluating features in terms of current ecological health and also vulnerability. The Strategy provides a science-based, collaborative blue-print to guide future efforts and to protect and restore habitat values, species communities and ecological functions that define a healthy Niagara River Watershed.	Niagara River Watershed (11 Sub-watersheds)	Buffalo Niagara Riverkeeper	Federal	$243,936	2010-2014	Habitat Restoration	Completed
Niagara River NY Strategic Navigation Dredging	Feasibility planning to remove contaminated sediments from the Niagara River. Existing sediment data was compiled and used to create GIS-database. This project led to initiation of the Black Rock Channel Strategic Navigation Dredging Project.	Niagara River	US Army Corp of Engineers	Federal	60,000	2010-2011	Navigational Dredging/Toxics Reduction	Terminated
Niagara River Toxics Management Plan	The four agencies committed to implement a set of actions designed to reduce loadings of chemicals to the Niagara River, focusing on 18 "priority toxics" that were present in the river at concentrations exceeding the most sensitive agency criteria. They also committed to ongoing monitoring of the river. A key milestone was to achieve a 50% reduction of ten of the priority toxics believed to be from significant Niagara River sources by 1996. Overall, the agencies met the 50% reduction goal for the ten priority toxics, reducing some by more than 75% through actions addressing point and non-point sources of contamination. This "umbrella" plan does not have specific funding associated with it.	Niagara River	US EPA, Environment Canada, NYSDEC & Ontario Ministry of the Environment	Federal	Not Available	1987-	Toxics Reduction	Ongoing
Niagara Street Gateway Project/Great Lakes Seaway Trail Green Street Project-Phase 1, Buffalo NY	Implementation of Green Infrastructure along Niagara Street within the City of Buffalo to reduce stormwater flows into the City's Combined Sewer System.	Niagara River	City of Buffalo Sewer Authority	Federal/Local	$500,000	2013-2016	Non-point Source Pollution	Completed
Niagara Street Phase 2, Buffalo NY	Implementation of Green Infrastructure along Niagara Street within the City of Buffalo to reduce stormwater flows into the City's Combined Sewer System.	Niagara River	City of Buffalo Sewer Authority	Federal/Local	$1.7 mil	2016-2017	Non-point Source Pollution	Underway
Niagara Street Phase 4	Implementation of Green Infrastructure along Niagara Street within the City of Buffalo to reduce stormwater flows into the City's Combined Sewer System.	Niagara River	City of Buffalo Sewer Authority	Federal/Local	Not Available	2018-?	Non-point Source Pollution	Planned
North Gorge Interceptor Project	Phase 1 Removal of sediment and debris from the North Gorge Interceptor to improve function and original capacity.	Niagara River	City of Niagara Falls	Federal	$11 million	2009-	Water Quality	Completed
Northern Chautauqua County Local Waterfront Revitalization Plan	The Northern Chautauqua County LWRP is a locally prepared, comprehensive land and water use plan for a community's natural, public and working waterfront.	Cattaraugus, Chautauqua, and Walnut Creeks	Chautauqua County and municipalities that border Lake Erie	State/Local	$230,000	Ongoing	Water Quality	Ongoing
NYDEC Ohio Street Boat Launch	332 linear feet of shoreline and riparian/upland restoration.	Buffalo River	Buffalo Niagara Riverkeeper	Federal	$306,000	2017-2018	Habitat Restoration	Underway
NYPA Planning Assistance (Flooding Impact Study)	Study to evaluate the impact of flooding on threshold water levels within the Niagara River.	Niagara River	US Army Corps of Engineers, New York Power Authority	Federal/Local	$60,000	2015	Infrastructure Support	Completed
Observing Systems and Monitoring Nearshore Lake Erie	This project increased the existing network of nearshore monitoring on Lake Erie with acquisition of three observational buoys to assess nutrients, energy and particulate fluxes between nearshore and open water zones at listed Great Lakes Areas of Concern, such as Ohio's Ashtabula River and New York's Buffalo River, and at Cattaraugus Creek. An automated underwater vehicle was used to monitor changes in water quality, hydrodynamic parameters and ice thickness. This project was designed to validate work by the University of Michigan on a hydrodynamic forecasting model to predict impacts of environmental and climate change on Lake Erie. Real-time data is available to Great Lakes stakeholders through a website.	Lake Erie	Buffalo State College Great Lakes Center	Federal	$962,583	2010-2012	Data Collection & Research	Completed

Old Bailey Woods	805 linear feet of shoreline and riparian/upland restoration.	Buffalo River	Buffalo Niagara Riverkeeper	Federal	$700,000	2017-2018	Habitat Restoration	Underway
Ontario Street Aquatic Habitat Restoration	The aquatic habitat at the mouth of Cornelius Creek is severely degraded and in need of restoration. FY10 funds were used to complete a Federal Interest Determination, which was negative due to lack of stakeholder support.	Niagara River	US Army Corp of Engineers	Federal	50,000	2009	Habitat Restoration	Terminated
Phase 2 Long Term Control Plan Receiving Water Quality Assessment	SUNY Buffalo State subcontracted with Malcolm Pirnie to conduct wet and dry weather sampling on Scajaquada Creek and the Niagara River in support of Phase 2 of the BSA Long Term Control Plan.	Niagara River	Buffalo State College	Local	$219,316	2008-2009	Data Collection & Research	Completed
Point Gratiot Beach Green Infrastructure Planning Study	NYS DEC Division of Water- Planning Study to implement green infrastructure at Point Gratiot beach (public) in order to reduce the volume of contaminated runoff to near shore waters. The Beach has experienced beach closings due to unacceptable bacteria tests in the past few years. Proposed projects include removal of impervious surfaces, and installation of bioinfiltration/bioretention areas and rain gardens, designed to reat, slow, divert or capture runoff to reduce pollutant concentrations that drain into the beach and nearshore areas.	Canadaway Creek	Dunkirk	NYSDEC	$75,000	2016-2017	Non-point Source Pollution	Underway
Reassessment of Niagara River Area of Concern Sources of Contamination	The project builds upon previous studies and monitoring efforts (completed in the late 1980`s to mid 1990`s) to reassess point and non-point sources of priority toxic chemicals that have contributed to five of the seven Beneficial Use Impairments (BUIs) at the Niagara River Area of Concern (AOC). While considerable progress has been made by state and local regulatory agencies, a comprehensive reassessment is needed to determine whether delisting criteria have been met and to identify remaining sources of contamination. The sampling program will focus on hazardous waste sites, wastewater discharges and primary tributaries. The expected outcomes include reduction of toxic substances entering the Niagara River and the eventual removal of five of the seven BUIs present at this AOC.	Niagara River	NYSDEC	Federal	$902,573	2011-	Data Collection & Research	Ongoing
RiverFest Park	460 linear feet of in-water habitat restoration.	Buffalo River	Buffalo Niagara Riverkeeper	Federal	$432,000	Not Available	Habitat Restoration	Underway
Robert Moses Removal	This is the removal of 2 miles of paved expressway adjacent to the Niagara River, between the Falls and Gorge. Traffic will be rerouted to the next road over, Whirlpool Drive. This will increase connectivity for green space and recreation, creating 300 acres of greenway.	Niagara River	New York State Office of Parks: Recreation and Historic Preservation, NYS Department of Transportation	State	$42 million	2018-2020	Infrastructure Support	Planned
Rush Creek Interceptor Project	Project to eliminate the Blasdell Wastewater Treatment Plant & sanitary overflows to area creeks	Smoke(s) Creek	Erie County Division of Sewerage Management	County	$16 million	2014-2017	Water Quality	Completed
Sanitary Surveys and Website for Beach Water Quality Information	In this project, 38 bathing beach sanitary surveys were conducted on the St. Lawrence River, Lake Ontario, and Lake Erie. Site assessments were performed to identify sources of pollution. Results will be used to direct remediation efforts to improve water quality, reduce bather exposure to pollution, and prevent potential illness. A publicly accessible web-based system with real-time water quality information for all Great Lakes beaches was developed.	Lake Erie	Health Research, Inc.	Federal	$850,000	2010	Data Collection & Research	Completed
Sanitary Surveys: Lake Erie, Lake Ontario, Niagara River NY State Parks	Sanitary surveys were conducted at seven beaches located on Lake Erie, western Lake Ontario, and the Niagara River. The sanitary surveys identified hydrological conditions, primary pollutants and their source locations. Information generated will be used to improve understanding of contamination problems and implement steps toward beach remediation.	Lake Erie, Niagara River, Smoke(s) Creek	NYS office of Parks, Recreation & Historic Preservation	Federal	$250,000	2010	Data Collection & Research	Completed

Scajaquada Creek and Hoyt Lake Restoration, Forest Lawn and Delaware Park, Buffalo NY	This assemblage of individual projects for technical assistance, all with the common goal of restoring the ecological function of Hoyt Lake and Scajaquada Creek within the City of Buffalo, has led to the implementation of a single project for removal of contaminated sediment and habitat restoration. Technical assistance included sediment characterization, engineering evaluations, planning and design for habitat restoration. Buffalo Sewer Authority is implementing the project in Forest Lawn and Delaware Park in close coordination with other partners.	Niagara River	US Army Corps of Engineers, Buffalo Olmsted Parks Conservancy, City of Buffalo (Buffalo Sewer Authority), Buffalo Niagara Riverkeeper, Forest Lawn	Federal/Local	$400,000	2011-	Toxics Reduction & Habitat Restoration	Ongoing
Scajaquada Creek and Hoyt Lake Technical Assistance for Ecosystem Restoration	This group of related technical assistance efforts resulted in sediment sampling and analysis, hydraulic modeling, planning and detailed design to support ecosystem restoration in the lower Scajaquada Creek and Hoyt Lake. A project is currently being implemented by Buffalo Sewer Authority.	Niagara River	US Army Corps of Engineers, Buffalo Niagara Riverkeeper, City of Buffalo (Buffalo Sewer Authority), Olmsted Parks Conservancy	Federal/Local	_	TBD	Toxics Reduction & Habitat Restoration	On Hold awaiting results of current studies
Scajaquada Creek Restoration Feasibility	Study looks at the feasibility of restoration needs for Scajaquada Creek corridor. Improvements would look at what's necessary to improve creek habitat, fish populations, and water quality.	Niagara River	US Army Corps of Engineers, Buffalo Niagara Riverkeeper	Federal/Local	$50,000	TBD	Toxics Reduction & Habitat Restoration	On Hold awaiting results of current studies
Seaway Landfill Site (CERCLA Remediation)	The Seaway Landfill site in Tonawanda, NY needs additional capping and remedial work to address soils contaminated with radium, thorium, and uranium. The Seaway landfill is currently undergoing remediation for removal of FUSRAP contaminated soils on the south side of the landfill perimeter. The contractor (TES) is completing work plans for this action and will mobilize to the site in May with completion of the remediation task in 2017.	Niagara River	US Army Corps of Engineers	Federal	$44.2 million	2012-2017	Toxics Reduction	Underway
Smoke Creek Flood Control Project Restoration	Dredging of sediment from the creek and excavation of accumulated soils from the banks to restore the flood-carrying capacity of the Smoke Creek Flood Control Project. Woody vegetation was also cleared from the banks.	Smoke(s) Creek	NYSDEC, Dormitory Authority of the State of New York	State	Not Available	2015	Flood Control	Completed
Smokes Creek Restoration	Feasibility study to restore ecosystem function at the mouth of Smoke's Creek, where sedimentation has degraded a critical fish spawning habitat. Study will look at dredging and creation of additional wetland and riparian habitat to restore creek corridor.	Smoke(s) Creek	US Army Corp of Engineers, City of Lackawanna	Federal	TBD	2012-	Habitat Restoration	On-hold
South Branch Cattaraugus Creek Round 18 Nutrient Management Implementation Project	Participating farms in the South Branch of Cattaraugus Creek watershed received funding to implement BMP's to reduce agricultural runoff and nutrient management.	Cattaraugus Creek	Cattaraugus County SWCD	State/County	$722,700	2012 - 2015	Non-point Source Pollution	Completed
South Branch of Cattaraugus Creek County Road 12 Bridge 9	The Cattaraugus County DPW and Cattaraugus County Soil & Water Conservation District determine emergency streambank projects around the county every year and budget funds to correct these issues to improve water quality, flood control, non-point source pollution and infrastructure protection. This project armored the stream bank with rock riprap to protect the road shoulder and repair existing rock. This will prevent further erosion and sediment loading.	Cattaraugus Creek	Cattaraugus County DPW & Cattaraugus County SWCD	County	$17,957	2015	Erosion Control	Completed

South Branch to Cattaraugus Creek County Road 12 Emergency Stream Bank Project #2	The Cattaraugus County DPW and Cattaraugus County Soil & Water Conservation District determine emergency streambank projects around the county every year and budget funds to correct these issues to improve water quality, flood control, non-point source pollution and infrastructure protection. This project armored both wing walls under the bridge and upstream from the bridge on the right descending bank with riprap. Two flow training structures were added to help improve alignment under the bridge.	Cattaraugus Creek	Cattaraugus County DPW & Cattaraugus County SWCD	County	$29,750	2016	Erosion Control	Completed
South Park Lake, NY	USACE initiated a feasibility study to evaluate alternatives for aquatic ecosystem restoration in South Park Lake in Buffalo. The project was terminated as a Federal project due to a lag in the required non-Federal cost-share. Erie County and the City of Buffalo have developed a strategy to pursue this project, building on the information provided by USACE.	Buffalo River	US Army Corps of Engineers	Federal	Not currently funded	2010-	Habitat Restoration	Terminated
Spicer Creek Wildlife Management Area Habitat Restoration	Records indicate that the nearshore area adjacent to the Wildlife Management Area supported emergent riverine wetlands. Riverine wetlands are now absent from this area, likely due to modified water levels for power generation, wave action from heavy boat traffic, seasonal beaching of boats for recreational purposes, and ice-driven disturbances. The goal of this project is to restore the wetlands through the installation of a segmented breakwall system to protect the area from disturbances.	Niagara River	NYSDEC	State		2017 -	Habitat Restoration	Ongoing
Spring Brook Stream Restoration and Habitat Improvement, Erie County, Springville, NY	The project improved brook trout habitat conditions by reducing sediment and nutrient inputs, reduced in-stream water temperatures, and reduced bank erosion. Approximately 2700 linear feet of stream channel were enhanced with grade control structures, rip rap and lunkers in the stream, and tree and shrub plantings in the riparian zone. A fish survey conducted in the summer 2015 found brook trout using the restored sections.	Headwaters Cattaraugus Creek	US Fish & Wildlife	Federal	$100,000	2013-2015	Habitat Restoration	Completed
Stella Niagara Habitat Enhancement	This 29 acre preserve was purchased by WNYLC, and the purpose of the project is to enhance the site for wetland and meadow restoration. The project includes invasive species removal, native plantings, including several rare plants, oak savannah plantings and grassland/meadow creation and maintenance. The project is intended to improve and create habitat which will sustain and support multiple species of greatest conservation need, including multiple species of birds, amphibians, native pollinators, among others. Creation of public recreational hiking paths is another component of the project.	Niagara River	WNY Land Conservancy	Local	$510,000	2016-2017	Habitat Restoration	Underway
Stormwater Mapping Project (Erie & Niagara Counties) - Phase 1 and Phase 2	Mapping the stormwater conveyance systems of Municipal Separate Storm Sewer Systems using GIS.	MS4 Communities within Erie & Niagara Counties	NYS DEC, Erie County Department of Environment & Planning, Western New York Stormwater Coalition	State/Local	$1,412,319, $556,307	2011-2017	Data Collection & Research	Underway
Strawberry Island Habitat Restoration	Habitat improvements designed to create approximately seven acres of new diverse wetland habitat for fish, wildlife and water birds on the state-owned island. The improvement project includes measures to protect downstream shallow water habitats that may be affected by erosion caused by severe storms.	Niagara River	New York Power Authority	State/Local	$2.3 million	2014-2016	Habitat Restoration	Underway

The Lake Erie Nearshore and Offshore Nutrient Study	This project assessed the causes of nutrient-related problems in the Lake Erie central and eastern basins. It quantified the major biotic and abiotic nutrient pools, rates of nutrient movement, and trophic pathways in the nearshore and offshore regions of Lake Erie. Additionally, data was coupled with hydrodynamic models of particle transport and phosphate source tracking to assess whether the pools of nutrients in the nearshore and offshore regions follow predicted patterns of lake mixing models. The models are used to determine where nutrients came from and how they move from the nearshore to offshore Lake Erie, providing information to managers on how and where to address excess nutrient input.	Lake Erie	Buffalo State College Great Lakes Center	Federal	$615,813	2011-2014	Data Collection & Research	Completed
Tifft Nature Preserve Site Improvements	This is a green infrastructure and storm runoff reduction project at Tifft Nature Preserve. The heavily compacted gravel parking lot, which floods and runs off into Lake Kirsty, will be replaced with pervious pavement. Numerous swales, bioretention areas, rain gardens and other native plantings will be installed to prevent invasive species establishment, and improve the riparian buffer. This project will emphasize education, have signage and learning areas to inform visitors about runoff and water quality issues. Additionally, this project will greatly improve visitor access, as the uneven gravel does not adequately accommodate school buses, families with young children and visitors with special needs.	Buffalo River	Tifft Nature Preserve (Buffalo Museum of Science)	Local	$533,738	2015-2017	Water Quality, Flood Control, Erosion Control, Habitat Restoration, Outreach & Education	Underway
Times Beach CDF Phragmites Demo (Buffalo, NY - Outer Harbor)	Times Beach is a former confined disposal facility (CDF) located on the shore of Buffalo Harbor. This project has entailed planning, design, and implementation of projects to demonstrate means of removing, adaptively monitoring and controlling aquatic invasive plants. A particular area of focus is expected to be control of Phragmites australis. This project also contains a restoration planting plan to bolster the existing native species.	Buffalo River	US Army Corp of Engineers	Federal	$1,376,000	2012-2018	Data Collection & Research	Underway
Toe of Katherine Street	805 linear feet of shoreline and riparian/upland restoration.	Buffalo River	Buffalo Niagara Riverkeeper	Federal	$500,000	2017-2018	Habitat Restoration	Underway
Tonawanda Creek Watershed Agricultural BMP Implementation Project	In the Niagara County section of the Tonawanda Creek Sub-watershed participating farms received funding to cover their Barnyards to reduce erosion of animal wastes.	Tonawanda (Lower and Middle) Creeks	Niagara County SWCD	State/County	$450,000	2011-2015	Non-point Source Pollution	Completed
Tonawanda Creek Watershed Agricultural BMP Implementation Project	After completing Agricultural Environmental Management Assessments, Participating Farms are implementing BMPs throughout the watershed. Covering Barnyards to reduce erosion of animal wastes.	Tonawanda (Lower, Middle, and Upper) Creek	Niagara County SWCD Genesee County SWCD Wyoming County SWCD	State/County	$1,647,000	2001-	Non-point Source Pollution	Ongoing
Town of Clarence Storm Modeling	The Town of Clarence requested planning assistance from the USACE to conduct hydrologic models for 5, 10, 25, and 50 year storm events based on the Town's current MS4 infrastructure. Models will be used to help assess solutions to flooding and drainage concerns.	Tonawanda (Lower and Middle) Creeks	US Army Corps of Engineers, Town of Clarence	Federal/Local	$100,000	TBD	Flood Control	On Hold
Town of Freedom Ditch Stabilization Project, Freedom, NY	The project corrected two roadside ditches in the Town of Freedom with significant erosion concerns that outlet into Clear Creek. The first section rock lined 225 liner feet with medium rock riprap, and a plunge pool was created where the water enters to prevent further scouring. The other section rock lined 500 linear feet with medium rock riprap. Both projects will reduce the amount of sediment that was once making its way to Clear Creek. The area was restored and hydoseeded upon completion of the project.	Headwaters Cattaraugus Creek	Cattaraugus County SWCD	State/Local	$21,800	2017	Erosion Control	Completed

Town of Otto Ditch Stabilization Project on Forty Road, Otto, NY	This project addressed a roadside ditch erosion problem, back in the flood of 2009 the bridge was swept away, since then this section of dirt road hasn't been maintained. The town has been diligently working on getting this road back and hopefully working towards funding for a new bridge. This project consisted of replacing multiple cross culverts, rock-lining 500 linear feet of newly dug ditch to prevent erosion. Ditches and road shoulders were hydoseeded to stabilize the area.	Cattaraugus Creek	Cattaraugus County SWCD	State/Local	$30,600	2017	Erosion Control	Completed
Tributary 5 to Mansfield Creek County Road 14 Emergency Stream Bank Project #3	The Cattaraugus County DPW and Cattaraugus County Soil & Water Conservation District determine emergency streambank projects around the county every year and budget funds to correct these issues to improve water quality, flood control, non-point source pollution and infrastructure protection. This project removed existing waste concrete blocks, reshaped the banks and installed stacked rock riprap with the bottom course pinned in place to protect the road shoulder and prevent further erosion.	Cattaraugus Creek	Cattaraugus County DPW & Cattaraugus County SWCD	County	$38,400	2016	Erosion Control	Completed
Tributary to Buttermilk Creek County Road 32 Stream Stabilization	The Cattaraugus County DPW and Cattaraugus County Soil & Water Conservation District determine emergency streambank projects around the county every year and budget funds to correct these issues to improve water quality, flood control, non-point source pollution and infrastructure protection. This project armored the stream bank with rock riprap to protect the road shoulder and repair existing rock. This will prevent further erosion and sediment loading.	Cattaraugus Creek	Cattaraugus County DPW & Cattaraugus County SWCD	County	$28,706	2013	Erosion Control	Completed
Tributary to Buttermilk Creek County Road 55 Stream Stabilization	The Cattaraugus County DPW and Cattaraugus County Soil & Water Conservation District determine emergency streambank projects around the county every year and budget funds to correct these issues to improve water quality, flood control, non-point source pollution and infrastructure protection. This project armored the stream bank with rock riprap to protect the road shoulder and repair existing rock. This will prevent further erosion and sediment loading.	Headwater Cattaraugus Creek	Cattaraugus County DPW & Cattaraugus County SWCD	County	$16,578	2014	Erosion Control	Completed
Tributary to Connoisarauley Creek County Road 12 Stream Stabilization	The Cattaraugus County DPW and Cattaraugus County Soil & Water Conservation District determine emergency streambank projects around the county every year and budget funds to correct these issues to improve water quality, flood control, non-point source pollution and infrastructure protection. This project armored the stream bank with rock riprap to protect the road shoulder and repair existing rock. This will prevent further erosion and sediment loading.	Cattaraugus Creek	Cattaraugus County DPW & Cattaraugus County SWCD	County	$9,883	2013	Erosion Control	Completed
Tributary to South Branch of Cattaraugus Creek County Road 12 Stream Stabilization	The Cattaraugus County DPW and Cattaraugus County Soil & Water Conservation District determine emergency streambank projects around the county every year and budget funds to correct these issues to improve water quality, flood control, non-point source pollution and infrastructure protection. This project armored the stream bank with rock riprap to protect the road shoulder and repair existing rock. This will prevent further erosion and sediment loading.	Cattaraugus Creek	Cattaraugus County DPW & Cattaraugus County SWCD	County	$11,961	2015	Erosion Control	Completed

Tributary to South Branch of Cattaraugus Creek County Road 14 Stream Stabilization	The Cattaraugus County DPW and Cattaraugus County Soil & Water Conservation District determine emergency streambank projects around the county every year and budget funds to correct these issues to improve water quality, flood control, non-point source pollution and infrastructure protection. This project armored the stream bank with rock riprap to protect the road shoulder and repair existing rock. This will prevent further erosion and sediment loading.	Cattaraugus Creek	Cattaraugus County DPW & Cattaraugus County SWCD	County	$5,360	2015	Erosion Control	Completed
Tributary to South Branch of Cattaraugus Creek County Road 75 Emergency Stream Bank Project #4	The Cattaraugus County DPW and Cattaraugus County Soil & Water Conservation District determine emergency streambank projects around the county every year and budget funds to correct these issues to improve water quality, flood control and non-point source pollution. This project armored the stream bank with rock riprap to protect the road shoulder and repair existing rock. This will prevent further erosion and sediment loading.	Cattaraugus Creek	Cattaraugus County DPW & Cattaraugus County SWCD	County	$20,950	2016	Erosion Control	Completed
Tributary to South Branch of Cattaraugus Creek Crumb Hill Road Bridge 20	The Cattaraugus County DPW and Cattaraugus County Soil & Water Conservation District determine emergency streambank projects around the county every year and budget funds to correct these issues to improve water quality, flood control, non-point source pollution and infrastructure protection. This project armored the stream bank with rock riprap to protect the road shoulder and repair existing rock. This will prevent further erosion and sediment loading.	Cattaraugus Creek	Cattaraugus County DPW & Cattaraugus County SWCD	County	$8,680	2015	Erosion Control	Completed
Tributary to South Branch of Cattaraugus Creek Crumb Hill Road Stream Stabilization	The Cattaraugus County DPW and Cattaraugus County Soil & Water Conservation District determine emergency streambank projects around the county every year and budget funds to correct these issues to improve water quality, flood control, non-point source pollution and infrastructure protection. This project armored the stream bank with rock riprap to protect the road shoulder and repair existing rock. This will prevent further erosion and sediment loading.	Cattaraugus Creek	Cattaraugus County DPW & Cattaraugus County SWCD	County	$12,336	2014	Erosion Control	Completed
Tributary to South Branch of Cattaraugus Creek Meyer Road Bridge 15	The Cattaraugus County DPW and Cattaraugus County Soil & Water Conservation District determine emergency streambank projects around the county every year and budget funds to correct these issues to improve water quality, flood control, non-point source pollution and infrastructure protection. This project armored the stream bank with rock riprap to protect the road shoulder and repair existing rock. This will prevent further erosion and sediment loading.	Cattaraugus Creek	Cattaraugus County DPW & Cattaraugus County SWCD	County	$8,168	2015	Erosion Control	Completed
Union Ship Canal	A brownfield remediation project at this location included restoration of ecological areas and features, such as reef groupings, benthic substrates, submerged and emergent wetland plantings, and an inland embayment area.	Buffalo River	NYSDEC, Erie County, City of Buffalo	State	Not Available	2011	Habitat Restoration	Completed
Upgrades to Lackawanna Wastewater Treatment Plant and associated systems	Project to upgrade the Lackawanna Wastewater Treatment Plant, excess flow management facility, and the upstream sewer system.	Smoke(s) Creek	Erie County Division of Sewerage Management	County	TBD	2017-?	Water Quality	Underway
Upgrades to Southtowns Advanced Wastewater Treatment Facility	Project to upgrade the Southtowns Advanced Wastewater Treatment Facility to increase capacity and address updated SPDES permit requirements.	Smoke(s) Creek	Erie County Division of Sewerage Management	County	$75 million	2017-2027	Water Quality	Underway
Upper Cattaraugus Creek Round 22 Water Resource Protection Project	Participating farms in the Upper Cattaraugus Creek watershed received funding to implement BMP's to reduce agricultural runoff and nutrient management.	Headwaters Cattaraugus Creek	Cattaraugus County SWCD	State/County	$3,090,511	2016 - 2020	Non-point Source Pollution	Underway

USACE Improvements to Unity Island	This project will utilize dredged sediment from the Buffalo River to partially fill in North Pond at Unity Island. The purpose of this infill is to create a hemi-marsh, or a marsh that is partially submerged and integrated with open water habitats. Large logs will be interspersed throughout the marsh to allow connecting pathways for amphibians and reptiles to move around and bask on. A fish weir will allow for fish movement between the river and hemi-marsh. The hemi-marsh design discourages establishment of invasive knotweed and Phragmites, which prefer wet meadow habitats. Preliminary testing on dredged sediment have shown that it is adequate substrate for the growth of native plants such as water celery. The project will also provide porcupine cribs, which are a type of shelter for small forage fishes.	Niagara River	US Army Corps of Engineers	Federal	~$2,900,000	2016-2020	Habitat Restoration	Underway
Vernal Pool Enhancement at Tifft Nature Preserve	The purpose of this project is to create and enhance existing vernal pools in the wetlands of Tifft Nature Preserve. Currently the vernal pools at this site dry up too quickly in the season to properly host amphibians such as salamanders, which require standing water for larval and juvenile growth. This project also has an upland forest restoration component, necessary for the adult phase of amphibian life cycles. To achieve these goals, invasive nuisance trees will be removed from the upland habitat and replaced with natives (wrapped for protection from deer). Natural debris will be removed from vernal pools, then a non-permeable liner will be placed at the bottom to enhance retention. The natural debris will be places back in the pools, and volunteers and workers will monitor for amphibian presence seasonally.	Buffalo River	Tifft Nature Preserve (Buffalo Museum of Science)	Local	$92,825	2017-2018	Habitat Restoration	Underway
Village of Silver Creek Flood Mitigation Feasibility Study	Feasibility Study for flood mitigation and dredging the mouth of Walnut Creek.	Walnut Creek	US Army Corps of Engineers, Chautauqua County & Village of Silver Creek	Federal/Local	$200,000	2018	Flood Control	Included in 2016 WRDA Bill
Weber Property Acquisition & Restoration	This three phase project will restore and reconnect Cayuga Creek to its floodplain and wetland forest. A 36.9 acre parcel will be acquired from Joseph C. Weber Inc. Following acquisition, the property will be assessed and a master restoration plan will be developed. The third stage will be construction of restoration efforts, including reconnecting the creek to its floodplain, invasive species management, flood mitigation and recreation trail work. The third stage requires public approval for funding.	Niagara River	Buffalo Niagara Riverkeeper, WNY Land Conservancy, Town of Niagara	Local	$452,000 (Estimate)	2016-2019	Habitat Restoration	Planning
Wetland Plantings and Management at Tifft Nature Preserve	This was a follow up project completed after extensive invasive species removal at Tifft Nature Preserve. This preserve hosts many state-listed species of birds and provides critical wetland habitat in the watershed. The project consisted of native wetland plantings and the purchase of a weather station to better track long term weather trends at the preserve. Without establishing native plants in the absence of Phragmites, a wetland is susceptible to recurrent invasions. A combination of bare roots, plugs and seeds were used to start natives, and protective grids surrounded each planting area to prevent herbivory or other means of damage.	Buffalo River	Tifft Nature Preserve (Buffalo Museum of Science)	Local	$113,000	2015-2016	Habitat Restoration, Data Collection & Research	Completed
Willert Park Green Infrastructure	Implementation of Green Infrastructure in the SPP 281 sewer shed.	Buffalo River	City of Buffalo Sewer Authority	State & Local	$4.8 mil	2017-2018	Non-point Source Pollution	Underway

Woodlawn Beach Pollution Source Identification & Remediation	This project continued Woodlawn Beach sanitary survey work by conducting pollution source identification on Rush Creek, Blasdell Creek and Foster Brook. Remediation efforts were conducted by studying various beach grooming techniques and other efforts to reduce pollution. Work conducted will help improve beach water quality, recreational opportunities, public health protection of swimmers, and public education.	Smoke(s) Creek	NYS Office of Parks, Recreation & Historic Preservation	Federal/State	$200,833	2010-2012	Data Collection & Research	Completed
Xenobiotics in Fish from New York's Great Lakes International Waters	Xenobiotics in fish data was collected from Lake Erie, Niagara River, and Cayuga Creek(Niagara County) from 2010-2012 including mercury, polychlorinated biphenyls (PCBs) and a selected group of organochlorine pesticides (OCPs), including dichlorodiphenyltrichloro-ethane (DDT) and its metabolites, chlordane and its metabolites, dieldrin, aldrin, mirex, photomirex, heptachlor, heptachlor epoxide, hexachlorocyclohexane (HCH) isomers, hexachlorobenzene (HCB), octachlorostyrene and other contaminants.	Cayuga Creek, Lake Erie, Niagara River	NYSDEC	Federal	$500,000	2010-2014	Data Collection & Research	Completed

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Chapter 8: Key Findings and Recommendations

Upon collection and review of the Niagara River/Lake Erie Watershed's health in the previous chapters, key findings were noted as important elements impacting the Watershed and current water quality conditions. These findings are presented in the following summary along with recommendations that aim to address each finding. In addition, the information in the previous chapters was used to rank the eighteen sub-watersheds by priority in preserving and protecting their health, as well as priority for focusing on improvements in water quality. These prioritized rankings follow the key findings and recommendations in this chapter and can be used to focus limited resources or plan for next steps. In chapter 9, the recommendations below are categorized and distilled down to more immediate next steps.

Key Finding #1: A high number of the watershed's stream segments are classified as "Impaired."

Approximately 30% of the Niagara River/ Lake Erie Watershed's stream segments are classified as "Impaired" or "Minor Impacts" by the NYSDEC. This indicates that many of our water courses are not supporting the uses they have been identified for, whether that be for public bathing, aquatic life or recreation. Furthermore, the majority of these impaired segments occur across the northern or more urban sub-watersheds, specifically Niagara River, Ellicott Creek, Lower, Middle, and Upper Tonawanda Creek Sub-watersheds, Smoke(s) Creek, and Canadaway Creek. In many cases, the other waterways in these sub-watersheds are either "Unassessed" or "Need Verification" illustrating that more testing is needed throughout the Watershed.

Recommendations:

a. Conduct additional data collection to outline the primary contributors to water quality impairments within each sub-watershed, including using Stream Visual Assessments Protocol, water quality sampling, and nutrient and bacterial loading.
b. Coordinate with County Soil and Water Conservation Districts to create a watershed-wide database of high-erosion areas and highly erodible soils.
c. Research and pinpoint primary contributors to aquatic life impairments in each sub-watershed.
d. In the most impaired sub-watersheds:
    i. Focus additional planning and outreach efforts to limit further degradation of water resources.
    ii. Limit further loss of natural living infrastructure and focus on restoration efforts.
    iii. Maximize the implementation of green infrastructure to capture and filter stormwater run-off.

   iv. Severely restrict the addition of new impervious cover.
   v. Create zoning overlays that protect waterways and waterfront lands from adverse land uses and development.

e. Develop model zoning regulations that provide performance standards to limit impervious cover, implement green stormwater infrastructure, and protect and restore functional forested riparian buffers.
f. Educate municipal staff and boards on how to review development from a water quality perspective.
g. Coordinate with the County Health Departments to identify areas of the watershed with high concentrations of septic systems that may be failing and contributing illegal discharges to area waterways.
   i. Expand the current Chautauqua County program for assessing septic systems within 250 feet of particular water bodies to all priority waterbodies in the Watershed dealing with bacteria contamination.
h. Collaborate with the WNY Stormwater Coalition, landscape architects, and stormwater engineers to develop design guidelines for Municipal Separate Storm Sewer System (MS4) infrastructure that provide more natural stormwater conveyance systems that mimic nature and filter stormwater prior to its discharge to area waterways.
i. Encourage waterfront communities to update and maintain Local Waterfront Revitalization Plans with a focus on protecting and restoring natural infrastructure.
j. Provide educational materials on landowner best management practices that improve water quality and encourage behavior change by:
   i. including mailings with utility and tax bills;
   ii. writing articles for newsletters and local newspapers;
   iii. providing informational real estate handouts for new landowners;
   iv. creating targeted workshops;
   v. conducting outreach at festivals and events;
   vi. social media and peer-to-peer campaigns;
   vii. including more education and interpretive signage at public sites;
   viii. developing innovative apps for education and action.

Key Finding #2: The lack of a sufficient regional living infrastructure network contributes to water quality impairments.

Living infrastructure refers to the interconnected natural systems in a landscape such as intact forests, woodlands, wetlands, parks, rivers, aquifers and agricultural soils that provide or protect clean water, air quality, wildlife habitat, and food. These systems contribute to a vibrant and healthy ecosystem by providing protection during flood events; mitigating stormwater run-off and sewer overflow events; filtering pollutants from the air, water, and soil; moderating temperatures and reducing energy use; providing wildlife habitat; storing carbon; providing food, wood, and other natural resources; increasing property values; providing recreational opportunities and improving quality of life.

The most direct living infrastructure components influencing how water is handled on (and by) the lands through which it passes include riparian buffers, floodplains, wetlands, natural springs, headwater forests, and groundwater recharge areas. Aside from the need for these components to exist and connect to their adjacent waterways and waterbodies, these systems should be interconnected in a larger regional network. When this regional interconnection of living infrastructure occurs, the network (and watershed itself) can better handle natural system ebbs and flows, reducing impacts to waterways and water quality, especially as extreme storm events increase in the region.

The lack of sufficient riparian buffers is a common living infrastructure issue found across many areas of the watershed and directly related to many water quality issues, including erosion and sedimentation, nutrient loading, and thermal pollution. Riparian buffers are the lands directly adjacent to waterways and serve as a transition between aquatic and upland habitats - a link between land and water. Riparian buffers can be designed in such a way to protect the waterway from negative impacts of adjacent land uses.[1] A well-functioning riparian buffer:

- improves water quality by acting as a filter for surface and ground waters;
- stabilizes banks to reduce erosion and sedimentation downstream;
- provides storage during seasonal high-volume and flood events;
- slows the velocity of flood waters;
- improves flooding issues and groundwater recharge by allowing for more surface water infiltration;
- maintains lower water temperatures that support aquatic habitats; and,
- supports wildlife habitat and wildlife movement corridors.

Forested riparian buffers in excess of 300 feet (width) are the gold standard in riparian protections, however smaller width buffers with even minimal vegetation do offer more benefits than mowed or hardened shoreline edges. Many areas of the watershed have inadequate riparian buffers, especially urban sub-watersheds, where development and grey infrastructure has encroached into riparian lands, in some cases leaving less than 25 feet between adjacent land uses and the water. In suburban areas of the watershed, waterfront landowners commonly remove vegetation for lawns and commercial developments build within 25 feet of streams. The restoration, protection, and improved

[1] Maryland Cooperative Extension Fact Sheet #733: “Riparian Buffer Management, Riparian Buffer Systems”, University of Maryland College Park-Eastern Shore.

design of our living infrastructure network are essential for long-term sustainability of our water resources.

Recommendations:

a. Outline and establish regional living infrastructure network through a mixture of conservation, easements, and land use policies/regulations.
b. Build off of the work of the Niagara River Habitat Conservation Strategy to further implement living infrastructure conservation and restoration opportunities in the watershed and expand the Strategy further south to include the rest of the Niagara River/ Lake Erie Watershed.
c. Focus conservation areas on critical habitat for plants and wildlife, along aquatic corridors, around hydrological reserves, and in areas that could be considered polluting areas if developed (such as steep slopes).
d. Identify areas where living infrastructure gaps exist and outline methods by which they may be restored. This can be done through a natural resource inventory.
e. Design and structure living infrastructure additions to address specific waterway impairments found within each sub-watershed. (i.e. pollution levels, nutrient loading, flooding, water classifications).
f. Vet the use of vacant lands adjacent to waterways for future protections/restoration of regional living infrastructure.
g. Prioritize the clean-up and reuse of contaminated lands adjacent to waterways for usage as living infrastructure.
h. Develop model regulations that establish or strengthen protections on living infrastructure lands, especially non-DEC wetlands, floodplains and riparian buffers.
i. Collaborate with County Soil and Water Conservation Districts, U.S. Department of Agriculture, and rural counties to promote/establish programs that place permanent restrictions/riparian protections on vacant agricultural lands upon transfer.
j. Investigate models for funding the permanent protection of, management of, and restoration of a regional living infrastructure network.
k. Conduct public outreach geared towards developers, municipal officials, waterfront landowners, and stormwater engineers to raise awareness of living infrastructure.
l. Research and outline the cost-benefit of regional living infrastructure as a public service utility.
m. Produce guidance materials on the appropriate design of riparian buffers and constructed wetlands to ensure restoration projects are functional to watershed health.
n. Consider living infrastructure in all local and state development review processes, including county planning departments, State Environmental Quality Review Act (SEQRA), NYSDEC, US Army Corps of Engineers, NYS Department of State.

o. Incorporate living infrastructure design and best management practices into site plan review procedures for waterfront properties.
p. Create financial incentive programs that provide landowners benefits for the re-establishment, protection, and permanent conservation of living infrastructure lands.
q. Collaborate with the Buffalo Niagara River Land Trust, Western New York Land Conservancy, Chautauqua Watershed Conservancy, and Grassroots Gardens on permanent conservation and land management projects involving living infrastructure.
r. Establish and showcase living infrastructure restoration projects in public parks as a means to educate the public, landowners, and municipal officials on their benefits and functional design.

Key Finding #3: The loss of wetlands within the watershed is substantial.

Wetlands are important components of the living infrastructure supporting clean and healthy water, flood resiliency, and thriving ecosystems. A lack of wetlands impairs how our watershed functions, and in certain sub-watersheds the loss of historic wetlands is greatly impacting water quality. For example, Scajaquada Creek once had a tremendous amount of wetlands in upstream riparian areas that have since been filled and channelized into drainage ditches. The Buffalo River within the City of Buffalo was also once predominantly marshland before it was dredged, filled and drained to support development.

Today DEC classified wetlands are protected from encroachment and filling, but Federal identified (non-DEC classified) wetlands are not. For non-protected wetlands, municipalities and developers commonly “mitigate” them to accommodate development with in-fill and permits allowing the re-creation of wetlands elsewhere. However the new wetland created doesn’t always translate to the same functionality and benefits for our waters, especially if it no longer has connectivity to the surface or ground waters it once served.

Recommendations:

a. Conduct on-the-ground assessments of wetland complexes to identify their quality and functionality.
b. Identify high quality aquatic habitats and riparian wetlands for conservation.*
c. Identify and protect wetland sites with high ecological value and use as reference sites for habitat restoration.*
d. Conduct shoreline assessments to identify ideal locations for the restoration of shoreline marshes, especially in highly urbanized sub-watersheds.
e. Identify vacant and underutilized land for wetland restoration in highly urbanized sub-watersheds.

f. Expand the Wetland Lidar Analysis conducted within the Niagara River Greenway Communities to the entire Niagara River/ Lake Erie Watershed to better identify smaller wetland habitats not yet documented by NYSDEC or the U.S. Fish and Wildlife Service National Wetlands Inventory.
g. Encourage alternative solutions to typical “wetland mitigation” measures (i.e. removal and re-creation elsewhere) for development projects.
h. Establish regional policies with county and municipal planning departments to evaluate wetlands prior to permit submittal for wetland mitigation to the NYSDEC.
i. Create wetlands and other natural filter systems to protect waterways and beaches from un-treated stormwater discharges, sedimentation, thermal pollution, and nutrient loading.
j. Outline design policies/guidelines that protect wetland functions in their use as stormwater infrastructure.
k. Guide the creation of stormwater retention ponds to be designed with functional wetland/marsh habitats.
l. Provide data on existing high-quality wetlands to county and municipal planning departments to better inform development decisions.
m. Further develop the educational programming and signage at publically accessible wetland areas, such as the Tifft Nature Preserve and wetlands along Route 219, on environmental stewardship and wetland function.
n. Create unique wetland restoration habitats with educational and public access components on public park land to foster citizen stewardship of wetlands in addition to providing water quality benefits.
o. Protect wetlands from mitigation and development with environmental conservation overlays in municipal zoning ordinances.

**Indicates Action Strategies outlined by the Niagara River Habitat Conservation Strategy.*

Key Finding #4: A loss of floodplains and floodplain connectivity from floodplain development and encroachment exists in the watershed.

Floodplains are meant to store and slow the speed of floodwaters, reducing shoreline erosion and turbidity. These processes protect water quality and storm damage to stream channels, lake shores, private property, and public infrastructure. The National Flood Insurance Program’s base flood regulations, dictating development within flood prone areas, allow for development within the 100 year floodplain. Over time, this ability has left many communities with floodplain development, reducing the functionality of this living infrastructure. A majority of the Niagara River/ Lake Erie Watershed’s municipalities have the bare minimum FEMA flood regulations.

When development encroaches into floodplains, homes and roads are built-up to bring them above base flood elevations. They also increase impervious cover in the floodplain. While one or two developments of this nature will not raise base flood elevations, several hundred of these developments collectively over time will reduce floodplain storage capacity and also restrict a waterway's connection to its floodplain, creating backups and new flooded areas elsewhere along the river corridor. This scenario is what has occurred within Erie County and is visible in the change from FEMA Flood Rate Insurance Maps created in the 70's versus those created more recently.

Recommendations:

a. Identify areas to create new floodplain in or near areas where floodplain has previously been lost and contributes to existing neighborhood flooding issues. Consider vacant land that would fulfill this purpose.
b. Co-locate public parks and greenways within protected floodplains to reduce development pressures and educate the public on the purpose of this living infrastructure.
c. Include public access to waterways for fishing, boating, etc. at these locations to encourage stewardship of the water and floodplain.
d. Develop model flood regulations that restrict the development of new structures within flood prone areas. Models can be developed to outline various protection thresholds.
e. Collaborate with county and municipal emergency planning officials in the buyout and removal of private structures that frequently flood and incur damages.
f. Reclaim previously built-up floodplains in high-vacancy neighborhoods to reduce excess housing stock, restore living infrastructure, and create public greenspace.
g. Guide municipalities through the steps to upgrade how they educate residents, plan for, regulate, and respond to flooding issues in order for property owners to qualify for flood insurance discounts through the National Flood Insurance Program's Community Rating System.
h. Create educational materials and signage for the public on the importance of floodplains and their function as living infrastructure.
i. Call attention to case studies that connect the protection and maintenance of floodplain to reduced flood events, improved resiliency, and better water quality and promote examples of proactive municipal planning for resiliency.
j. Outline design guidelines for developments near flood prone areas to ensure road infrastructure, stormwater drainage, and re-grading do not negatively impact the floodplain.
k. Collaborate with Cornell Local Roads program to develop an educational series on designing transportation infrastructure that supports the movement of stormwater and maintains connections to floodplain.

l. Encourage county and municipal planning departments to complete and implement resiliency planning.

Key Finding #5: Erosion and sedimentation issues cause major water quality impairments within the watershed.

Erosion of shorelines contributes to turbidity and sedimentation of our waterways and their effects are evident in our water quality data. The Buffalo Niagara Riverkeeper Riverwatch program, for example, identifies turbidity issues in the Buffalo River, Niagara River, Buffalo Creek, Buffalo's Inner and Outer Harbor, Lower and Middle Tonawanda Creek, Cayuga Creek, Gill Creek, and in tributaries on Grand Island. Lack of riparian buffers, poor shoreline stabilization practices, and land uses that disturb soils are most often the primary causes of erosion and sedimentation issues. County Soil and Water Conservation Districts are also aware of some high-erosion areas throughout the Watershed.

Recommendations:

a. Conduct additional research and data collection to fully characterize the erosion and sedimentation issues in the watershed including Stream Visual Assessments.
    i. Inventory culverts, bridge abutments, stormwater infrastructure, and shorelines to identify erosion problems earlier.
b. Prioritize erosion mitigation projects based on high-turbidity water quality data, threats to important habitat, and public infrastructure.
c. Identify and protect highly erodible soil areas and make information available to local planning entities to better inform planning and development processes.
d. Mitigate erosion and sedimentation issues from stormwater runoff through improved stormwater infrastructure design, greater usage of green infrastructure, and installation/protection of high-quality forested riparian buffers.
e. Establish lakefront development setbacks that protect the shoreline from natural erosion processes and impacts from extreme storm events, as well as protect natural shoreline infrastructure such as sand dunes, islands, beaches, and wetlands that provide resiliency benefits

Key Finding #6: A majority of the watershed's tributaries receive additional downstream impacts from highly urbanized sub-watersheds.

A large portion of the watershed encompasses major metropolitan areas that can contribute to certain kinds of water quality issues. Urban and suburban development often translates to channelized waterways and/or waters that are directed underground; development encroachment into riparian buffers limiting their effectiveness; and increased impervious cover, in the form of pavement, sidewalks, and dense building development. With all of these elements, the natural systems necessary to protect and filter our waters are limited or non-existent. In the Niagara River/ Lake Erie Watershed these urban areas are also located downstream from the headwaters of each sub-watershed, meaning urban influences are contributing to waters already impacted from rural land uses found upstream, compounding the problem. The result is waters with both rural and urban water quality issues directly conveyed to Lake Erie and the Niagara River with little natural opportunities for filtration.

Recommendations:

a. Identify opportunities where living infrastructure/riparian lands can be restored for each urban water corridor and work through re-establishing these areas through a mixture of municipal policies & programs and restoration projects.
b. Prioritize ideal areas for the removal of hardened shoreline and replace with shoreline protection that implements in-water habitats and shoreline marshes.
c. Soften the hardscape surrounding urban creek corridors to create unique natural respites from urban life (greenways) and utilize features to educate the public on natural systems and garner public ownership for our environmental corridors.
d. Revise zoning regulations and development review procedures to limit the expansion of impervious cover.
e. Develop model zoning language provisions for incentive zoning or performance standards to encourage creative design methods to improve on-site stormwater infiltration and storage in site design.
f. Restore underground and channelized waterways in urban areas back to traditional meander and flow patterns as a method to both restore ecological function and create unique urban blueways.
g. Create and maintain waterfront greenways as a means to better connect citizens to their natural resources in their communities, facilitating stewardship of water resources.
h. Develop collaborations between city governments, non-profits, block clubs, community foundations, planners, and developers to launch green initiatives that restore the image of our waterfront cities and create a citizen movement to protect and restore water resources.
i. Co-locate multi-use public trail systems with urban shoreline greenways (riparian lands) and green infrastructure networks to alleviate automotive usage and support public connections to the natural world.
j. Relocate adverse land uses from within critical riparian lands surrounding urban river/creek corridors, such as junk yards, car impound lots, gas stations, auto maintenance facilities, and heavy manufacturing operations.
k. Vet the usage of vacant and underutilized land within the watershed’s cities, towns, and villages for opportunities to create green stormwater infrastructure, water habitats,

riparian buffers, shoreline wetlands, and floodplains, especially in communities with combined sewer systems.

l. Coordinate with watershed municipalities to establish regional policies that establish impervious cover thresholds by sub-watershed.

Key Finding #7: The watershed's agricultural sub-watersheds create sedimentation and nutrient loading impacts.

While only 23% of the land in the watershed is used for agricultural purposes, much of the agricultural land uses are concentrated in the eastern and southern portion of the watershed. The highest number of agricultural-use acres can be found in Cattaraugus Creek, Upper Tonawanda Creek, Headwaters Cattaraugus Creek, Buffalo Creek, Middle Tonawanda Creek, Cayuga Creek, Canadaway Creek, and Murder Creek sub-watersheds, in that order. Sixmile Creek and Chautauqua Creek sub-watersheds are included in the list as well when looking at percentage of land use in agriculture. Over 25% of the land use is agricultural in all listed sub-watersheds. Because of the amount of agriculture upstream, urban areas in Dunkirk, Buffalo, and Tonawanda receive high levels of agricultural pollution inputs that further compound the urban and suburban pollution inputs occurring downstream.

Recommendations:

a. Expand the financial resources available to the local U. S. Department of Agriculture Natural Resource Conservation Service and County Soil and Water Conservation Districts to better assist farms in layout and implementation of structural and operational best management practices to reduce impacts from agriculture runoff.
b. Evaluate all state and federal agriculture programs that exist to support environmentally responsible, economically viable and sustainable businesses and identify hurdles limiting their successful use.
c. Ensure the NYSDEC has the resources and expertise necessary to enforce existing Concentrated Animal Feeding Operation (CAFO) regulations while providing financial assistance to farms so that they may fully implement their CAFO plans.
d. Collaborate with state, federal, and other agencies to promote the use and expansion of programs that install and protect vegetative riparian buffers on agricultural lands.
e. Provide additional technical assistance funding to assist small and medium sized farms in implementing Agricultural Environmental Management Plans.
f. Collaborate with NYS Department of Agriculture and Markets to further promote agriculture best management practices that support water quality to watershed farmers.

Key Finding #8: Most municipalities do not adequately protect water resources in planning, regulations and development review.

While many municipalities in the watershed have taken steps to improve elements that affect water quality that are within their control, there remains much more that can be done to comprehensively protect the health of our watershed at the municipal level. Presently community planning incorporating water quality usually stems from flooding issues or MS4 SPDES permitting requirements, not the protection of natural resources. Very few of the municipalities in the watershed have undertaken conservation planning or have programs in place to conserve and protect natural resources. Of the several regulatory tools afforded to our "home rule" communities, zoning districts, permitted land uses, site plan review, flood regulations, environmental overlays, subdivision review, and setback requirements are rarely structured to evaluate and protect water resources.

In addition to a lack of regulatory tools, municipal training on how to interpret and utilize regulatory tools from the water resource protection lens is needed. According to the outreach conducted from the Municipal Laws & Practices Assessment, many communities are interested in doing this work, but require training on how to interpret development plans and enforce regulatory tools for planning and zoning boards.

Recommendations:

a. Encourage watershed counties and municipalities to conduct a natural resource inventory and develop open space and conservation plans that address the protection living infrastructure.
b. Investigate and promote programs that provide for permanent conservation of land.
c. Encourage municipalities to plan for the protection and function of regional living or greenway infrastructure networks in comprehensive planning processes.
d. Develop and promote model environmental zoning overlay protections for sensitive waterfront environments, water quality, wetlands, headwater forests, important habitats and riparian buffer protection.
e. Ensure public access to waterways is not hindered by non-water-dependent development.
f. Expand development setbacks on waterfront yards to a minimum of 100 feet, encroachment should require a variance.
g. Strengthen local floodplain regulations to better protect flood prone areas from unnecessary or inappropriate development.
h. Restrict the spread of sewer, water, and road infrastructure in order to curb sprawling development patterns.
i. Encourage low impact design, green infrastructure, and reduction of impervious cover in private development through incorporating performance standards or stricter regulations into zoning and site plan review ordinances.

j. Incorporate stronger regulatory protections for conservation/natural resources in subdivision review procedures.
k. Develop design guidelines and model zoning regulations that outline appropriate design and vegetation usage for functional riparian buffers.
l. Train municipal staff, councils, and planning boards on how to review development through a water quality lens and offer alternative design examples to common development scenarios that protect water resources from development impacts.
m. Pursue enabling language in New York State statutes to create special taxing districts to maintain and improve MS4 infrastructure and living infrastructure networks.
n. Restrict the siting of adverse land uses adjacent to stream, creeks, and waterbodies.
o. Regulate private dock placement and design in waterfront communities to protect shorelines and habitat areas.
p. Implement marina ordinances that guide best management practices in marina design, operations and maintenance including adding services like fish cleaning stations to prevent pollution of waterways. Legally municipalities have jurisdiction 1100' out into the navigable waterways and can pursue their regulatory authority.
q. Document green initiatives and practices initiated by municipal staff into formal department policies in order to retain departmental knowledge as staff change-over occurs.
r. Develop outreach and educational materials for waterfront landowners that addresses better yard management practices, riparian buffer design, and how best to mitigate shoreline erosion.
s. Develop a Clean Marina citizen education program to improve management of private marinas and docking facilities.
t. Implement Certificates of Occupancy requirements to ensure development occurs according to permit requirements.
u. Collaborate with NYS Department of Agriculture and Markets to draft model regulations that incorporate appropriate best management practice into zoning codes addressing Agricultural Districts.
v. Collaborate with the Agricultural and Farmland Protection Program, such as conducting workshops about conservation options for rural landowners and purchasing development rights in priority agricultural areas which are experiencing the most developmental pressure. Encourage programs such as the Navigator Program through the American Farmland Trust, which match farmers looking to sell farmland to farmers looking to purchase land to keep it as working farmland.
w. Promote agricultural Best Management Practices or enrollment in the Agricultural Environmental Management Program through educational brochures and collaborative workshops with County Soil and Water Conservation Districts.

x. Develop fines and enforce ordinance violations, especially regarding provisions that affect water quality (shoreline vegetation removal, yard waste dumping, etc.).
y. Ensure proper maintenance and upkeep of private stormwater management systems by adopting codes that strengthen enforcement authority (i.e. establishing fines for violations).
z. Develop regulations to address BMP forestry practices, site clearing, and limit vegetation removal along creeks, wetlands, and in floodplains.
aa. Conduct municipal tree inventories and establish policies to maintain and enhance urban forests and canopy cover throughout the municipality.

Key Finding #9: The watershed is experiencing sprawl and an increase in development despite substantial population losses, compounding water quality issues.

Between 2000 and 2010, the Niagara River/ Lake Erie Watershed added an additional 13,398 acres of land considered "urbanized" according to the US Census Bureau. During this same time, the watershed lost approximately 35,722 people. This trend is indicative of sprawl, where communities and development is sprawling outwards from city and village centers in a way that requires more land and space to supply a smaller population with its built environment. Thirty-six percent (36%) of land use in the Watershed is considered residential. Unfortunately low-density residential development carries implications for water quality, including increased non-point source pollution; channelizing natural waterways into stormwater corridors; fragmenting agricultural and forest lands; degrading wildlife habitat; and increasing the cost of infrastructure. The most visible consequence of sprawling trends is the large-scale loss of natural forests, fields, and other undeveloped land.

Recommendations:

a. Remove the watershed's "essential lands" from development pressures (i.e. regional living infrastructure network) through local and regional land use policies.
b. Municipal policies should focus on reducing low-intensity residential development by addressing how land is converted to residential uses (i.e. conservation, subdivision, site design regulations).
c. Restrict the expansion of water, sewer, and road infrastructure as it aids sprawling development patterns, unless the infrastructure is necessary to address issues directly affecting water quality (i.e. failing septic systems associated within an already built out area). If expansion is necessary, create appropriate zoning and regulations to protect water quality from future development.
d. Encourage first and second ring suburbs to conduct Smart Growth planning that clearly outlines sustainable development practices and policies.
e. Identify and highlight the best municipal programs utilized to combat sprawl and excessive development pressures within New York municipalities.

f. Participate in implementing the One Region Forward plan and continue to track watershed health metrics for impact/performance.
g. Implement zoning performance standards that allow for creative development patterns and layouts, such as cluster development, that limit the footprint of developments and infrastructure, and protect sensitive natural features found on-site.
h. Conduct workshops with local officials on determining critical environmental site features and implementing sustainable site design alternatives for their protection.
i. Foster in-fill development through variances and other zoning provisions that allow creative use of small lots or underutilized properties or turn those small lots into enhanced green infrastructure to limit stormwater from surrounding areas from impacting water quality.
j. Adopt incentive zoning provisions or overlay districts that protect natural resources, conserve open space, large old-growth forests, and important agricultural lands.
k. Create and implement tax incentive programs that support the preservation of large tracts of open space, especially within agricultural and forested areas.
l. Conduct agricultural and forestry preservation planning in second and third ring suburbs.
m. Investigate the use of impact fees for development proposed in non-urbanized areas.
n. Establish Transfer of Development Rights programs in second and third ring-suburban communities within the watershed.

Key Finding #10: The inadequate amount of water quality and watershed infrastructure data available limits the ability to plan for watershed health.

During the research for the various components of the Watershed Management Plan, a lack of data relative to water course base conditions and modeling, and water quality became evident across the board. There are several data sets that, if produced would assist in a wide variety of watershed analysis and planning. Presently the current extent of condition identification, trends, and recommended actions for the Niagara River/ Lake Erie Watershed is limited by a lack of data in several areas, primarily on-the-ground data that is collected frequently, such as water quality sampling, Stream Visual Assessments, and sediment loading.

Recommendations:

a. Expand collection of hydrologic flow data in rivers, streams and creeks to determine baseline conditions for:
    i. sediment transport loading and critical erosive force thresholds;
    ii. pollution inputs and critical pollution thresholds;
    iii. stormwater and MS4 infrastructure contributions; and
    iv. frequency and effect of storm events.

b. Continue to collect additional water quality data to adequately characterize the water quality conditions in our rivers, streams and creeks, including:
   i. a more comprehensive sampling of sites throughout the watershed to assess the waterways that haven't been assessed in over 15 years;
   ii. a greater frequency of collection than once every 5 years; and,
   iii. the regular collection and analysis of bacterial and nutrient inputs, such as *E-coli*, phosphorus, and nitrogen.

c. Conduct water quality sampling of small lakes and ponds to better understand the conditions occurring and plan for corrective actions.

d. Conduct additional assessments according to the Natural Resource Conservation Service's Stream Visual Assessment Protocol in order to effectively characterize conditions of wade-able streams.

e. Inventory and document high erosion areas along local waterways to lessen the impact of channel and bank erosion on water quality, infrastructure and private property.

f. Expand invasive species mapping and monitoring to document the extent and spread of invasive species and better inform mitigation programs and funding needs.

g. Conduct water quality sampling and ecological assessments of wetlands to identify the highest quality wetlands, inform wetland restoration efforts, and prioritize those that need protection.

h. Track volumes of combined sewer overflow (CSO) and sanitary sewer overflow (SSO) discharge events, in order to determine pollutant inputs and track the progress of corrective actions and infrastructure upgrades.

i. Conduct Biologic Assessment Profiles more frequently and more comprehensively throughout the watershed to effectively capture detailed trending information necessary for planning and mitigation actions.

j. Expand Rotating Integrated Basin Studies to address areas classified as "needing verification" and "un-assessed".

k. Conduct a comprehensive and current assessment of the ground-water quality as identified by the *USGS Ground-Water Quality in Western New York 2006* Report.

l. Incorporate volunteers into data collection programs to better engage citizens in the health and stewardship of the watershed.

m. Conduct a dam assessment to ensure proper maintenance of necessary dams and removal of unnecessary dams.

Key Finding #11: The lack of climate change data and trend tracking affects the ability to plan for watershed resiliency.

The extent to which climate change will affect the Niagara River/ Lake Erie Watershed is unknown at this point. There are larger-context predictions outlined by New York State, however in order to adequately plan for what climate change will actually do to Lake Erie and our watershed, additional data collection and long-term trend tracking is needed. For example, if the frequency and extent of extreme weather events are likely to occur, the region will require additional investments into coastal ecosystems and living infrastructure to buffer the impact of these storms. This type of research, data collection, trend analysis, and planning is what is needed for effective and comprehensive resiliency planning. At this time, only Niagara County has undertaken an initial resiliency planning effort.

Recommendations:

a. Collect sufficient data to evaluate potential climate change trends to influence more comprehensive planning efforts. Data collections should include:
    i. rainfall levels at more points within the watershed;
    ii. waterway base flow and high-water data;
    iii. lake levels;
    iv. storm frequency and intensity tracking;
    v. Lake Erie seiche events and inland high-water level effect;
    vi. damaging freeze-thaw (ice flow) events and locational damage;
    vii. temperature changes;
    viii. seasonal flooding (frequent low-level flooding); and,
    ix. aquifer volume estimates.
b. Conduct an inventory of assets and vulnerabilities to fully understand what infrastructure may be at risk and to what degree (i.e. risk analysis).
c. Collaborate with area universities and NYSDEC to analyze climate change trends and identify trends and preemptively evaluate potential impacts to habitat and watershed health.
d. Identify high-erosion areas, highly erodible soils, and steep slopes for use in local land-use planning decisions.
e. Regularly inspect culverts, shorelines, sewer connections, outfalls, manholes and bridge abutments to identify vulnerable and under-sized infrastructure.
f. Conduct county-wide or Watershed-wide resiliency planning to identify the best methods or needs to quickly recover from natural disasters and intense storm events.
g. Incorporate findings from County All-Hazard Emergency Management Plans into municipal land use planning decisions.
h. Coordinate with county emergency management officials to document areas with frequent damage to highlight problem areas before major storms occur.
i. Investigate state and federal funding opportunities to preemptively fix failing infrastructure, especially along shorelines, and replace with living shoreline infrastructure when possible.

Key Finding #12: The NYSDEC Water Classifications do not always reflect desired public uses.

Currently, most of our waterways are designated as Class C, meaning that they are protected for fishing but not for primary contact, such as swimming, even though the community has a strong desire for primary contact in area waterways, and in some cases is already using it this way. If water quality is not assessed for these uses, they are not typically planned for in management policy or plan restoration. This is a concern within the City of Buffalo currently where no waters are designated for public bathing. Unfortunately this does not stop residents from swimming along the Outer Harbor, in the Buffalo River, Black Rock Canal and in Cazenovia Creek at Cazenovia Park on hot summer days.

Recommendations:

a. Conduct reviews of water quality classifications at least once every three years, according to the U.S. Clean Water Act (40 CFR §131.20).
b. Ensure water quality classification reviews conducted by the NYSDEC occur with an open public process that incorporates citizen input in decision making.

Key Finding #13: A high loss of fish habitat is evident in the watershed.

According to the Niagara River Habitat Conservation Strategy, the northern portion of the Niagara River/Lake Erie watershed has seen a decline in fish habitat due to a number of factors. In some cases this is due to the hardening of shorelines and employment of shoreline engineering techniques that remove sloped areas and transitional-marshes that support fish spawning and young fish habitat. In other areas of the watershed, migratory cold-water fish face increased water temperatures caused by the lack of forested riparian buffers and higher-temperature stormwater in-flows. In Grand Island and other areas with small tributaries off the Niagara River, migratory fish barriers in the stream channels reduce the ability of fish to migrate further. These fish barriers include improperly designed culverts, invasive species, sedimentation and small dams.

Recommendations:

a. Assess and address known barriers to native and naturalized trout spawning.*
b. Identify opportunities to mitigate the effects of channelization and altered flows.*
c. Remove known fish barriers to up-stream fish spawning locations for native migratory fish within the watershed.
d. Identify ideal locations to restore lost spawning habitat along coastal and in-land tributaries.
e. Train municipal officials on the appropriate design and installation of culverts and other infrastructure to support fish migration.

f. Encourage public works departments and County Soil and Water Conservation Districts to conduct regular culvert inventories to identify problem culverts for fish passage and plan for their upgrade or replacement. This can be combined with resiliency planning efforts to address both habitat and resiliency at the same time. Data can be used through the North Atlantic Aquatic Connectivity Collaborative.
g. Conduct further research into declining fish populations and integrate findings into watershed planning.
h. Document in-water and shoreline invasive plant species and prioritize areas for removal actions.
i. Identify methods to limit the impacts of aquatic invasive species on native fish populations.
j. Track emerging (not yet established) invasive aquatic species to identify the immediate and long-term threats to the Great Lakes ecosystem.
k. Collaborate with Cornell Local Roads program to develop a training module on designing road side ditches and MS4 infrastructure to limit thermal loading, erosion, and sedimentation.
l. Promote transitional shoreline environments that employ bioengineering and healthy riparian buffers to protect fish habitat in lieu of traditional hardened shorelines with limited habitat potential.

**Indicates Action Strategies outlined by the Niagara River Habitat Conservation Strategy.*

Key Finding: #14: There is a substantial lack of grassland and shrub habitat in the watershed.

In the Niagara River Habitat Conservation Strategy, a lack of sufficient grassland and shrub habitat was found.

Recommendations:

a. Increase grassland habitat values for breeding birds.*
b. Collaborate with County Parks Departments on the management of public parks and open space to protect grassland areas and support breeding of grassland bird species.
c. Develop educational guidance materials on the management of grassland open space for the ecological benefit.
d. Conduct educational outreach to owners of capped landfills and hay fields on recommended mowing practices to support breeding of grassland bird species.
e. Re-establish or promote conservation incentive programs for protecting grassland areas such as NYSDEC’s Landowner Incentive Program for Grassland Protection and Management and U.S. Fish and Wildlife Service’s grassland restoration services.

**Indicates Action Strategies outlined by the Niagara River Habitat Conservation Strategy.*

Key Finding #15: The lack of shoreline wetlands and marshes is affecting habitat and watershed health.

Shoreline wetlands and marshes are part of a living infrastructure network that not only help our river systems function and lake shores stabilize, but provide essential habitat that supports clean water. Shoreline wetlands and marshes provide a transitional zone for young fish and other smaller organisms that require protection from stronger currents and larger predators. The ecological conditions found in these areas also significantly support water quality through filter feeding, oxygenation, turbidity reduction, and erosion protection.

Many of our downstream river corridors of the watershed's main tributaries no longer host shoreline wetlands or marshes due to navigational dredging, shoreline development, and traditional engineering structures. The re-creation of these environments is essential for watershed health and biological diversity.

Recommendations:

a. Encourage municipalities to conduct natural resource inventories to identify high quality aquatic habitats and riparian wetlands for conservation.*
b. Identify and protect sites with high ecological value and use as reference sites for habitat restoration.*
c. Evaluate shoreline areas for the creation of new shoreline wetlands and marshes.
d. Collaborate with U.S. Fish and Wildlife, NYSDEC, and Buffalo Niagara Riverkeeper to identify priority locations for the creation of new shoreline wetlands/marshes within the Areas of Concern, Impaired stream segments, and along important fish migration routes.

**Indicates Action Strategies outlined by the Niagara River Habitat Conservation Strategy*.

Key Finding #16: The lack of wildlife corridors limits wildlife movements and safe migration.

Wildlife migrates for food, breeding, and to follow seasonal changes. In the Niagara River/ Lake Erie watershed, the Niagara River corridor is designated as an Important Bird Area, and is really the only wildlife corridor officially recognized and managed as such. Opportunities to expand the migratory bird connections exist, but are commonly an afterthought in local and regional land use planning.

Other land and water wildlife corridors are planned for or protected even less so. For example, land development commonly fragments large tracts of forest land, isolating wildlife and limiting habitat area, which negatively affects their viability. In-water wildlife corridors have the same impacts; however, in-water fragmentation is often caused by dams, invasive species, poorly designed culverts, thermal changes, pollution, and sedimentation.

Recommendations:

a. Support wildlife corridors and movement through the creation/protection of the regional living infrastructure network that includes interconnected waterways, lakes, ponds, riparian buffers, wetlands, flood plains, headwater forests, grasslands, large forest tracts, and agricultural lands.
b. Encourage municipalities to plan for the protection and connectivity of the natural areas outlined in Recommendation #15. a. in comprehensive planning.
c. Develop model environmental overlays in zoning ordinances that incorporate protections for regional living infrastructure networks.
d. Identify and protect at-risk forested areas from fragmentation due to development pressure.*
e. Identify opportunities to mitigate the effects of channelization and altered flows.*
f. Assess and address known barriers to native and naturalized trout spawning.*
g. Collaborate with NYSDEC to identify important wildlife migration corridors and utilize the information to inform regional planning and development.

**Indicates Action Strategies outlined by the Niagara River Habitat Conservation Strategy.*

Key Finding #17: Thermal pollution exists within the watershed, impairing ecosystems.

As temperatures rise in rivers, streams, and water bodies their ecosystems are affected, placing stressors on species that influence water quality. Macroinvertebrates, cold water fish species, and amphibians, are all sensitive to rising temperatures. Higher water temperatures are caused by the increased solar radiation from the lack of forested cover, urban and suburban stormwater run-off, poorly designed MS4 infrastructure, dams, and industrial processes. Various trout species are especially vulnerable and warming of streams in the southern extent of the watershed is evident in the reduction of trout habitat there.

Recommendations:

a. Improve forest canopy over streams and lake edges through riparian buffer protections in zoning ordinances and design guidelines for waterfront landowners.
b. Encourage landowners and municipalities to use NYSDEC programs such as *Buffer in a Bag* and *Trees for Tribs*, or the Lake Erie Watershed Protection Alliance riparian buffer program.
c. Design MS4 infrastructure that buffers stormwater from solar loading and allows for opportunities to cool stormwater prior to discharge into lakes and streams.
d. Eliminate the use of materials in MS4 infrastructure and drainage channels that amplify solar impacts in stormwater.

e. Encourage the installation of green infrastructure with tree features to collect and store stormwater on-site, especially for parking lots.
f. Restrict lot-clearing to the building envelope for existing forested properties within a 25 mile radius of sub-watershed headwaters.

Key Finding #18: Inadequate tracking and management of invasive species limits the ability to reduce their impact.

Several kinds of invasive species have been documented in the Niagara River/ Lake Erie Watershed, however for certain species there is very limited data outlining their location, extent, and movement. Essentially, invasive species lack inventories and analysis of trending, both of which are necessary to plan for their management and reduction.

Recommendations:

a. Support the efforts of Western New York Partnership for Regional Invasive Species Management (WNY PRISM) to combat the spread of invasive species in region.
b. Conduct regular inspections for invasive aquatic plants in waterways, lakes and small ponds, and engage volunteers in removal efforts.
c. Expand public knowledge of the iMap Invasives Website and other citizen's campaigns to document invasive species in New York State.
d. Support on-going funding of Buffalo State College's Great Lakes Center, the NY Sea Grant Program, WNY PRISM, and U.S. Fish and Wildlife Service as they continue to research invasive species and removal techniques. Collaborate on communication of the results and findings.
e. Improve public knowledge of invasive species, identification, threats and best management practices through expanded educational programming, outreach materials, and signage.
f. Expand research into removal and mitigation techniques for invasive species to identify the most effective methods with the least impact on native species.

Key Finding #19: Combined sewer overflows are a major pollution contributor within the watershed.

While it's not fully known the exact volume of untreated sewage that combined sewer overflows contribute to the watershed each year, the estimates are extensive and the evidence is quite apparent in the Niagara River, Buffalo River, and Scajaquada Creek. The most predominant contributor is the City of Buffalo's Sewer Authority, where over 52 permitted outfalls discharge to the Niagara River and Buffalo River Sub-watersheds. The discharges of these systems disrupt the natural balance of our waterways, impacting water quality, ecosystems, and recreation.

Recommendations:

a. Outline the issues associated with accurate reporting of CSO discharges and identify ways to improve discharge volume tracking.
b. Create tools to assist municipalities in tracking and maintaining infrastructure.
c. Ensure CSO communities participate in watershed planning initiatives.
d. Prepare and implement Long-term Control Plans for the mitigation of CSO events that minimize the use of grey infrastructure solutions and maximize the use of green infrastructure solutions as practical.
e. Utilize adaptive management to adjust Long-Term Control plans based on actual results.
f. Collaborate with NYSDEC and U.S. EPA to maintain oversight on CSO communities and implementation of Long-Term Control Plans.
g. Advocate for NYS Environmental Facilities Corporation to prioritize CSO communities for NYS Green Infrastructure Grant Program funding.
h. Amend zoning regulations to incorporate performance standards that require 100% on-site stormwater capture, storage, and infiltration for 2" or less rain events; and, limit the percentage of impervious cover on individual lots and subdivision development to reflect current understanding of Best ManagemenU.S.t Practices.
i. Incorporate low-impact development and sustainable sites design into development regulations.
j. Utilize vacant lots for stormwater storage, infiltration, and green infrastructure installations.
k. Develop downspout disconnection programs and educate private property owners on how they can help mitigate CSO issues.
l. Investigate the use of utility discounts to encourage property owners to install green infrastructure or conduct downspout disconnections.

Key Finding #20: Sanitary sewer overflows are a bigger problem than originally suspected.

Sanitary sewer overflows (SSOs) present the same impacts to waterways as combined sewer overflows, since they also discharge raw untreated sewage intended for the wastewater treatment plant. In many cases SSOs occur during heavy rain events in the spring, when snowmelt and rainfall inflow and infiltrate into sanitary sewers through broken connections and pipes. Presently Scajaquada Creek, Niagara River and Ellicott Creek receive the brunt of these discharges.

Recommendations:

a. Collaborate with the sanitary sewer operators to effectively characterize the full extent of Sanitary Sewer Overflow issues within the watershed, including:
    i. volumes discharged during each event;
    ii. all discharge locations;

iii. current and most recent conditions leading to the discharge event; and,
iv. suspected causes for each discharge event.

b. Create tools to assist municipalities in tracking and maintaining infrastructure.
c. Identify SSO event hot spot areas in the watershed to prioritize for engineering investigations and design system improvements.
d. Encourage sanitary sewer operators to conduct regular inspections on infrastructure and perform corrective actions on cracked, broken or undersized pipes.
e. Host a round-table discussion on SSO events and their impact on water quality and what some of the watershed's sanitary sewer operators are doing to address.
f. Establish funding mechanisms to address SSO issues at the local and regional level.
g. Develop programs that assist private property owners in repairing broken sanitary sewer connections in low-income communities.
h. Encourage municipalities to enforce violations and establish fines for illicit discharge and connections to sanitary sewers.

Key Finding #21: Improved design and maintenance of stormwater infrastructure is needed to reduce non-point source pollution.

The infrastructure that makes up storm sewer systems includes a wide variety of elements that together store and direct stormwater run-off into area waterbodies. Stormwater infrastructure, which typically includes such things as storm drains and underground pipes, roadside ditches, stormwater retention ponds, and cisterns, rarely includes components that filter stormwater prior to its release into area waterways. Because this infrastructure is primarily designed to quickly collect and convey stormwater away from land surfaces, stormwater infrastructure can contribute to water quality impairments based on its design and maintenance. For example, narrow and deep roadside ditches may have a smaller footprint, but ultimately contribute to erosion and sedimentation of the ditch and downstream. Direct conveyance of stormwater from streets, roofs, driveways and parking lots are major contributors to PAHs and PCBs in our waterways.

Recommendations:

a. Develop design guidelines for stormwater infrastructure to improve function and protection of water quality.
b. Create tools to assist municipalities in tracking and maintaining infrastructure.
c. Identify stormwater outfall locations with high pollutant loading and prioritize for infrastructure improvements within the upstream conveyance systems, including green infrastructure interceptors that filter waters prior to discharge.
d. Set regional policies to require end-of-pipe buffers and filter systems prior to discharge of stormwater in high pollutant load stream segments.

e. Highlight municipal stormwater improvement projects that demonstrate enhanced design and protection of water quality at the WNY Stormwater Coalition Conference and NYS Floodplain and Stormwater Managers Association's Annual Conference.
f. Host training events for Stormwater Management Officers on new stormwater management designs and technology that reduces erosion, sedimentation, and thermal inputs, plus improve filtration.
g. Advocate for the NYS Environmental Facilities Corporation to expand the Green Infrastructure Grant Program to fund design improvements for poorly functioning stormwater infrastructure.
h. Provide training to municipal and county engineers and public works departments on the design and installation of culverts and roadside ditches to support water quality, as well as fish passage and climate change.
i. Improve oversight and enforcement actions by local Stormwater Management Officers, including the establishment and issuance of fines for violations for improper design and maintenance of stormwater infrastructure.
j. Collaborate with the WNY Stormwater Coalition to develop educational materials and tools geared towards private property owners on how to maintain the function of MS4 infrastructure that abuts their properties in a way that protects water quality.
k. Establish beginning-of-pipe programs for homeowners to expand public knowledge of property maintenance practices that generate stormwater pollutants.
l. Collaborate with the Cornell Local Roads Training Program to educate public works staff on best management practices for roadside stormwater ditch maintenance.
m. Collaborate with the Lake Erie Watershed Protection Alliance for hydroseeding of ditches after cleaning to prevent erosion and sedimentation.

Key Finding #22: Innovative funding mechanisms are needed to address infrastructure-related pollution issues.

Municipalities today face a difficult situation in determining how and to what extent they fund the maintenance, replacement, and creation of infrastructure. A recurring theme for water and sewer entities is the desire to make their systems more effective in addressing water pollution with limited funding mechanisms beyond the rate payers or the municipal budget. This issue is evident in the CSO, SSO and MS4 infrastructure conditions and long-term plans needed to address infrastructure that is out of compliance. Aside from traditional grey infrastructure, green stormwater infrastructure and living infrastructure networks also lack adequate funding mechanisms to support their protection and maintenance.

Recommendations:

a. Outline a funding plan to implement watershed and sub-watershed management plans; develop additional phases of watershed planning to reach EPA planning standards; and, track watershed plan progress over the long-term and amend plans as necessary.
b. Research innovative funding programs and mechanisms employed in other areas of New York State and the U.S. for the:
    i. purchase, conservation and/or protection of regional living infrastructure networks;
    ii. creation and restoration of wetlands, riparian buffers, floodplains and habitat;
    iii. improved capacity to manage and design MS4 infrastructure;
    iv. correction of combined sewer and sanitary sewer overflows;
    v. design and implementation of green stormwater infrastructure;
    vi. creation of waterfront public access, blueway and greenway trails; and,
    vii. purchase, conservation and/or protection of important open space and wildlife corridors, headwater forests, and primary agricultural lands.
c. Develop a coalition of regional partners to address the funding needs identified in Recommendation #22b. i.-vii. (above), including, but not limited to, an evaluation of special taxing districts, impact fees, violation-fine programs, public utilities, and voluntary donation programs.

Key Finding #23: Legacy contamination is a substantial problem within urban sub-watersheds.

Remnants of our industrial past still dot our landscape today. Many of the highly contaminated properties in the region have been remediated and are not considered a threat to public health or the environment any longer. However, known or suspected contaminated properties still remain that require investigation and clean-up. Our urban sub-watersheds, Buffalo River, Niagara River, and Canadaway Creek Sub-watersheds host the majority of these sites.

In addition, legacy contamination is still present in various forms in our waterways themselves, most often as contaminated sediments and past illegal dumping. Contaminated sediments found in river and creek bottoms are caused by erosion from contaminated properties and groundwater migration. Once in sediments, contaminants can work their way up through the food chain. In the Buffalo and Niagara River Areas of Concern (AOC), the presence of various contaminants in biological samples (fish and other aquatic species) confirms this toxic past. While dredging and capping of contaminated sediments has occurred in the Buffalo River, other waterways are impacted throughout the Watershed on a smaller scale.

Recommendations:

a. Engage the U.S. Congressional Delegation to maintain funding for the U.S. EPA Great Lakes Legacy Act Program as the leading resource to investigate and remediate contaminated sediments found within the Areas of Concern.
b. Advocate for NYS to continue funding for New York State's Environmental Restoration Program (ERP) Initiative and NYS Department of State Brownfield Opportunity Area.
c. Advocate for NYS to continue tax incentives for the NYSDEC Brownfield Cleanup Program.
d. Continue to support the management of the Areas of Concern and their Remedial Action Plans locally and communicate progress and setbacks with regional stakeholders.
e. Support post-dredging monitoring of the Buffalo River sediments to meet delisting criteria for the Buffalo River Remedial Action Plan.
f. Implement monitoring protocols of the Buffalo River Remedial Action Plan to confirm the progress/impact of delisting actions.
g. Conduct sediment investigation within the Niagara River Area of Concern to characterize contaminant inputs from tributary source areas.
h. Identify quality habitat areas within the Niagara River Area of Concern for long-term protection and/or acquisition to foster delisting of BUI #14.
i. Identify shoreline and in-water areas ideal for habitat creation and restoration within the Niagara River Area of Concern to foster delisting of BUI #14.
j. Conduct public outreach on the watershed's legacy contamination, efforts to address the contamination, and ways to ensure future actions do not repeat the past.
k. Continue to monitor NYSDEC managed Inactive Hazardous Waste Sites.
l. Encourage the U.S. EPA to foster engagement between the various Great Lakes Areas of Concern to review what's worked, progress made, and lessons learned.
m. Ensure site access and long-term monitoring is provided for Buffalo River habitat restoration projects to inform delisting evaluation under the Buffalo River Remedial Action Plan.

Key Finding #24: The impacts of emerging contaminants in the watershed are unknown.

Aside from the watershed's legacy contamination, there are new substances that pose a threat to water quality. For example, current wastewater treatment plants are unable to filter and process chemicals such as pharmaceuticals, micro plastics, microfibers, flames retardants (PFAS) and leachates (BPA) at this time. The threats from these to ecology, wildlife, and public drinking water are not fully characterized at this time.

Recommendations:

a. Identify emerging contaminants, new technologies, and behavioral changes with the potential to affect watershed health.
b. Partner with area research universities to further evaluate the threat from emerging contaminants.
c. Draft and advocate for policy reforms to limit the impact of emerging contaminants.
d. Continue and expand County-wide efforts to collect pharmaceutical drugs for property disposal through "Drug Drop Off" days.
e. Develop and disseminate public educational materials to highlight the potential threat from emerging contaminants.
f. Collaborate with hospitals and pharmacies to address proper disposal of prescription drugs with educational materials distributed with prescriptions.

Key Finding #25: Some small improvements in watershed health indicators are evident.

Some areas of the watershed have seen slight improvements that indicate some improvement is occurring. Along the Buffalo River, vacant land uses have naturally regenerated from past industrial uses, as well as habitat restoration projects have been implemented and there is evidence of wildlife returning to the Buffalo River corridor in the city. This trend may be assisted by wildlife located nearby at the Tifft Nature Preserve outgrowing their habitat constraints and venturing into new areas, as well as the 100' development buffer enacted by the City of Buffalo over a decade ago. Deer, beaver, fox, garter snake, perch, geese, ducks, heron, skunk, and turtles have all be sighted along the Buffalo River in greater frequencies on former industrial properties.

According to macroinvertebrate sampling (Predicted Biotic Assessment Profile Scores), continually degrading water quality conditions are evident in much of the Watershed; however there are a few stream segments that have improved slightly in recent years. These include portions of Rush Creek, Smokes Creek, Eighteenmile Creek (near the Lake Erie shoreline), and Little Tonawanda Creek.

Recommendations:

a. Research areas of the watershed that see improvements to identify the conditions influencing these trends.
b. Continue to track and communicate watershed improvements to citizens to outline progress in watershed management planning and implementation.
c. Track Best Management Practices throughout the Watershed to track improvements in water quality.

d. Document before and after conditions of watershed improvement projects, such as shoreline restorations, green infrastructure installations, and MS4 design improvements to gauge benefits and inform project design decisions.

Prioritization of Sub-watersheds

The dual goals of any watershed plan are to preserve and protect the conditions leading to high water quality and vital ecological habitat, and also to intervene in conditions which lead to impairment of water quality and habitat.

Measuring the health of a watershed is imprecise, subjective and involves the interplay of numerous factors. The fact that we do not always have substantial, consistent, pertinent, and measureable direct data across the Niagara River/Lake Erie Watershed forces us to look at predictors and indicators. The data gathered for the Watershed Characterization Report and other sources were used to score and rank each sub-watershed for each specific characteristic. Each sub-watershed was ranked from 1 to 5 in each category. A high score was given when healthy characteristics were low or unhealthy characteristics were high. For instance, a sub-watershed with a high amount of impervious cover, which can lead to large amounts of polluted runoff, was given a low score, whereas a high percentage of forest cover, which can absorb water and potential pollutants, was given a high score.

Sub-watershed Prioritizing Data Sets	Good Indication	Poor Indication
% of Impervious Cover	Low % Impervious Cover	High % Impervious Cover
% of Forest Cover	High % Forest Cover	Low % Forest Cover
% of Industrial Land Use	Low % Industrial Land Use	High % Industrial Land Use
% Total Acres of Land Protected	High % Protected	Low % Protected
Density of Stream Miles	High Density	Low Density
# of Road/Bridge Crossings per acre	Low # of Crossings	High # of Crossings
# of Remediation Sites per acre	Low # Sites	High # Sites

Metrics for Prioritization

Impervious Cover

The effects of urbanization on stream ecosystems are largely driven by impervious or impermeable cover. This metric typically increases with the increase in residential and commercial development including pavement, roofs, and other impermeable surfaces in a sub-watershed. Impervious surfaces associated with urbanization reduce infiltration and increase surface runoff altering the pathways by which water and any associated contaminants reach urban streams. This impervious cover data is from GIS overlays. Urban sprawl should be avoided, but implementing green infrastructure where possible should be encouraged.

Sub-watershed	% of Sub-watershed	Score
Niagara River	23.81%	1
Smoke(s) Creek	18.51%	2
Ellicott Creek	15.31%	2
Buffalo River	11.67%	2
Lower Tonawanda Creek	9.39%	3
Cayuga Creek	6.72%	3
Canadaway Creek	5.46%	3
Big Sister Creek	4.12%	4
Buffalo Creek	3.99%	4
Middle Tonawanda Creek	3.72%	4
Eighteenmile Creek	3.58%	4
Murder Creek	3.58%	4
Upper Tonawanda Creek	3.51%	4
Chautauqua Creek	3.30%	5
Sixmile Creek	3.15%	5
Walnut Creek	3.07%	5
Headwaters Cattaraugus Creek	2.92%	5
Cattaraugus Creek	2.80%	5

Forest Cover

Forested areas are the most healthy land cover in a watershed. They increase rainwater infiltration, reduce runoff, stabilize soil are the least polluting land use and are of critical importance to water quality. Natural forested areas should be protected but urban management and reforestation are important components of watershed management.

Sub-watershed	% of Sub-watershed	Score
Niagara River	8.40%	1
Lower Tonawanda Creek	16.10%	2
Ellicott Creek	18.30%	2
Middle Tonawanda Creek	18.80%	2
Murder Creek	21.30%	2
Smoke(s) Creek	24.30%	3
Upper Tonawanda Creek	31.80%	3
Cayuga Creek	33.00%	3
Buffalo Creek	39.20%	4
Big Sister Creek	43.9%	4
Canadaway Creek	45.90%	4
Sixmile Creek	46.00%	5
Eighteenmile Creek	47.60%	5
Buffalo River	48.00%	5
Headwaters Cattaraugus Creek	49.50%	5

Walnut Creek	52.40%	5
Chautauqua Creek	53.50%	5
Cattaraugus Creek	56.70%	5

Industrial Land Use

Industrial land use contributes numerous impairments to water quality. Industrial waste is a big contributor to ground and surface water pollution. Surface water runoff disturbances and impervious cover are also components of industrial use.

Sub-watershed	% of Sub-watershed	Score
Murder Creek	13.92%	1
Ellicott Creek	23.22%	1
Upper Tonawanda Creek	3.63%	2
Niagara River	3.64%	2
Smoke(s) Creek	6.44%	2
Buffalo River	1.42%	3
Headwaters Cattaraugus Creek	2.08%	3
Lower Tonawanda Creek	2.17%	3
Middle Tonawanda Creek	2.48%	3
Cattaraugus Creek	0.45%	4
Buffalo Creek	0.63%	4
Canadaway Creek	0.67%	4
Cayuga Creek	0.89%	4
Walnut Creek	0.05%	5
Sixmile Creek	0.24%	5
Big Sister Creek	0.25%	5
Chautauqua Creek	0.26%	5
Eighteenmile Creek	0.38%	5

Protected Land

Approximately 12% of the Niagara River/ Lake Erie Watershed is considered protected through a variety of mechanisms, including conservation easements, fee title acquisition, regulatory protections on environmental features (i.e. wetlands), reservations, and land under governmental jurisdiction (parks, forests, trails, canals) according to the 2014 NYS Natural Heritage Program. These lands are less likely to be developed and are more likely to remain natural and provide ecosystem services.

Sub-watershed	% of Total Acres Protected	Score
Walnut Creek	3.22	1
Sixmile Creek	3.52	1
Chautauqua Creek	4.32	1
Eighteenmile Creek	4.72	1

Canadaway Creek	6.14	2
Cayuga Creek	6.14	2
Headwaters Cattaraugus Creek	7.23	2
Buffalo Creek	7.84	2
Buffalo river	7.87	2
Smoke(s) Creek	10.99	3
Niagara River	12.43	3
Ellicott Creek	13.29	3
Upper Tonawanda Creek	15.70	3
Cattaraugus Creek	16.11	4
Big Sister Creek	16.91	4
Lower Tonawanda Creek	18.67	4
Murder Creek	24.27	5
Middle Tonawanda Creek	29.46	5

Stream Density

High stream density is indicative of a large number of waterways miles per square mile in the sub-watershed. It is a measure of how well a watershed is drained by stream channels. In the Niagara River/ Lake Erie Watershed these tend to be in the forested headlands of the sub-watersheds.

Sub-watershed	Stream Density per mile	Score
Niagara River	1.3883	1
Lower Tonawanda Creek	1.7597	1
Canadaway Creek	1.8577	1
Big Sister Creek	1.9155	2
Buffalo River	1.9316	2
Smoke(s) Creek	1.9410	2
Ellicott Creek	2.0328	2
Chautauqua Creek	2.2525	3
Eighteenmile Creek	2.2847	3
Walnut Creek	2.2999	3
Sixmile Creek	2.3444	3
Buffalo Creek	2.4300	4
Headwaters Cattaraugus Creek	2.4518	4
Middle Tonawanda Creek	2.6789	4
Cattaraugus Creek	2.7120	4
Cayuga Creek	2.8019	5
Upper Tonawanda Creek	2.9610	5
Murder Creek	3.0475	5

Road/Waterway Crossings

The intersection of a waterway by a roadway is a crucial area of interference. Bridge abutments change the geometry of the stream bed and floodplain. They narrow the channel, increase the velocity and cause scour around the abutments. They also have the potential to impeded fish passage.

Sub-watershed	Count Per Acre	Score
Ellicott Creek	19.1296	1
Buffalo River	20.5898	1
Niagara River	31.0269	1
Smoke(s) Creek	33.1416	1
Eighteenmile Creek	11.1916	2
Canadaway Creek	11.3141	2
Cayuga Creek	11.4271	2
Lower Tonawanda Creek	11.9285	2
Chautauqua Creek	8.1963	3
Murder Creek	8.9963	3
Big Sister Creek	9.6214	3
Walnut Creek	10.5513	3
Upper Tonawanda Creek	6.2054	4
Buffalo Creek	7.0822	4
Sixmile Creek	1.1268	5
Headwater Cattaraugus Creek	5.1037	5
Cattaraugus Creek	5.4673	5
Middle Tonawanda Creek	5.9406	5

Remediation Sites

The NYS DEC Environmental Site Remediation Database includes state regulated hazardous waste sites in the watershed.

Sub-watershed	By Acre/1000	Score
Niagara River	152	1
Smoke(s) Creek	46	2
Buffalo River	79	2
Cayuga Creek	10	3
Lower Tonawanda Creek	16	3
Ellicott Creek	17	3
Cattaraugus Creek	6	4
Headwaters Cattaraugus Creek	6	4
Upper Tonawanda Creek	7	4
Canadaway	8	4
Big Sister Creek	1	5
Chautauqua Creek	1	5

Murder Creek	1	5
Walnut Creek	1	5
Middle Tonawanda Creek	3	5
Eighteenmile Creek	4	5

Overall Scoring

	Big Sister Creek	Buffalo Creek	Buffalo River	Canadaway Creek	Cattaraugus Creek	Cayuga Creek	Chautauqua Creek	Eighteenmile Creek	Ellicott Creek	Headwaters Cattaraugus	Lower Tonawanda	Middle Tonawanda	Murder Creek	Niagara River	Sixmile Creek	Smoke(s) Creek	Upper Tonawanda	Walnut Creek
Impervious Cover	4	4	2	3	5	3	5	4	2	5	3	4	4	1	5	2	4	5
Forest Cover	4	4	5	4	5	3	5	5	2	5	2	2	2	1	5	3	3	5
Industrial	5	4	3	4	4	4	5	5	1	3	3	3	1	2	5	2	2	5
Protected Land	4	2	2	2	4	2	1	1	3	2	4	5	5	3	1	3	3	1
Stream Density	2	4	2	1	4	5	3	3	2	4	1	4	5	1	3	2	5	3
Road Crossings	3	4	1	2	5	2	3	2	1	5	2	5	3	1	5	1	4	3
Remediation Sites	5	5	2	4	4	3	5	5	3	4	3	5	5	1	5	2	4	5
Total	27	27	17	20	31	22	27	25	14	28	18	28	25	10	29	15	25	27

Prioritize for Protection and Preservation**

Watersheds where the goal is to protect and preserve high quality conditions are generally characterized by a large amount of forest cover. They have low levels of urbanization and impervious cover. By focusing on these sub-watersheds tools can be developed and outcomes measured which will be most effective in protecting the health of sub-watersheds. It is also important to continue to address issues that do arise in these sub-watersheds in order to preserve their health.

Sub-watershed	Score
Cattaraugus Creek	31
Sixmile Creek	29
Middle Tonawanda	28
Headwaters Cattaraugus	28
Buffalo Creek	27
Walnut Creek	27
Big Sister Creek	27
Upper Tonawanda	25
Eighteenmile Creek	25
Chautauqua Creek	25
Murder Creek	25

Priority Sub-watersheds to Protect & Preserve (Good Conditions):

- Cattaraugus Creek Sub-watershed
- Sixmile Creek Sub-watershed
- Middle Tonawanda Creek Sub-watershed
- Headwaters Cattaraugus Creek Sub-watershed

Prioritize for Addressing Impairments**

Watersheds that should be targeted for water quality improvement have the most potential to affect factors contributing to the impairment of water quality and habitat conditions. They are often characterized by high density urban development and have a large percentage of impervious cover and industrialization. There may be large amount of infrastructure interfering with the natural flow of water.

Sub-watershed	Score
Niagara River	10
Ellicott Creek	14
Smoke(s) Creek	15
Buffalo River	17
Lower Tonawanda	18
Canadaway Creek	20
Cayuga Creek	22
Chautauqua Creek	25
Murder Creek	25
Upper Tonawanda	25
Eighteenmile Creek	25

Priority Sub-watersheds to Address Impairments (Poor Conditions):

- Niagara River Sub-watershed
- Ellicott Creek Sub-watershed
- Smoke(s) Creek Sub-watershed
- Buffalo River Sub-watershed

***It should be noted that the Priority Sub-watersheds identified are based on the full sub-watershed geography as a whole, not solely the principle tributary for which the sub-watershed is named.*

Chapter 9: Management Plan Phase 3 Strategy

In the very beginning of the watershed management planning process it became apparent that the sheer size and scale of the Watershed, in addition to the vast complexity of issues impacting water quality, required a multi-phased approach. Phases 1 and 2 of the Regional Niagara River/Lake Erie Watershed Management Plan development aimed to characterize the entire Niagara River/Lake Erie Watershed, capturing how it currently functions, what the primary issues are, and better understand the trends and major impairment contributors. This planning process also helped to identify what we do not know, where data is lacking and where we need to research further in order to outline specific management actions for each sub-watershed.

The Regional Niagara River/Lake Erie Watershed Management Plan is intended to be a living planning document, one that evolves over time, tracks progress, and is updated regularly based on new conditions and progress. In addition, it will serve as a foundation for developing a Nine-Element Watershed Management Plan for the region. In order to reach this level, the Lake Erie Watershed Protection Alliance and NYSDEC, along with other stakeholder organizations aim to develop a NYSDEC-approved Nine-Element Watershed Management Plan for the Niagara River/ Lake Erie Watershed in Phase 3 over the next several years. Upon completion, a Nine-Element Watershed Plan will outline strategies for restoration that are based on quantifiable metrics to enable on-going tracking of watershed health and the effectiveness of restoration initiatives. The nine elements[1] required in the plans are:

A. Identify and quantify sources of pollution in watershed.
B. Identify water quality target or goal and pollutant reductions needed to achieve goal.
C. Identify the best management practices (BMPs) that will help to achieve reductions needed to meet water quality target/goal.
D. Describe the financial and technical assistance needed to implement BMPs identified in Element C.
E. Describe the outreach to stakeholders and how their input was incorporated and the role of stakeholders to implement the plan.
F. Estimate a schedule to implement BMPs identified in plan.
G. Describe the milestones and estimated time frames for the implementation of BMPs.
H. Identify the criteria that will be used to assess water quality improvement as the plan is implemented.
I. Describe the monitoring plan that will collect water quality data needed to measure water quality improvement (criteria identified in Element H).

[1] https://www.dec.ny.gov/chemical/103264.html

Water Quality Monitoring and Modeling

As the Phase 2 Watershed Characterization was being worked on, NYSDEC initiated a partnership with U.S. Geological Survey to conduct water quality sampling at 19 sites throughout the watershed. This will serve as the monitoring required by a Nine-Element Plan to develop baseline conditions. Additional gage stations were set up at several of the locations to measure flow. Because nutrient monitoring is so important in Lake Erie and its watershed at this time, phosphorus and nitrogen are being measured in addition to traditional water quality parameters, such as temperature, dissolved oxygen, etc. This sampling process is scheduled to take place from fall 2017 through fall 2019 and will result in a report on the findings from the U.S. Geological Survey in 2020. The Lake Erie Watershed Protection Alliance (LEWPA) has also undertaken a water quality sampling project for bacteria. From spring 2019 through spring 2020, LEWPA will be sampling at the same 19 sites for *E. coli*, fecal coliform, and total coliform. A report will follow from LEWPA, also in 2020.

NYSDEC and U.S. Geological Survey have also partnered to create nine sub-watershed models throughout the Niagara River/Lake Erie Watershed to determine the potential impacts of certain BMPs and model the impacts that corrective actions could have on water quality. These are expected to be developed in 2019 and 2020 and be available around 2021.

These reports will be used toward sections A, B, and C of the Nine-Element Watershed Plan. Potential pollution sources have been identified in the Watershed Characterization laid out in Phases 1 and 2 and the water quality sampling and modeling results will be used to quantify those sources in the major waterways and identify the areas most impacted in the Watershed and most receptive to BMP implementation. Phase 3 will involve LEWPA and NYSDEC working together with regional and local stakeholders to develop target pollutant reductions, BMPs for implementation, and finalizing the rest of the nine-elements based upon the results from the monitoring and modeling.

Sub-watershed Planning

In Phase 2, five of the 18 sub-watersheds that were prioritized in Phase 1 received Stream Visual Assessment Protocol (SVAP) review, also funded by NYS Department of State. Three of these were prioritized for protection and two were prioritized for improvement. Teams from Buffalo Niagara Riverkeeper walked lengths of streams to determine the state of health of the waterways and came up with specific actions for implementation. Their findings are described in a separate report[2] for the following five sub-watersheds:

- Lower Tonawanda Creek (needs improvement)
- Smoke(s) Creek (needs improvement)

[2] *Healthy Niagara: Regional Niagara River/Lake Erie Watershed Management Plan – Phase 2*, found at https://bnwaterkeeper.org/projects/healthyniagara/

- Buffalo River (needs protection)
- Eighteenmile Creek (needs protection)
- Upper Tonawanda Creek (needs protection)

Phase 3 will focus on developing Sub-watershed Implementation Plans for the rest of the 18 sub-watersheds utilizing the information collected and reported in Plan, as well as ongoing data collection and modeling from U.S. Geological Survey. In addition, in order to ground-truth the results of the model outputs and determine locations for projects, SVAP will again be used to assess the health of the waterways and identify areas for action. LEWPA, NYSDEC, and stakeholders will identify critical pollution source areas and specific potential actions for improvement based upon the data. In the case of healthy areas, riparian buffers and forested areas will be identified for protection.

The result will be eighteen Sub-watershed Implementation Plans covering the Niagara River/Lake Erie Watershed that outline how to move ahead with detailed management actions, through prioritizing and ranking the most effective and influential actions (cost-benefit), as well as outlining benchmarks, timelines, partners, and funding for implementation. Stakeholders have indicated their further participation in this process and are eager to advance the plan forward.

Next Steps

Chapter 8 describes a comprehensive set of recommended actions that would advance the goals of this Watershed Management Plan. Some can be initiated shortly or are already underway, while others will require more upfront work, coordination and funding. The following chart outlines recommended actions from Chapter 8 that should be focused on in the short-term and/or can be part of the Phase 3 watershed planning, broken down into larger categories.

CONSERVATION, PROTECTION & MANAGEMENT

Conserve, protect and effectively manage the natural living infrastructure network that preserves watershed function, provides habitat and sustains biodiversity.

- ► Outline the living infrastructure network for the watershed and identify gaps or threatened components by encouraging municipalities to complete natural resource inventories.
- ► Establish a protection plan for living infrastructure components by Sub-watershed.
- ► Promote the role of living infrastructure to area land trusts, conservation groups, and local municipalities.
- ► Promote and implement the Niagara River Habitat Conservation Strategy and the New York Natural Heritage Program Statewide Riparian Opportunity Assessment.
- ► Design restoration plans for severely altered watercourses to replace missing living infrastructure and habitat.

INFRASTRUCTURE

Correct, upgrade, install, and maintain watershed related infrastructure that will protect and improve water resources, plus sustain and expand watershed function.

- Develop design guidelines and training modules on infrastructure designed to support water quality.
- Create tools to assist municipalities in tracking and maintaining infrastructure.
- Promote the benefits of green stormwater infrastructure.
- Install, evaluate, and endorse green infrastructure demonstration projects and promote them as educational resources.
- Implement Long-Term Control Plans to address known infrastructure deficiencies.
- Inventory and identify problem stormwater infrastructure.
- Call attention to and communicate private property violations to local regulatory authorities.
- Educate the public on infrastructure issues and proper maintenance to increase awareness of system workings, reduce non-point source pollution, increase the adoption of green infrastructure, and increase the longevity of existing systems.

DEVELOPMENT

Create only high-quality development, in-fill, and retrofits that work in conjunction with natural systems, minimize impacts on watershed health, and improve the public's relationship to water resources.

- Develop ordinance models and example zoning provisions for protecting water quality.
- Develop design guidelines and training modules on development designed to support water quality.
- Conduct outreach to municipal officials and boards on sustainable development.
- Highlight development projects that utilize low-impact and sustainable designs.

DATA

Fill data gaps to provide better understanding and analysis of watershed conditions for effective and resilient planning of water resources.

- Collect and analyze data from current water quality sampling efforts to establish comprehensive baseline conditions for the Watershed.
- Advocate for filling needed data gaps including natural resource and tree inventories, erosion assessments, septic system assessments, and new data collection and analysis as necessary.
- Highlight what certain data sets can do for planning efforts.

EDUCATION

Expand local knowledge of water resources, watershed conditions, non-point source pollution prevention, and natural living systems to foster public investment and practices to advance watershed health.

- Communicate and publicize the findings of the Watershed Management Plan.
- Educate local officials on the data and tools available to assist with local planning efforts.
- Disseminate information on Best Management Practices.
- Incorporate water stewardship education into recreational tours and activities.
- Expand outreach opportunities to include newspaper campaigns, social media and other peer-to-peer sharing, innovative water quality tools, and additional educational and interpretive signage.

FUNDING

Establish long-term funding mechanisms to effectively manage the watershed and water resources, including research, mitigation, restoration, and outreach.

- Secure additional grant and foundational funding to continue Phase 3 planning.
- Research various long-term and short-term funding mechanisms.
- Build the connection between clean water and economic vibrancy.

REGIONAL POLICY

Institute local, county, and state policies that enhance protections on water quality and watershed health, and improve watershed planning collaboration between local, county, and state organizations.

- Conduct outreach to local, county, and state organizations.
- Communicate and publicize the findings of the Watershed Management Plan.
- Establish watershed-wide roundtable discussions.
- Outline the Regional Watershed Plan Manager role.
- Build relationships with elected officials and representatives to promote new policies.
- Create regional sub-watershed roundtables to solicit local stakeholder input and support decision making.

Structure for Implementation

Regional Watershed Plan Manager

One of the most important factors to developing and implementing a successful watershed management plan is the collaboration and organization of key stakeholders and watershed-related organizations. Partnerships between governmental entities, environmental organizations, citizens groups, local and regional experts, and even businesses and utilities (water and sewer) are all instrumental to move this plan toward action. Many of these organizations have been involved in the development of the plan as Advisory Committee members; while others were consulted throughout the process. Still there are other entities need to be engaged further, such as schools, municipal boards, and local and county environmental commissions as planning enters Phase 3.

In a watershed with so many important partners, stakeholders, and different governmental jurisdictions, identifying who or what type of organization will lead the plan into action is essential. Discussions at the Advisory Committee level in Phase 1 came to the consensus that:

- no new organization or body be created;
- nor should any one county, water quality committee, environmental organization, or soil and water conservation district take on the lead role;
- nor should an individual entity take on the lead role without continuous adequate funding to do so.

The Lake Erie Watershed Protection Alliance, formed in 2012, is an inter-municipal organization made up of three counties committed to working together on water quality and water quantity issues; Cattaraugus, Chautauqua, and Erie counties. It fits the criteria established in Phase 1 and is funded through the NYS Environmental Protection Fund. This organization has taken on the role of Regional Watershed Plan Manager in Phase 2 and is applying for funding for Phase 3 of the Regional Niagara River/Lake Erie Watershed Management Plan in an effort to coordinate stakeholders and implement water quality improvement projects.

Key Stakeholders & Implementation Partners[3]

The following entities are essential players, partners and stakeholders for the implementation of the Phase 1 and Phase 2 plans and for engagement in Phase 3 planning efforts:

[3] Please note this is not meant to be an exclusive list and it can be expanded moving forward.

U.S. Environmental Protection Agency
U.S. Fish and Wildlife Service
U.S. Army Corps of Engineers
National Oceanic and Atmospheric Administration (NOAA)
NYS Dept. of Environmental Conservation
NYS Dept. of State
NYS Empire State Development
NYS Environmental Facilities Corporation
NYS Sea Grant
Cattaraugus County
Chautauqua County
Erie County
Genesee County
Niagara County
Wyoming County
Tuscarora & Seneca Nations
County Soil & Water Conservation Districts
University at Buffalo
Buffalo State College
Buffalo State Great Lakes Center
County Water Quality Committees
Lake Erie Management Commission
Tonawanda Creek Watershed Committee
Municipalities
Chautauqua Watershed Conservancy
WNY Land Conservancy
Land Trusts
Buffalo Niagara Riverkeeper
WNY Partnership for Regional Invasive Species Management
WNY Environmental Alliance
Sewer Districts & Water and Sewer Utilities
Fishing, Sportsman/Outdoorsmen's Groups

Funding[4]

Continued plan development and coordination funding for Phase 3 of the Regional Niagara River/Lake Erie Watershed Management Plan, in addition to project specific funding for implementing the five Sub-watershed Implementation plans, is necessary. This will require a mixture of resources including public grant monies, foundation grants, volunteer in-kind donations, capital campaigns, incentive-based funding, and public and private investments. The list below outlines some of these potential funding resources:

U.S. EPA Great Lakes Restoration Initiative
U.S. EPA Nonpoint Source Pollution (Section 319) Funding
U.S. EPA 5 Star Restoration Funding
U.S. EPA State/Local/ Tribal Wetlands Grant Programs
U.S. EPA Great Lakes Shoreline Cities Green Infrastructure Grants
U.S. EPA Urban Waters Small Grants Program
U.S. Fish and Wildlife Service (Various Grants & Cooperative Agreements)
U.S. Army Corps of Engineers (various Sections relative to habitat, flood infrastructure, navigation and shoreline protection)

[4] This is not meant to be a comprehensive list and only outlines the variety of resources available to the Niagara River/Lake Erie Watershed.

USDA NRCS Conservation Innovation Grants
USDA NRCS Agricultural Conservation Easement Program
USDA NRCS Agricultural Management Assistance Program
USDA NRCS Conservation Reserve Program
USDA NRCS Conservation Stewardship Program
USDA NRCS Debt for Nature Program
USDA NRCS Environmental Quality Incentives Program
USDA NRCS Healthy Forests Reserve Program
USDA NRCS Regional Conservation Partnership Program
USDA NRCS Watershed and Flood Prevention Operations Program
NYS Soil & Water Conservation Committee Agricultural Environmental Management Program
NYS Soil & Water Conservation Committee Agricultural Nonpoint Source Abatement and Control Program
NYS Water Quality Management - 604(b) Funding
NYS Water Quality Improvement Program
NYS Non-Agriculture and Non-Point Source Grant Program
NYS Great Lakes Basin Small Grants Program
NYS Landowner Incentive Program
NYS Conservation Partnership Program
NYS Urban & Community Forestry Grants
NYS Environmental Justice Grants
NYS Green Innovation Grant Program
NYS Environmental Protection Fund
NYS Sea Grant (various programs)
NYS Community Development Block Grants
NYS Canal Corporation
NYS Local Waterfront Revitalization Program
Chautauqua County 2% Occupancy Tax funding
County Soil and Water Conservation District funding
Municipal budgets
Margaret L. Wendt Foundation
John R. Oishei Foundation
Community Foundation for Great Buffalo
NYPA Greenway Commission (Standing Committees)

Future planning efforts should also look to establish consistent long-term funding mechanisms and incentive programs that will foster watershed health and stability, such as development impact fees, transfer of development rights, tax assessment programs, in-fill and brownfield tax credits, utility districts and utility incentive programs, adopt-a-stream programs, and green infrastructure incentives and tax credits. There are many areas of the country where such programs are successfully financing the protection and management of living infrastructure, including Portland, Oregon and Milwaukee, Wisconsin.

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