Chapter 4: Water Quality

More than 1 billion people in the world do not have access to safe drinking water, yet we are privileged to have 20 percent of the world's accessible fresh water at our front door.

Clean water is an essential human need and one whose value will increase as global climates change. The Niagara River Watershed 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 provide drinking water to 34 million people in the United States and Canada, and support more than 1.5 million U.S. jobs that generate $62 billion in wages[1].

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[2]. 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

Water Quality Sampling in Buffalo Creek (BNRK)

[1] U.S. EPA Great Lakes Basin Report
[2] NYS Water Quality Standards Program (overseen by the US EPA.)

protected (i.e. Anti-degradation policies). Table 4.1 outlines the various Water Quality Classifications for surface and ground waters in New York State.

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

Use classifications are applied according to water bodies or water course segments. For the Niagara River Watershed there are a total of 2,963 segments provided, with 726 designated as Class A, 872 designated as Class B, 1,351designated as Class C, and 14 designated as Class D. The State's Water Quality Classifications Map is provided on the following page and identifies each segment's classification as well as segments designated as trout and trout spawning waters.

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 (Figure 4.1). This data set provides a summary of general water quality conditions, tracks the degree to which a waterbody supports its designated uses, and monitors

Niagara River Watershed Management Plan

STATE WATER QUALITY CLASSIFICATIONS

Stream Class

- A
- A(T)
- A(TS)
- B
- B(T)
- C
- C(T)
- C(TS)
- D

Sub-Basin Boundary

County

Municipality

5 2.5 0 5
Miles
5 2.5 0 5
Kilometers

Sub-Basins of the Niagara River Watershed

This data set provides the water quality classifications of New York State water bodies.
The classification AA or A is assigned to waters used as a source of drinking water.
Classification B indicates a best usage for swimming and other contact recreation, but not for drinking water.
Classification C is for waters supporting fisheries and suitable for non - contact activities.
The lowest classification and standard is D.
Waters with classifications A, B, and C may also have a standard of (T), indicating that it may support a trout population, or (TS), indicating that it may support trout spawning (TS).
Special requirements apply to sustain these waters that support these valuable and sensitive fisheries resources.
Streams designated as C (T) or higher (i.e., C (TS), B, or A) are collectively referred to as "protected streams."
Sub-Watersheds are based on the U.S. Geological Survey10-Digit Hyrologic Unit Codes (HUC).

BUFFALO NIAGARA RIVERKEEPER®

NEW YORK STATE DEPARTMENT OF STATE

This map was prepared for the New York State Department of State with funds provided under Title 11 of the Environmental Protection Fund Act.

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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

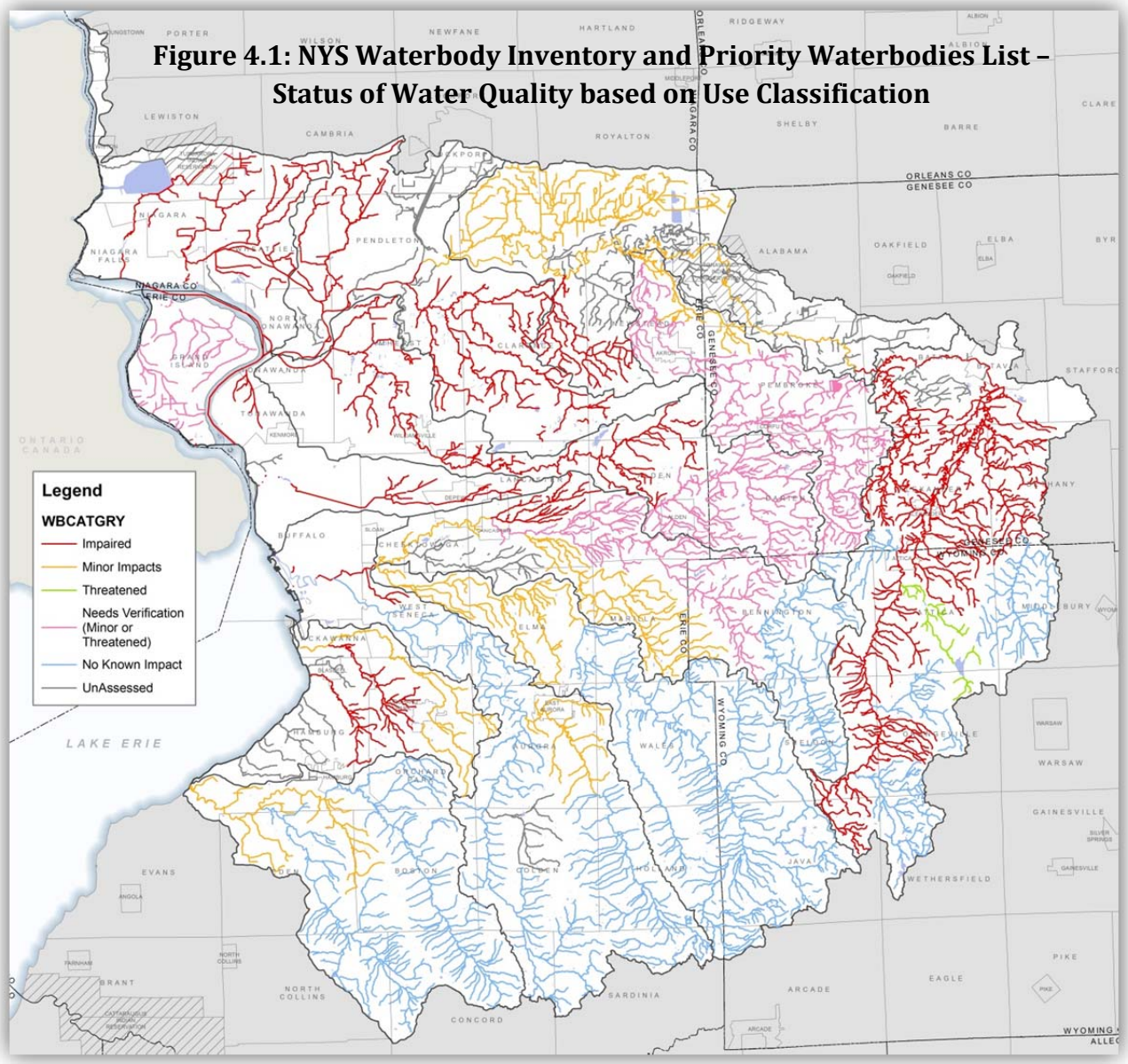
Impaired Waters	Waterbodies with well documented water quality problems.
Waters with Minor Impacts	Waterbodies where less severe water quality impacts are apparent, but classification uses are considered fully supported.
Threatened Waters	Waterbodies for which uses are not restricted and no water quality 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 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.
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.
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. EPA 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 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. EPA 303(d) List are the focus of remedial/corrective and resource protection actions, as well as priorities for funding resources.

The Priority Waterbody List for the Niagara River/Lake Erie Basin was reviewed and updated with sampling done in 2005-06 and issued in September 2010. The data is collected and maintained by the New York State Department of Environmental Conservation. The next update and review effort in the basin will begin in 2015 and is expected to be completed by 2017.

Figure 4.1: NYS Waterbody Inventory and Priority Waterbodies List – Status of Water Quality based on Use Classification



Source: NYS DEC WI/PWL

Of the watershed's total 3,245 miles of waterways, approximately 1,548.8 stream miles (47.7%) are considered Priority Waterbodies, meaning they have water quality impacts or issues that restrict the

water's beneficial uses. The NYS WI/PWL also includes 255.8 water body acres and 25.4 Lake Erie shoreline miles as Priorities. Of these water bodies and segments, 64% have been placed on the *U.S. EPA 303(d) Impaired Waters List* and include much of the Niagara River, Ellicott Creek, Smokes Creek, Lower and Upper Tonawanda Creek Sub-watersheds, and all of the Lake Erie Shoreline miles within the state. Only the southern end of the watershed and headwaters of Eighteenmile Creek, Buffalo River, Buffalo Creek, Cayuga Creek, and Upper Tonawanda Creek Sub-watersheds have no known impacts at this time (Figure 4.1). Table 4.3 on the following pages outlines the RIBS water quality data by each sub-watershed, including the uses that are impacted and their known or suspected causes.

According to the 2010 Niagara River/Lake Erie RIBS report, the primary water quality issues in the watershed stem from past industrial uses which center on the Lake Erie Lakewide Action Management Plan (LAMP) and the Great Lakes Areas of Concern (AOCs) located along the Buffalo and Niagara Rivers. Historical contamination issues are well documented in the RIBS data for the Niagara River Sub-watershed overall, where a number of impaired stream segments have 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.

1951 Aerial of the Buffalo River near South Park Ave

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[3]. Outside of the Buffalo and Niagara River corridors, there are a few remaining areas within the watershed that have impairments from known or suspected contaminated sediments, and include the more urban/suburban areas of Eighteenmile Creek, Ellicott Creek, and Tonawanda Creek, as well as the Lake Erie Shoreline (see Table 4.3).

[3] 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 Watershed - Water Quality Summary Conditions by Sub-watershed (RIBs Data)

ID number	Waterbodies/ Segments	Length/Size	WQ Category	Class	Impacted Uses & Severity	Pollutants**	Pollutant Sources**
Niagara River Sub-watershed							
Ont 158 (portion 1)	Niagara River, Lower, Main Stem	12.0 miles	**IMPAIRED**	A-Spcl	Water Supply - Threatened, Fish Consumption - Impaired, Habitat/Hydrology - Impaired	Priority Organics (Dioxin, PCBs, PAHs), Pesticides (mirex, Org.Chlor.Pest/HCB)	Tox/Contaminated Sediments, Habitat Modification
Ont 158 (portion 2)	Niagara River, Upper, Main Stem	24.8 miles	**IMPAIRED**	A-Spcl	Water Supply - Threatened, Fish Consumption - Impaired, Habitat/Hydrology - Impaired, Aquatic Life - Stressed	Priority Organics (PCBs, PAHs), Pesticides (Org. Chlor. Pest/HCB), Water Level/Flow, Restricted Passage	Habitat Modification, Tox/Contaminated Sediments, Landfill/Land Disp., Combined Sewer Overflow, Urban/Storm Run-off
Ont 158 (portion 3)	Chippewa (West) Channel	12.8 miles	**IMPAIRED**	A-Spcl	Water Supply - Threatened, Fish Consumption - Impaired	Priority Organics (PCBs)	Tox/Contaminated Sediments, Landfill/Land Disp.
Ont 158 (portion 4)	Black Rock Canal	2.2 miles	**IMPAIRED**	C	Fish Consumption - Impaired, Aquatic Life - Stressed, Habitat/Hydrology - Impaired	Priority Organics (PCBs)	Tox/Contaminated Sediments, 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	Aquatic Life - Stressed, Habitat/Hydrology - Threatened	Silt/Sediment	Hydro Modification, Urban/Storm Run-off
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 Run-off, Tox/Contaminated Sediments
Ont 158-1 thru 5	Minor Tribs to Niagara River		Unassessed				
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), Oxygen Demand	Urban/Storm Run-off
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 Sediments, Urban/Storm Run-off
Ont 158-13	Two-mile Creek and Tribs	7.1 miles	**IMPAIRED**	B	Public Bathing - Impaired, Aquatic Life - Impaired, Recreation - Impaired, Aesthetics - Stressed	Aesthetics (odors, floatables), Oxygen Demand, Pathogens, Nutrients, Priority Organics	Combined Sewer Overflow, Municipal (Kenmore/Tonawanda (T)), Urban/Storm Run off, Industrial, Other Sanitary Discharge, Tox/Contaminated Sediments
Ont 158-15	Scajaquada Creek, Upper and Tribs	15.1 miles	**IMPAIRED**	B	Public Bathing - Impaired, Aquatic Life - Impaired, Recreation - Impaired	Nutrients (phosphorus), Oxygen Demand, Pathogens, Silt/Sediment	Urban/Storm Run-off, Combined Sewer Overflow
Ont 158-15	Scajaquada Creek, Middle and Tribs	8.3 miles	**IMPAIRED**	C	Aquatic Life - Precluded, Recreation - Impaired, Habitat/Hydrology - Stressed, Aesthetics - Stressed	Aesthetics (floatables), Oxygen Demand, Nutrients (phosphorus), Pathogens, Priority Organics, Silt/Sediment	Combined Sewer Overflow, Urban/Storm Run-off, Habitat & Hydro Modification, Tox/Contaminated Sediments

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), Oxygen Demand, Pathogens, Nutrients (phosphorus), Priority Organics	Combined Sewer Overflow, Urban/Storm Run-off, Habitat & Hydro Modification, Tox/Contaminated Sediments
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 Sediments, Urban/Storm Run-off
Ont 158-15-P25	Delaware Park Pond	1.3 acres	**IMPAIRED**	B	Public Bathing - Impaired, Fish Consumption - Impaired, Recreation - Impaired	Algal/Weed Growth, Nutrients (phosphorus), Oxygen Demand, Priority Organics (PCBs)	Tox/Contaminated Sediments, Urban/Storm Run-off
Buffalo River Sub-watershed							
Ont 158..E-1	Buffalo River, Main Stem	8.6 miles	**IMPAIRED**	C	Fish Consumption - Precluded, Aquatic Life - Stressed, Recreation - Stressed	PCBs, Dissolved Oxygen, Pathogens, Silt/Sediment	Tox/Contaminated Sediments, Habitat & Hydro Modification, Urban/Storm Run-off, CSOs
Ont 158..E-1-4	Cazenovia Creek and Tribs	51.7 miles	No Known Impacts	B	No Uses Impaired		
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 Run-off
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..E1-4-15-10	Pipe Creek and Tribs		Unassessed				
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 Run-off
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 Run-off, Agricutlure
Ont 158..E-1*	Buffalo Creek, Upper, and Minor Tribs	285.1 miles	No Known Impacts	A	No Uses Impaired		
Ont 158-12-77-3-P20b	Faun Lake	44.3 acres	No Known Impacts	C	No Uses Impaired		
Ont 158..E-1*-55-P??	Beaver Meadow Pond		Unassessed				
Cayuga Creek Sub-watershed							
Ont 158..E-1-6	Cayuga Creek, Lower and Tribs	13.5 miles	**Minor Impacts**	C	Fish Consumption - Stressed, Aquatic Life - Stressed	Nutrients, Silt/Sediment, Metals, PAHs, Pathogens	Streambank Erosion, Urban/Storm Run-off
Ont 158..E-1-6	Cayuga Creek, Middle and minor Tribs	116.6 miles	Needs Verification	B	Aquatic Life - Stressed, Recreation - Stressed	Nutrients, Pathogens, Silt/Sediments	On-site Septic Systems (Cowlesville), Streambank Erosion
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, Oxygen Demand, Nutrients	Unknown Source, Municipal, Urban/Storm Run-off

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		
Ont 158..E-1-6-2	Slate Bottom Creek and Tribs		Unassessed				
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, PCBs, Pathogens	Streambank Erosion, Urban/Storm Run-off, Agricutlure, Hydro Modification, Tox/Contaminated Sediments
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), Oxygen Demand	Agriculture, Urban/Storm Run-off
Smoke Creek Sub-watershed							
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, Silt/Sediment, Pathogens	Urban/Storm Run-off, 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 Run-off, 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 Run-off
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 Run-off
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), Unkown Toxicity	Municipal (Hamburg, Blasdell SSOs) Urban/Storm Run-off, other Sanitary Discharge
Ont 158..E-4 thru 12	Minor Tribs to Lake Erie		Unassessed				
Ont 158..E-2-1-P81b	Green Lake	18.6 acres	**IMPAIRED**	B	Public Bathing - Impaired, Aquatic Life - Stressed, Recreation - Impaired	Nutrients (phosphorus), Oxygen Demand	Urban/Storm Run-off
Ellicott Creek Sub-watershed							
Ont 158-12-1	Ellicott Creek, Lower and Tribs	112.0 miles	**IMPAIRED**	B	Fish Consumption - Stressed, Aquatic Life - Impaired, Recreation - Stressed, Aesthetics - Stressed	Nutrients (phosphorus), Silt/Sediment, Pesticides (chlordane), Thermal Changes	Urban/Storm Run-off, Habitat & Hydro Modification, Municipal (unknown), Agriculture, Other Sanitary Discharge, Tox/Contaminated Sediments
Ont 158-12-1	Ellicott Creek, Upper and Tribs	112.1 miles	Needs Verification	C*	Aquatic Life - Stressed, Recreation - Stressed	Silt/Sediment	Agriculture
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		
Ont 158-12-11-1-P13	Akron Reservoir	47.4 acres	No Known Impact	A	Water Supply - Threatened		
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 Run-off, Other Sanitary Discharge, Streambank Erosion
Ont 158-12-3	Bull Creek and Tribs	48.6 miles	**IMPAIRED**	C	Aquatic Life - Impaired	Unknown Toxicity, Oxygen Demand, Nutrients	Unknown Source, Municipal, Urban/Storm Run-off
Ont 158-12-6	Ransom Creek, Lower and Tribs	49.5 miles	**IMPAIRED**	C	Aquatic Life - Impaired, Recreation - Impaired, Aesthetics - Stressed	Oxygen Demand, Pathogens, Aesthetics (odors), Nutrients, Silt/Sediment	On-site Septic System (Clarence Hollow), Private Comm/Institutional (various residential), Urban/Storm Run-off
Ont 158-12-6	Ransom Creek, Upper and Tribs	44.2 miles	**IMPAIRED**	C (T)	Aquatic Life - Impaired, Recreation - Impaired, Aesthetics - Stressed	Oxygen Demand, Pathogens, Aesthetics (odors), Nutrients, Silt/Sediment	On-site Septic System (Clarence Hollow), Private Comm/Institutional (various residential), Urban/Storm Run-off
Ont 158-12-2 thru 5	Minor Tribs to Lower Tonawanda Creek		Unassessed				
Ont 158-12 (portion 1a)	NYS Barge Canal (portion 1)		Unassessed				
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	**Minor Impacts**	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	Oxygen Demand, Nutrients (phosphorus), Pathogens	
Ont 158-12-20-P15	Divers Lake		Unassessed				
Ont 158-12-7 thru 31	Minor Tribs to Tonawanda Creek		Unassessed				
Upper Tonawanda Creek Sub-watershed							
Ont 158-12 (portion 3)	Tonawanda Creek, Middle, Main Stem	11.7 miles	**IMPAIRED**	C	Aquatic Life - Impaired, Recreation - Impaired, Aesthetics - Stressed	Nutrients (phosphorus), Silt/Sediment, Oxygen Demand	Other Sanitary Discharge, Streambank Erosion, Urban/Storm Run-off, Agricutlure, Municipal (Batavia WWTP), On-site Septic Systems (East Pembroke)
Ont 158-12 (portion 4)	Tonawanda Creek, Upper and minor Tribs	255.1 miles	**IMPAIRED**	A	Water Supply - Impaired, Aquatic Life - Stressed, Recreation - Stressed	Silt/Sediment, Nutrients, 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	Oxygen Demand, Nutrients (phosphorus), Pathogens	
Ont 158-12-32	Little Tonawanda Creek, Lower and Tribs	52.8 miles	**IMPAIRED**	A	Water Supply - Impaired, Public Bathing - Stressed, Recreation - Stressed	Silt/Sediment, Nutrients, 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 158-12-66	Stony Brook and Tribs	25.0 miles	No Known Impact	A	No Uses Impaired		
Ont 158-12-77	East Fork and Tribs	48.5 miles	No Known Impact	A	No Uses Impaired		
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

Lake Erie Shoreline							
Ont 158-E (portion 1)	Lake Erie (Erie Basin)	4.4 shore mi.	**IMPAIRED**	C	Fish Consumption - Impaired	Priority Organics (PCBs)	Tox/Contaminated Sediments
Ont 158-E (portion 2)	Lake Erie (Outer Harbor, North)	7.3 shore mi.	**IMPAIRED**	B	Fish Consumption - Impaired	Priority Organics (PCBs)	Tox/Contaminated Sediments
Ont 158-E (portion 3)	Lake Erie (Outer Harbor, South)	1.9 shore mi.	**IMPAIRED**	C	Fish Consumption - Impaired	Priority Organics (PCBs)	Tox/Contaminated Sediments
Ont 158-E (portion 4)	Lake Erie (Northeast Shoreline)	2.8 shore mi.	**IMPAIRED**	C	Fish Consumption - Impaired	Priority Organics (PCBs)	Tox/Contaminated Sediments, Urban/Storm Run-off
Ont 158-E (portion 5)	Lake Erie (Main Lake, North)	9.0 shore mi.	**IMPAIRED**	B	Public Bathing - Impaired, Fish Consumption - Impaired, Recreation - Impaired	Priority Organics (PCBs)	Tox/Contaminated Sediments, Urban/Storm Run-off

* has smaller tribs under different classification

(T) indicates Trout waters

** only known or suspected are included in this chart

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. For the rural sub-watersheds of Cayuga Creek, Eighteenmile Creek, Buffalo Creek, Murder Creek, Middle and Upper Tonawanda Creek many of the known or suspected impairments are attributed to agricultural activities, 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. While the more urban/ suburban sub-watersheds (Lower Tonawanda Creek, Smokes Creek, Ellicott Creek, Buffalo River, Niagara River) are experiencing similar issues, pathogens and nutrient loading are introduced through other means, such as combined sewer overflows events and stormwater run-off from improper lawn care practices. Lake Erie itself (beyond the shoreline) 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[4]. 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" on page 4 - 19.

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 other 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[5]. 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.

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

[4] Myers, Donna N., et al. *Water Quality in the Lake Erie-Lake Saint Clair Drainages* (USGS 2000)
[5] U.S. EPA

through the U.S. EPA[6]. In the Niagara River watershed 12 out of the 35 waterbodies/segments (34%) identified in the most recent(2010) 303(d) Impaired Waters 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 Watershed

Id #	Waterbodies/ Segments	Type	Class	Impairment	Known Cause
Ont 158-6	Gill Creek & Tribs	River	C	Aquatic Toxicity	Urban Run-off, Contaminated Sediment
Ont 158-6-Pla	Hyde Park Lake	Lake	B	Phosphorus	Urban/Storm Run-off
Ont 158-8-1	Bergholtz Creek and Tribs	River	C	Phosphorus, Pathogens	Urban Run-off
Ont-158-12-6	Ransom Creek, Lower & Tribs	River	C	Oxygen Demand, Pathogens	Onsite Waste Treatment Systems
Ont-158-12-6	Ransom Creek, Upper & Tribs	River	C (T)	Oxygen Demand, Pathogens	Onsite Waste Treatment Systems
Ont-158-13	Two Mile Creek & Tribs	River	B	Floatables, Oxygen Demand, Pathogens	CSOs, Municipal
Ont-158-15	Scajaquada Creek, Lower & Tribs	River	B	Floatables, Oxygen Demand, Pathogens, Phosphorus	CSOs, Urban Run-off
Ont-158-15	Scajaquada Creek, Upper & Tribs	River	C	Floatables, Oxygen Demand, Pathogens, Phosphorus	CSOs, Urban Run-off
Ont-158-15	Scajaquada Creek, Middle & Tribs	River	B	Oxygen Demand, Pathogens, Phosphorus	CSOs, Urban Run-off
Ont-158-E (portion 5)	Lake Erie (Northeast Shoreline	Great Lake	B	Pathogens	Urban, Storm Run-off
Ont-158.E-2-1-P81b	Green Lake	Lake	B	Phosphorus	Urban Run-off
Ont-158.E-3	Rush Creek & Tribs	River	C	Pathogens, Phosphorus	CSOs, Urban Run-off, Municipal

Source: 2012 Section 303(d) Impaired Waters List

None of these waters listed are scheduled for TMDL development by the NYS DEC at this time and the Niagara River Watershed is currently the only area of the state that has not had any TMDLs developed. According to the NYS DEC this is due to a number of factors, including the lack of comprehensive base data existing in the region; 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); and, how there historically hasn't

[6] TMDLs are a key metric for the US EPA's 9 Element Watershed Management Plan (preferred planning model).

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.

Aquatic Habitat - Water Quality Indicators

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 preformed 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 (NYS DEC, 2013), and water quality in general. The map provided on the following page contains BAP scores from 3 different years of sampling ranked by the assessment score. 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."

Macroinvertebrate Sampling

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. Predicted BAP scores by percentage of waterways within each sub-watershed are displayed in Table 4.5 for comparison purposes.

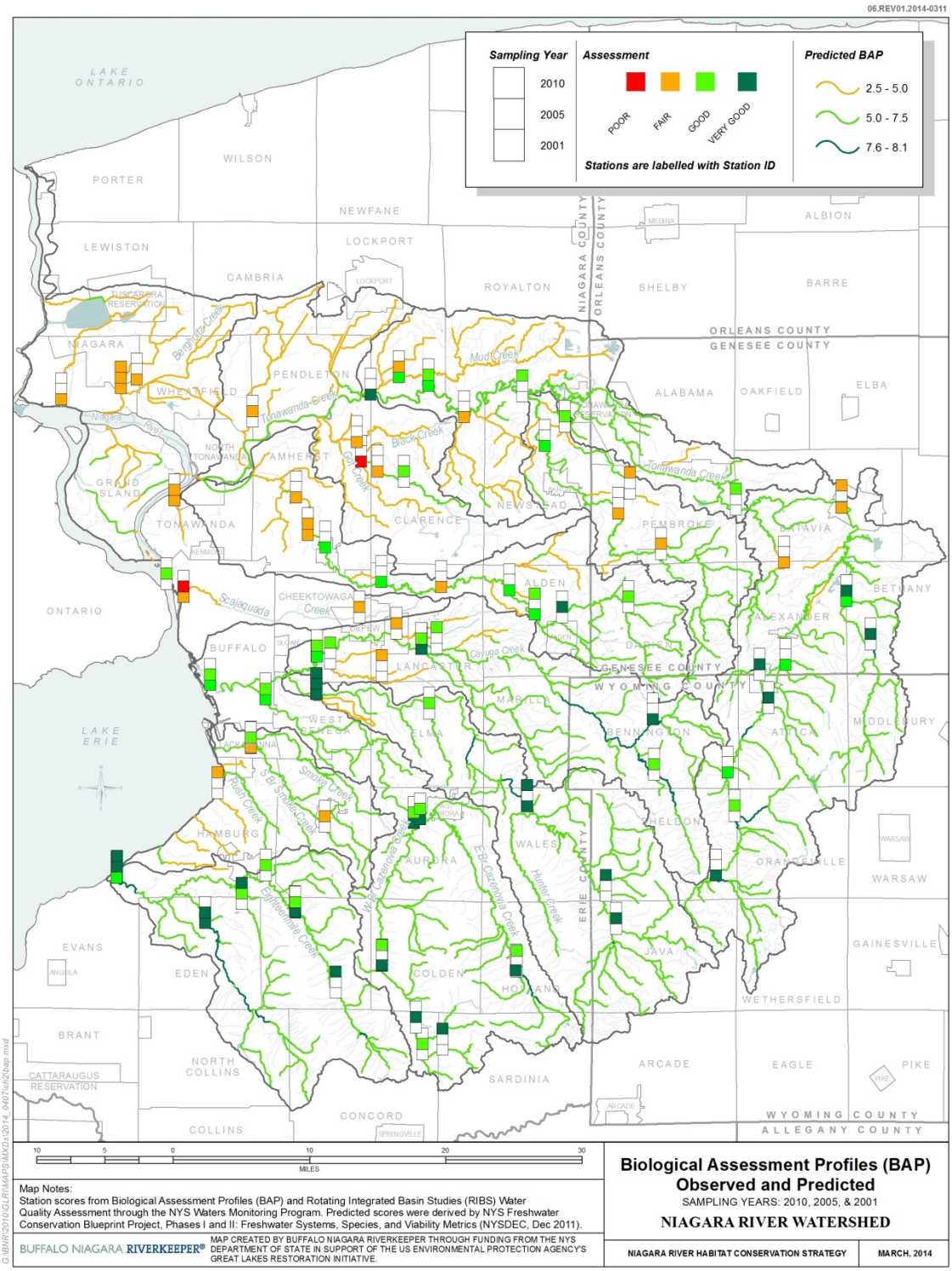

06.REV01.2014-0311
Sampling Year
2010
2005
2001
Assessment
POOR
FAIR
GOOD
VERY GOOD
Stations are labelled with Station ID
Predicted BAP
2.5 - 5.0
5.0 - 7.5
7.6 - 8.1
LAKE ONTARIO
LAKE ERIE
ONTARIO
PORTER
WILSON
NEWFANE
LEWISTON
LOCKPORT
CAMBRIA
ROYALTON
SHELBY
ALBION
BARRE
NIAGARA COUNTY
ORLEANS COUNTY
GENESEE COUNTY
NIAGARA
PENDLETON
WHEATFIELD
AMHERST
CLARENCE
NEWSTEAD
ALABAMA
OAKFIELD
ELBA
PEMBROKE
BATAVIA
BETHANY
ALEXANDER
GRAND ISLAND
TONAWANDA
CHEEKTOWAGA
ALDEN
BUFFALO
LANCASTER
DARIEN
WYOMING COUNTY
MARILLA
WEST SENECA
ELMA
BENNINGTON
ATTICA
MIDDLEBURY
HAMBURG
AURORA
WALES
SHELDON
ORANGEVILLE
WARSAW
EVANS
ANGOLA
EDEN
COLDEN
HOLLAND
JAVA
GAINESVILLE
WETHERSFIELD
BRANT
NORTH COLLINS
CATTARAUGUS RESERVATION
SARDINIA
ARCADE
EAGLE
PIKE
CONCORD
COLLINS
ALLEGANY COUNTY
Tonawanda Creek
Black Creek
Mud Creek
Scajaquada Creek
Cayuga Creek
Smoke Creek
Rush Creek
Eighteenmile Creek
Hunter Creek
E Br Cazenovia Creek
MILES
Map Notes:
Station scores from Biological Assessment Profiles (BAP) and Rotating Integrated Basin Studies (RIBS) Water Quality Assessment through the NYS Waters Monitoring Program. Predicted scores were derived by NYS Freshwater Conservation Blueprint Project, Phases I and II: Freshwater Systems, Species, and Viability Metrics (NYSDEC, Dec 2011).
BUFFALO NIAGARA RIVERKEEPER®
MAP CREATED BY BUFFALO NIAGARA RIVERKEEPER THROUGH FUNDING FROM THE NYS DEPARTMENT OF STATE IN SUPPORT OF THE US ENVIRONMENTAL PROTECTION AGENCY'S GREAT LAKES RESTORATION INITIATIVE.
Biological Assessment Profiles (BAP)
Observed and Predicted
SAMPLING YEARS: 2010, 2005, & 2001
NIAGARA RIVER WATERSHED
NIAGARA RIVER HABITAT CONSERVATION STRATEGY
MARCH, 2014

Table 4.5 Predicted BAP Scores by Percentage of Waterways

Sub-watershed	Poor < 2.5	Fair 2.5 - 5.0	Good 5.0 - 7.5	Very Good > 7.5	Grand Total
Buffalo Creek	0.0%	5.3%	91.6%	3.1%	**11.7%**
Buffalo River	0.0%	0.0%	97.9%	2.1%	**11.0%**
Cayuga Creek	0.0%	16.8%	72.6%	10.6%	**9.8%**
Eighteenmile Creek	0.0%	0.8%	89.2%	9.9%	**8.4%**
Ellicott Creek	0.0%	30.6%	69.4%	0.0%	**8.1%**
Lower Tonawanda Creek	0.0%	77.4%	22.6%	0.0%	**7.9%**
Middle Tonawanda Creek	0.0%	50.8%	49.2%	0.0%	**10.9%**
Murder Creek	0.0%	18.7%	81.3%	0.0%	**6.1%**
Niagara River	0.0%	88.2%	11.8%	0.0%	**6.3%**
Smoke Creek	0.0%	22.7%	77.3%	0.0%	**4.9%**
Upper Tonawanda Creek	0.0%	3.7%	92.2%	4.1%	**14.9%**
Grand Total	**0.0%**	**24.9%**	**72.1%**	**3.1%**	**100.0%**

Source: NYS Freshwater Conservation Blueprint Project, L. Matthies-Wiza

The BAP scores (point & predicted) show similar findings to the overall RIBS data set, which indicates poorer water quality conditions in the northern portions of the watershed: Niagara River Sub-watershed, Ellicott Creek Sub-watershed, Murder Creek Sub-watershed, and Lower, Middle, and Upper Tonawanda Creek Sub-watersheds. However, when reviewing trends shown in the BAP data over the sampling years it's clear that some of the southern sub-watersheds are beginning to show signs of degrading conditions as well. This is most apparent in Cazenovia Creek (and tributaries), portions of Eighteenmile Creek and its South Branch, and Cayuga Creek within the first ring suburbs. There are also a few stream segments where conditions have improved slightly, such as portions of Rush Creek, Smokes Creek, Eighteenmile Creek (near the Lake Erie shoreline), and Little Tonawanda Creek.

Overall, the Niagara River Sub-watershed has the highest percentage of stream segments considered "fair" (88.2%), with Lower and Middle Tonawanda Creek Sub-watersheds coming in a close second and third highest, with 77.4% and 50.8% respectively. Cayuga Creek Sub-watershed has the highest percentage of stream segments considered "very good" according to the predicted BAP scores, but this only accounts for 10.6% of its stream segments, not nearly enough to consider the entire sub-watershed as "very-good". 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.

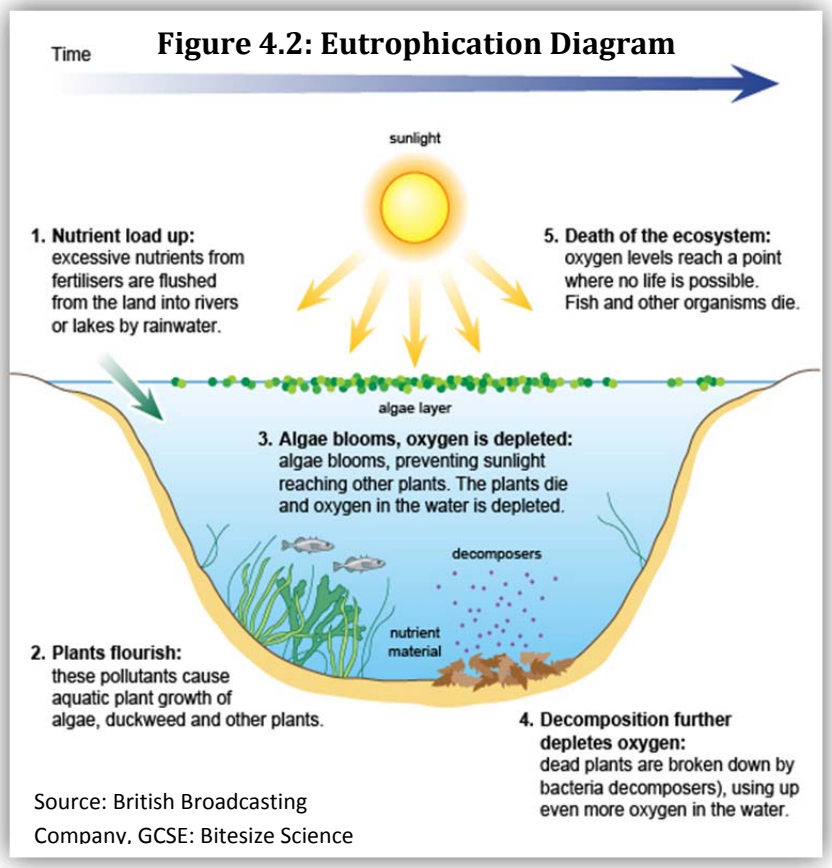
Water Quality of Wetlands & Lakes

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."[7] 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.

Smaller lakes and ponds within the watershed are monitored as part of the NYS WI/PWL as well, and drinking waterbodies are assessed by the NYS Department of Health's Source Waters Assessment Program (SWAP). The Niagara River Watershed has 10 smaller waterbodies included in the NYS WI/PWL (See Table 4.3) of which Hyde Park Lake, Attica Reservoir, Delaware Park (Hoyt) Lake, and Green Lake are the most degraded according to their use classifications. The causes for water quality impairments in the lakes are very similar to the other primary watershed impairments, with data showing nutrient loading and signs of eutrophication.

Figure 4.2: Eutrophication Diagram



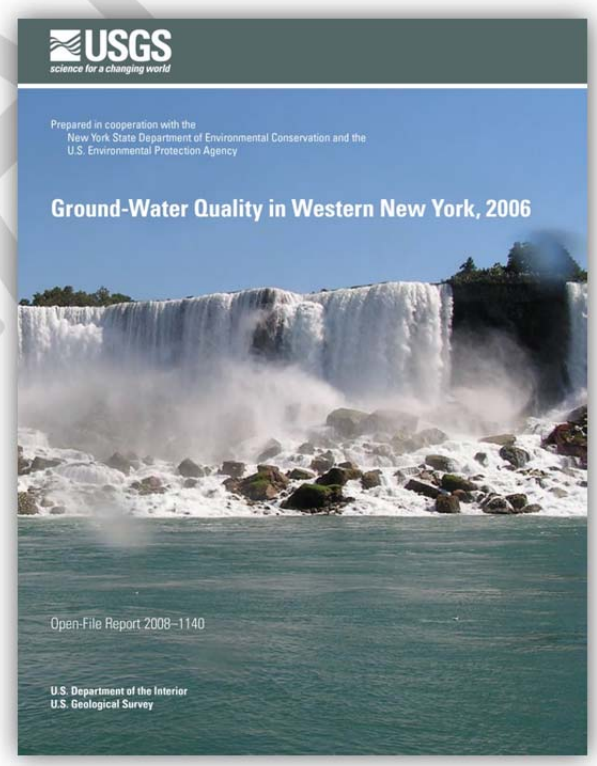
Source: British Broadcasting Company, GCSE: Bitesize Science

[7] NYS DEC New York State Wetlands Assessment

The urban lakes, Delaware Park (Hoyt) Lake and Hyde Park Lake, have the most issues and both are considered impaired. Delaware Park (Hoyt) Lake's issues stem from high pathogen levels and toxic sediments due to combined sewer overflows and legacy contamination, and excessive algal growth and low oxygen levels from its altered hydrology. Hyde Park Lake is located in the City of Niagara Falls and directly adjacent to the municipal golf course which directly contributes to the lake's documented eutrophication issues (Figure 4.2). Divers Lake and Beaver Meadow Pond in have yet to be assessed and Akron Reservoir and Faun Lake in have no known impacts at this time.

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[8]). Water samples were taken from 7 production wells and 26 private residential wells across Western New York in 2006, with eight of the sampling wells located in the Niagara River Watershed. These samples were analyzed for five physical properties and 219 constituents that included inorganic major ions, nutrients, organic carbon, trace elements, radon-222, 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 limited constituents such as sodium, sulfate, iron, manganese, and total coliform appeared in a few water sources that exceeded maximum USEPA and NYS DOH standards. The citations that were detected in the highest concentrations were calcium, magnesium, and sodium. The anions that were detected in the highest concentrations were bicarbonate, chloride, and sulfate and the predominant nutrients were nitrate and ammonia. The report also indicates that 18 pesticides were detected in 14 of the 33 wells sampled, and 14 Volatile Organic Componds (VOCs) were detected in 12 samples, but neither of their concentrations exceeded regulatory thresholds.



[8] Prepared by the NYS DEC, US EPA, US Dept. of Interior and US Geological Survey.

It should also be noted that the USGS Ground-water Quality in Western New York, 2006 Report recommends "a comprehensive and current assessment of the ground-water quality throughout the entire area is needed."

Drinking Water Supplies

The largest water suppliers are the Erie County Water Authority and the Niagara Falls Water Board. The ECWA had 158,650 customers or over 550,000 persons in 35 municipalities in Erie, Genesee and Wyoming counties in 2010. The Niagara Falls Water Board serves about 55,000 persons in Niagara County through 19,500 service connections. Their water sources are Lake Erie and the Niagara River. More information about these two water suppliers can be found in their most recent water quality reports that are included in the Appendix X.

Many of the rural communities and residents that are not supplied by these two 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 on the following page[9]. 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.

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.

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

[9] The Wells and Aquifers map only outlines public water supply wells, private wells are not documented.

Niagara River Watershed Management Plan

WATER WELLS AND UNCONSOLIDATED AQUIFERS

Water Well Discharge Rate (Gallons per Minute)

- 0-19
- 20-75
- 100-300
- 600-1000
- 10000
- N/A

Unconsolidated Aquifer

- Primary Aquifer Region
- Unconfined, High Yield
- Unconfined, Mid Yield
- Confined, No Overlying Surfical Aquifer
- Confined, Unknown Depth and Thickness
- Kame, Outwash or Alluvium
- Moraine

Sub-Basin Boundary

County

Municipality

5 2.5 0 5 Miles

5 2.5 0 5 Kilometers

Sub-Basins of the Niagara River Watershed

Water well data is developed from well completion reports submitted to NYS DEC and is not always verified.The aquifers represent an effort by NYS DEC to facilitate the identification of the location and extent of significant unconsolidated aquifers; those that consist of sand and gravel and yield large supplies of water to wells. Sub-Watersheds are based on the U.S. Geological Survey10-Digit Hyrologic Unit Codes (HUC).

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This map was prepared for the New York State Department of State with funds provided under Title 11 of the Environmental Protection Fund Act.

C:\Users\WKS7\Documents\ArcGIS\Packages\11x17_aquifers\v10\11x17_aquifers.mxd

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[10]. Areas of Concern are "delisted" when all Beneficial Use Impairments 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. The Buffalo River and City Ship Canal are man-made waterways which were created to allow for industrialization of the area. That industrialization lead to the contamination of bottom sediments, poor water quality, and degradation of 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 1 and Stage 2 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) to take over coordination of the RAP. (FBNR changed its name in July 2005 and is now known as Buffalo Niagara RIVERKEEPER®). 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 (Table 4.6). The main impairment causes are contaminated sediments, loss of wildlife habitat, and ongoing contamination from point and non-point source pollution.

[10] US EPA

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.
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 is being funded ($20 million) by the Great Lakes Legacy Act Program. This phase will dredge approximately 480,000 cubic yards of contaminated sediment from the side

Phase II of Buffalo River Dredging (2013)

slopes of the River and cap approximately 9 acres in the City Ship Canal[11]. Dredging was competed in 2014, leading to significant progress towards delisting 7 of the 9 Impaired Beneficial Uses.

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 will be enhanced/restored with in-water plantings and the placement of in-water structures. Erie County has received funding from USEPA to enhance shoreline and upland habitat at their two community pocket parks on the River (Smits Street Park and Bailey Avenue Peninsula). Funded by various sources, the RiverBend habitat restoration project will enhance approximately 4,320 linear feet of shoreline in the AOC.

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 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 workplan, 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 7 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

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

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	Impaired	Hazardous waste sites, contaminated sediment
5	Bird or Animal Deformities or Reproductive Problems	Impaired	Hazardous waste sites, contaminated sediment
6	Degradation of Benthos	Impaired	Hazardous waste sites, contaminated sediment
7	Restrictions on Dredging	Impaired	Hazardous waste sites, contaminated sediment
8	Eutrophication or Undesirable Algae	Not Impaired	
9	Restrictions on Drinking Water	Not Impaired	
10	Beach Closings	Not Impaired	
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 remediation (and subsequent monitoring) of the remaining 7 hazardous waste sites along the Niagara River through Federal and State Superfund Programs will decrease the amount of pollutants entering the system. Projects to address contaminated sediment have been completed at 18 locations, resulting in the removal of over 300,000 cubic yards of contaminated material. Remaining contaminated sediment in the River and tributaries (source areas) will likely be addressed by the US Army Corps of Engineers and the Great Lakes Legacy Act Program.

Other efforts have focused on the habitat loss and impacts to fish and wildlife. More than 25 habitat related projects are either completed or ongoing. As a benefit of the 2007 Niagara Power Project relicensing, the New York Power Authority agreed to fund eight selected habitat projects and 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.

Lakewide Area Management Plans

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 Area 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.

Lake Erie Lakewide Area Management Plan

The 2013 Lake Erie LAMP report lists three immediate challenges to the health of the lake. First is the need to reduce pollutants in the lake along with a call for assistance. Invasive species, Asian Carp and non-native phragmites, are the two other cited challenges.

One of the next steps to meet these concerns is the implementation of the Binational Nutrient Management Strategy. This strategy is concerned with phosphorus from tributaries and impacts to coastal wetlands. LAMP will work with partners to develop domestic action plans targeted at priority areas, research goals and collaboration, education and awareness. In addition, the work group will review any new and emerging science to develop, review, revise or update any phosphorus targets as needed to achieve the goals of the Strategy and the renewed GLWQA commitments.

Another important action is the LAMP adoption of the Binational Biodiversity Conservation Strategy. The BCS identifies priority areas for conservation action and recommends strategies to deal with critical threats to biodiversity, including:

- reducing the impact of agricultural pollutants,
- preventing and reducing the impact of invasive species,
- coastal conservation - preventing and reducing the impacts of incompatible development and shoreline alterations,
- reducing the impacts of urban pollutants.

The LAMP work group plans to review the binational Lake Erie BCS to determine how best to implement it in the United States and Canada and to incorporate it into future LAMP activities.

Lake Ontario Lakewide Area Management Plan

A very small portion of the Niagara Watershed along the eastern boundary of the lower Niagara River downstream is located in the Lake Ontario LAMP's Niagara River area.

On the U.S. side, the New York State Department of Environmental Conservation is reassessing cumulative inputs of toxic substances from historical sources along the Niagara River. This assessment of groundwater and surface water discharging to the river will also indicate if more work to identify pollution sources is necessary. On the Canadian side, no further action is required under the Canadian Niagara River Remedial Action Plan (RAP). The Canadian RAP is entering its final phase and is working to delist this Canadian AOC. 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.

Fish Consumption

Because of the industrial past of the Western New York region, fish consumption advisories also 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; those specifically listed include Carp, Rock Bass, Yellow Perch, Burbot, Channel Catfish, Coho Salmon, Chinook Salmon, Rainbow Trout, Smallmouth Bass, White Sucker, White Perch and Brown Trout. However, there are several locations within the watershed where the Department of Health cautions against eating "all other fish" as well, such as the Niagara River, Lewiston Reservoir, Lake Erie, Delaware Park (Hoyt) Lake, Cayuga Creek, Buffalo River, City of Buffalo Inner and Outer Harbor, and portions of the Erie Canal and Eighteenmile Creek. 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 fish in the Buffalo and Niagara Rivers, many times unknowingly exposing themselves to toxic

chemicals. A majority of these transplants are often uninformed about the potential health risks resulting from exposure to contaminants via the degraded waterway and its fish and many are subsistence fishing. To better inform these anglers in the City of Buffalo and regional anglers overall, Buffalo Niagara RIVERKEEPER® 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. 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. *The Protecting Water Resources through Local Controls and Practices: An Assessment Manual for New York Municipalities*[12] 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 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.

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

While water pollution results from a variety of sources and activities, generally pollutants can be classified as being toxic, sediment, nutrient or bacterial. 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 toxics 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.

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. Sediment also often picks up other forms of pollution such as toxics, 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 organisms of the oxygen they need (aka. eutrophication). The depletion of oxygen also kills the small aquatic invertebrates consumed by fish. 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 care fertilizers.

Bacterial pollution occurs when an excess of harmful bacteria is present. This can be lethal to animals and humans that may consume contaminated water. Sources of bacterial pollution include combined sewage overflows, sanitary sewer overflows, failing septic systems, leaking sanitary sewer infrastructure, and animal 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 degredation 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 such things as stream corridors lack over hanging trees and vegetation, which exposes waters to sunlight and natural heating processes, are considered natural processes. Man-made influences can include power plants and other manufacturing processes where high water volumes are discharged to with higher temperatures than waterway or waterbody they are discharged to.

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 Watershed these include National Pollution Discharge Elimination System (NPDES) permitted facilities; State Pollution Discharge Elimination Systems (SPDES) permitted facilities, Combined Sewer Overflow Systems (CSOs), Sanitary Sewer Overflows (SSOs), and Municipal Separate Storm Sewer Systems (MS4s).

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

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. Buffalo Niagara Riverkeeper was able to identify 330 NPDES/SPDES permitted facilities (points) within the Niagara River Watershed with data obtained from NYS DEC. This data set includes such companies/facilities as Praxair, NYPA's

Lewiston Power Plant, DuPont, O-AT-KA Milk Products Cooperative, Niagara Mohawk's Huntley Generating Station, the Alabama Quarry, and East Aurora Wastewater Treatment Plant. However, it is suspected that there are several hundred more NPDES/SPDES permitted facilities within the watershed[13]. All of these facilities are provided for on the maps on the following pages. (SPDES, EPA 1 and EPA 2).

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/Institutaional (to groundwater, 1,000 – 10,000 gpd)
- Concentrated Animal Feeding Operations (Medium or Large)
- Construction
- High Volume Hydraulic Fracturing
- 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. Without a full dataset of the SPDES facilities in the region, a further analysis of the issues presented by NPDES/SPDES permitted facilities is hard to quantify at this time.

CSOs contribute toxic, sediment, nutrient and bacterial pollution.

Combined Sewer Overflows (CSOs)

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 periods of heavy rainfall or snowmelt, the total water volume in a combined sewer

[13] Buffalo Niagara Riverkeeper was unable to obtain the rest of the NYS DEC NPDES/SPDES data set for the region without doing a foil request for each individual facility. At this time we settled on utilizing a former dataset obtained from DEC several years ago.

Niagara River Watershed Management Plan

STATE POLLUTANT DISCHARGE ELIMINATION SYSTEM (SPDES)

SPDES Discharge

- 01-State Significant Industrial
- 02-Non Significant P/C/I
- 03-EPA Major Industrial
- 04-Non Significant Industrial
- 05-EPA Major Municipal
- 07-State Significant Municipal

Sub-Basin Boundary

County

Municipality

5 2.5 0 5

Miles

5 2.5 0 5

Kilometers

Sub-Basins of the Niagara River Watershed

State Pollution Discharge Elimination System Locations from NYS Department of Environmental Conservation Division of Water, and qaulity checked by Buffalo Niagara Riverkeeper, 2010.

Sub-Watersheds are based on the U.S. Geological Survey10-Digit Hyrologic Unit Codes (HUC).

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Niagara River Watershed Management Plan

ENVIRONMENTAL PROTECTION AGENCY REGULATED FACILITIES (1 OF 2)

- Currently on the Final NPL
- Deleted from the Final NPL
- Proposed for NPL
- Treatment, Storage and/or Disposal Facility
- Permit Compliance System Site
- Permit Compliance System Pipe
- RCRA Transporter
- CERCLA Superfund Site
- Toxic Release Inventory Site

Sub-Basin Boundary

County

Municipality

5 2.5 0 5
Miles

5 2.5 0 5
Kilometers

Sub-Basins of the Niagara River Watershed

The Environmental Protection Agency (EPA) is responsible for environmental oversite over a variety of industrial activities under many federal statutes including the Clean Air Act (CAA), Permit Compliance System (PCS). the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), Clean Water Act (CWA), the Resource Conservation and Recovery Act (RCRA), and Emergency Planning and Community Right-to-Know Act (EPCRA).
Sub-Watersheds are based on the U.S. Geological Survey10-Digit Hyrologic Unit Codes (HUC).

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Niagara River Watershed Management Plan

ENVIRONMENTAL PROTECTION AGENCY REGULATED FACILITIES (2 OF 2)

- Combined Sewage Overflow Event
- NPDES Major Facility
- NPDES Non-Major Facility
- Large Quanitity Generator (LQG)
- Small Quantity Generator (SQG)
- Conditionally Exempt SQG (CESQG)
- RCRA Hazardous Waste Permits
- STORET Water Monitoring Locations

Sub-Basin Boundary

County

Municipality

5 2.5 0 5
Miles

5 2.5 0 5
Kilometers

Sub-Basins of the Niagara River Watershed

The Environmental Protection Agency (EPA) is responsible for environmental oversite over a variety of industrial activities under many federal statutes including the Clean Air Act (CAA), Permit Compliance System (PCS). the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), Clean Water Act (CWA), the Resource Conservation and Recovery Act (RCRA), and Emergency Planning and Community Right-to-Know Act (EPCRA).
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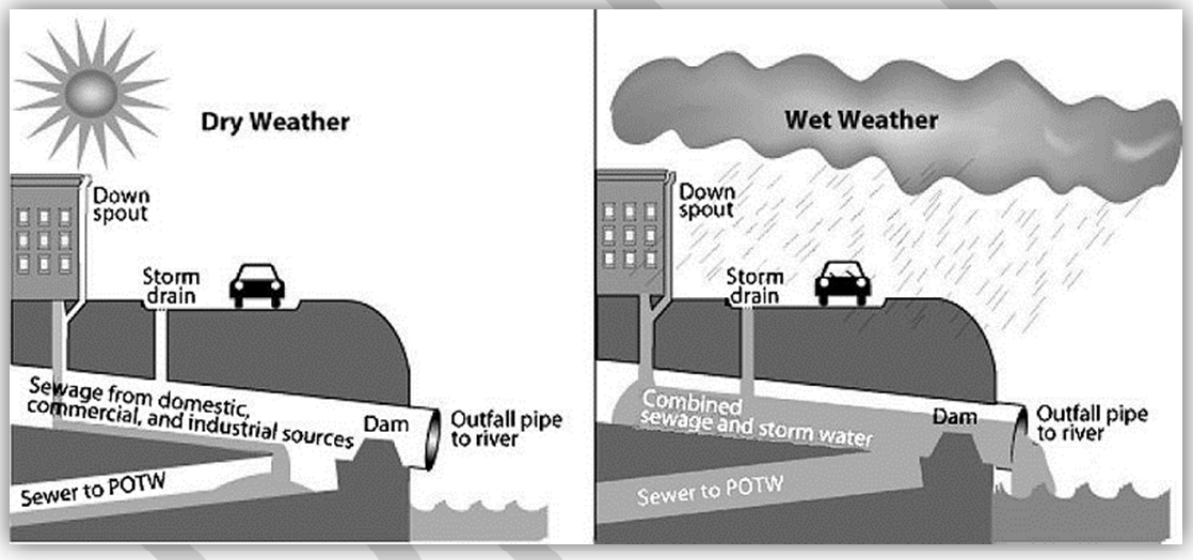
system can exceed the capacity of the sewer system or treatment plant. In this instance, CSSs will overflow and discharge untreated or partially treated water directly into streams, rivers, or other waterbodies in order to prevent basement back-ups and flooding (Figure 4.3).

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 4.3 Combined Sewer System Outfalls in Dry and Wet Weather



Source: US EPA

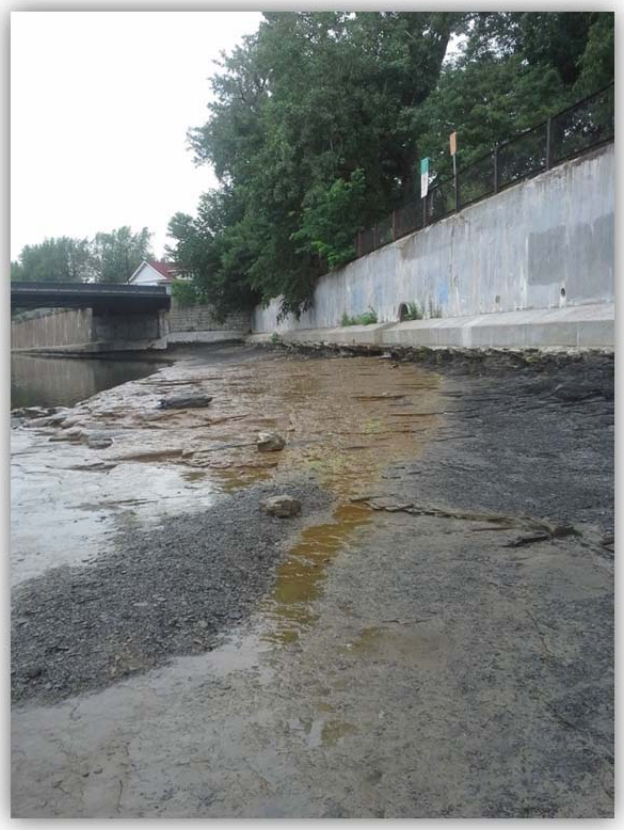
In the Niagara Watershed, six communities have Combined Sewer Systems: The City of Buffalo (in Erie County); the Cities of Lockport, North Tonawanda, and Niagara Falls (in Niagara County); and the Village and Town of Lewiston.

Combined sewer overflows are regulated as point sources of pollution by the New York State Department of Environmental Conservation, and are no longer a legal means of preventing sewer back-up problems. The City of Buffalo is the largest CSO system in the watershed, having 790 miles of combined sewer lines and 52 permitted outfalls, and is currently negotiating a Consent Decree with the New York State Department of Environmental Conservation and the Environmental

Protection Agency, which will bring the Buffalo Sewer Authority into closer compliance with the Clean Water Act. This Long Term Control Plan is still in draft form, but as currently written it is projected to have a major positive impact on water quality in the Niagara River watershed.

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. If implemented as projected, the Buffalo Sewer Authority's Long Term Control Plan is expected to reduce annual CSO volume from 1752.3 million gallons per year to 486.3 million gallons, and increase the wet weather flow percent capture from 91.3% to 97.4%.

The City of Niagara Falls has significantly fewer combined sewer outfall points than the City of Buffalo, six total. The Niagara Falls CSO's are owned and operated by the Niagara Falls Water Board a separate water-sewer utility entity. The number of CSO events is currently not well tracked, as visual inspections of the overflows occur monthly to identify whether an event occurred. All of the CSOs discharge to the Niagara Gorge. Presently the water board suspects that groundwater is also 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. At this time the City's has begun to address the infiltration issue and has made improvements in the last few years. The water board is not under a consent order from the EPA at this time, as they have recently completed a Long-Term Control Plan that was approved by the DEC and has completed all of the required improvement projects. The water board is currently in the water quality monitoring stage of the Long-Term Control Plan.



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%) and in the last few years has only experienced 1 overflow events/year. The City currently has 10 CSOs, 7 of which are located in the watershed. Currently the City is working with NYS DEC to close 8 or 9 of the existing CSOs, since they haven't had any events. The only CSO where overflow events occur every year and they plan to keep open is CSO #2 (East of Jackson/North of William), which discharges to Eighteen Mile Creek in Niagara County, outside of the watershed.

The City of North Tonawanda's combined sewer system includes 5 Combined Sewer Outfalls, all of which discharge to the Niagara River. The city typically only utilizes the CSOs, or old bypasses as their referred to, during major residential flooding events, which has been once or twice in recent years. Additional data as to the volumes they discharge is not known at this time.

The last 2 CSOs existing within the watershed are located in the Village and Town of Lewiston, and both discharge to the lower Niagara River. For the Village of Lewiston's CSO, overflow events are detected via observation and occur 1 time/year (on average). The Lewiston Sewer District's CSO is located near the Stella Niagara Property and also typically sees only 1 overflow event annually.

SSOs contribute toxic, sediment, nutrient and bacterial pollution.

Sanitary Sewer Overflows (SSOs)

Sanitary Sewer Overflows (SSOs) fulfill a similar purpose to Combined Sewer Overflows, but are used in sanitary sewer systems in which household waste and stormwater are diverted into different pipelines. In this case, system blockages, groundwater infiltration into sewage pipes, or infrastructure problems can result in sanitary sewage overflow events into local waterways. SSOs are no longer permitted by New York State as a legal means of preventing sewer back-ups and have been phased out in many communities. However many communities in the watershed still have overflow events a few times a year. According to reporting to DEC a total of 1,440 sanitary sewer overflow events occurred between May 13, 2013 and November 5, 2014, discharging raw untreated sewage into the watershed. The volumes discharged are not fully documented unfortunately, as the amounts are not always reported or accurately known. Of these 1,440 incidents, the top five communities with SSO discharges during this timeframe are as follows:

1. Town of Cheektowaga = 511 overflow incidents
2. Town of Hamburg = 213 overflow incidents
3. Town of Tonawanda = 183 overflow incidents
4. Town of West Seneca = 180 overflow incidents
5. Town of Grand Island = 110 overflow incidents

For the other 20 communities reporting incidents during this time period, discharges were all below

80, most municipalities documented only 1 incident. In this same data set where the receiving waters of the discharge were noted, Scajaquada Creek by far received the most illegal sewage discharges, with 494 recorded discharges, the Niagara River was the second highest recipient with 189 discharges, and third highest was Ellicott Creek with 173 discharges. All other receiving waters had under 100 discharge events. This just illustrates the extent to which SSOs are a problem in the watershed. In majority of the 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.

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.

Municipal Separate Storm Sewer Systems (Stormwater Run-off)

As mentioned in Chapter 2, Municipal Separate Storm Sewer Systems (MS4s) are a conveyance network of pipes, culverts and ditches that transport stormwater into retention ponds or area waterways. MS4s are the primary collectors 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, MS4 stormwater is not treated.

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

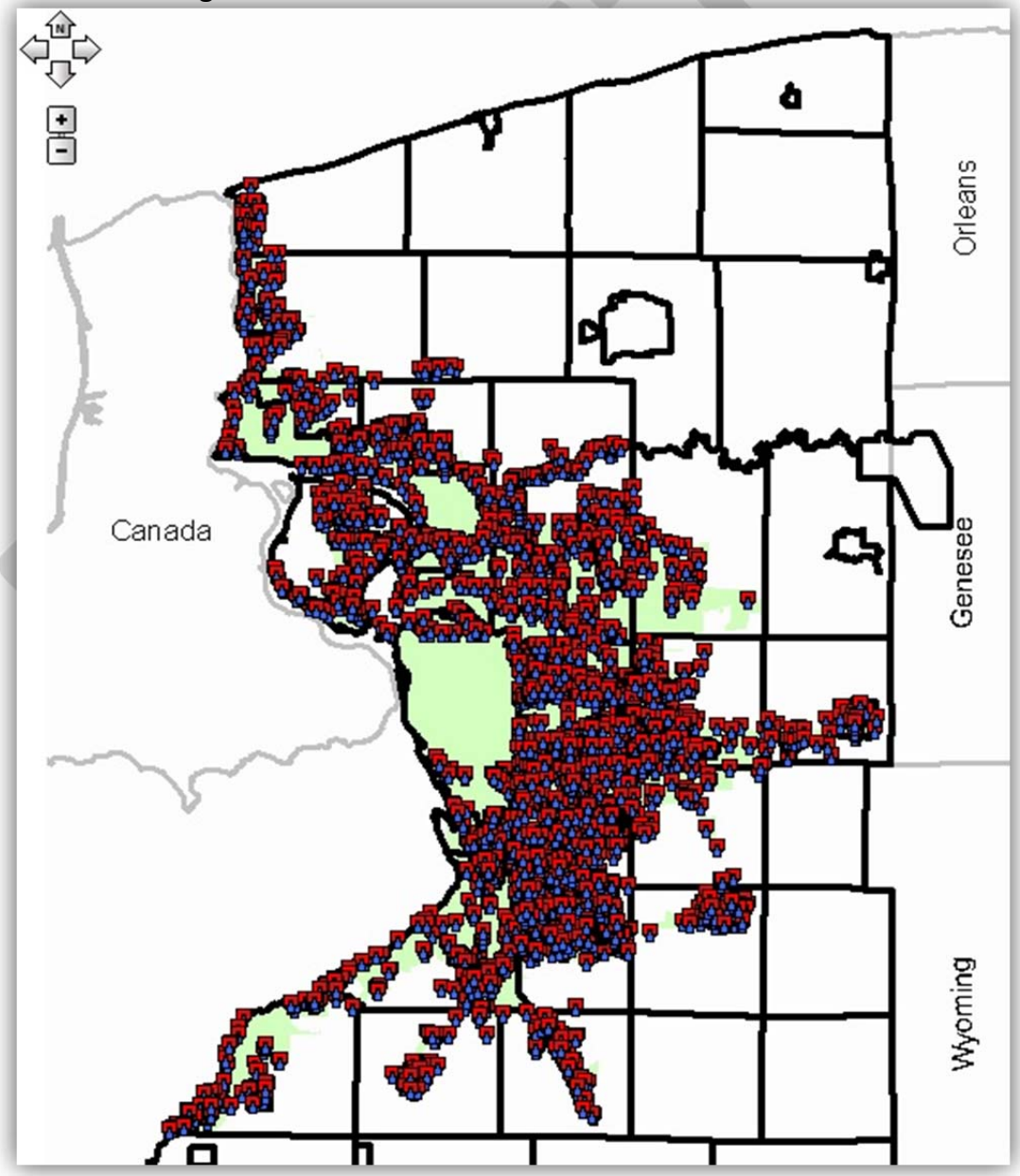
Example of MS4 Pollution (nykography.com)

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. 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.

All areas of the watershed have some form of MS4 infrastructure. In more urban areas, MS4s may be fully underground, with storm drains and pipes. In rural communities much of the MS4 network is made up of roadside ditches and retention ponds. Suburban municipalities usually include a mixture

Figure 4.4 WNY Stormwater Coalition Outfall Locator



of both types of infrastructure. Recently, the WNY Stormwater Coalition undertook a major mapping effort to document the MS4 infrastructure, their flow directions and outfall locations in order to better plan and maintain this infrastructure in MS4 regulated communities. Figure 4.4 below outlines the MS4 outfall locations in the watershed as documented by the WNY Stormwater Coalition's mapping effort.

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. 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 MS4 system design to build in natural green infrastructure to 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. Currently the Town of Aurora has begun regarding 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.

Agricultural Operations

Agricultural Operations can cause many impacts to neighboring waters. In the 2000 National Water Quality Inventory, states 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 Watershed, five of the 11 sub-watersheds have over 40% of their land use in agriculture, with another 4 hosting 20-39%, and the last two between 10- 19%.

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.

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.

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

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. For more than 30 years, the Clean Water Act has enacted statutes, regulations and performance standards for CAFOs. NYS DEC currently regulates CAFO's 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 Plans (CNMP) to reduce impacts to the environment. The map on the following page 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 USDA 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.

Recently the DEC revised a rule applying to Agricultural Feeding Operations to exempt dairy farms with "200-299 mature dairy cows, whether milked or dry that does not cause a discharge" meaning these farms would no longer be considered a Medium CAFO and are no longer required to receive a SPDES permit. These dairy farms are granted the exemption because they have already developed and fully implemented their CNMP and have demonstrated to NYS DEC through on farm inspections that they do not pose a significant risk to the environment. This change is concerning because there is uncertainty if there will be any future

Niagara River Watershed Management Plan

STATE PERMITS FOR CONCENTRATED ANIMAL FEEDING OPERATIONS (CAFOS)

- Large CAFO
- Medium CAFO

- Sub-Basin Boundary
- County
- Municipality

5 2.5 0 5
Miles
5 2.5 0 5
Kilometers

Sub-Basins of the Niagara River Watershed

The New York State Departments of Environmental Conservation and Agriculture and Markets, the State Soil and Water Conservation Committee, farmers, agribusiness, and other interested parties develop CAFO Permits.
These five-year term permits meet the business needs of farmers and assist
CAFO owners or operators in complying with State and Federal water quality requirements.
Sub-Watersheds are based on the U.S. Geological Survey10-Digit Hyrologic Unit Codes (HUC).

BUFFALO NIAGARA RIVERKEEPER®

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monitoring of these farms to insure they're maintaining a high level of environmental stewardship.

Emerging agricultural concerns in the watershed is 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. Erie County contains the second largest city in New York and has the infrastructure and industry to produce Biosolids. 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)

As mentioned previously, the 2010 Niagara River/Lake Erie RIBS report, the primary water quality issues in the watershed stem from past industrial uses. Properties contaminated with toxic substances (brownfields) are considered another source of 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 located in the cities of Buffalo, Niagara Falls, and Lackawanna 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 US EPA 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 on the following pages outlines the

following facilities, whose 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[14] Superfund sites;
- National Pollution Discharge Elimination System (NPDES)[15] 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[16] permits); and,
- facilities or sites where a hazardous substance release occurred (Toxic Release Inventory, EPCRA[17]).

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

Presently, the watershed hosts 4 brownfields currently on the National Priorities List and 181 US EPA CERCLIS 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 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

[14] Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS).
[15] As part of the Clean Water Act
[16] Resource Conservation and Recovery Act
[17] Environmental Protection and Community Right-to-Know Act

operations. RCRA permitted facilities are those facilities required to track the generation, use and/or disposal of certain hazardous materials. As of 2008, the watershed has 178 facilities operating with RCRA permits. 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 of the Environmental Protection and Community Right-to-Know Act. As of 2008, 228 spills have been documented in the watershed. Known brownfields and Hazardous Waste Sites under NYS jurisdiction are represented in the State Regulated Remediation Sites Map provided on the following page and in Table 4.8 below[18].

Table 4.8 State Regulated Hazardous Waste Sites by Sub-Watershed (2008)

	NYS DEC Site Class						
Sub-watershed	**02**	**03**	**04**	**05**	**A**	**C**	**Total**
Buffalo River	6	4	5	2	22	13	52
Buffalo Creek							
Cayuga Creek	1	1	5			2	9
Eighteenmile Creek			1		1	2	4
Lower Tonawanda Creek	2	1	3		4	4	14
Middle Tonawanda Creek	1		1				2
Upper Tonawanda Creek			1		1	1	3
Murder Creek			1				1
Niagara River	17	12	33	1	21	26	110
Smoke Creek	2		2		6	3	13
Ellicott Creek	2	1	1		6	4	14
Total	31	19	53	3	61	55	222

Source: NYS DEC Environmental Site Remediation Database

The Niagara River Sub-watershed has 110 Hazardous Waste sites, the most of all the sub-watersheds. Twenty-one of these sites are currently considered Active, meaning "remedial work is underway" and 17 of which are considered Class 02, "posing a significant threat". Buffalo River sub-watershed also has a numerous sites listed in the database (52), with 22 active and 6 identified as Class 02 sites. The State Regulated Remediation Sites Map also clearly shows these sites concentrating in the urban areas of the watershed, along the Lake Erie and Niagara River shoreline, and along Tonawanda Creek, Scajaquada Creek, and Smokes Creek.

[18] See Map for NYS DEC Site Classification Key.

Niagara River Watershed Management Plan

STATE REGULATED REMEDIATION SITES

Remediation Site Class

- 02 - Significant Threat; Action Required
- 03 - No Signifcant Threat; Action May Be Deferred
- 04 - Site Properly Closed; Requires Management
- 05 - Site Properly Closed; No Further Action
- A - Active, Remedial Work is Underway
- C - Remediation Complete

Sub-Basin Boundary

County

Municipality

5 2.5 0 5
Miles
5 2.5 0 5
Kilometers

Sub-Basins of the Niagara River Watershed

Points representing the locations for each remediation site in New York State. The file formerly known as Inactive Hazardous Waste Sites is now included in the Remediation Sites file. November 2008

Sub-Watersheds are based on the U.S. Geological Survey10-Digit Hyrologic Unit Codes (HUC).

BUFFALO NIAGARA RIVERKEEPER®

This map was prepared for the New York State Department of State with funds provided under Title 11 of the Environmental Protection Fund Act.

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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, riparian buffers, and green stormwater infrastructure, which are lacking in urban areas where brownfields concentrate.

Thermal Increases

Thermal pollution affects many aquatic species.

Increases in the temperature of waters can negatively affect water conditions in how they support aquatic life and the ecosystem. For 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, and Buffalo 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 MS4 systems. There currently are limited areas in the watershed where Stream Visual Assessment Protocol (SVAP) data collection has been completed, which limits the means to assess the quality of riparian areas for watershed as a whole. Where SVAPing has occurred, inadequate riparian cover is consistently documented as an issue affecting stream health.

Erosion causes sediment pollution and degrades water quality.

Erosion & Sedimentation

Many of the causes of erosion and sedimentation in the watershed have already been touched on as part of the discussion of MS4 Infrastructure and Agricultural Feeding 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 steeps slopes/banks and highly erodible soils; stream channel changes include down cutting and meandering; and man-made conditions include loss of riparian buffers.

Presently the extent of erosion areas in the watershed are not fully characterized; however, it is evident that erosion issues are occurring due to high sedimentation and turbidity issues found in water quality sampling. According to the *Riverwatch 2013 Water Quality Report*, turbidity thresholds were exceeded consistently majority of the time in certain waterways (Table 4.9).

Table 4.9 2013 Riverwatch Program Turbidity Findings

Sampled Waterways	% of Samples where Turbidity Exceeded Thresholds*
Cayuga Creek	9%
Buffalo Creek	52%
Cazenovia Creek	15%
Buffalo River	94%
Inner & Outer Harbor	73%
Niagara River	50%
Scajaquada Creek	61%
Grand Island	100%
Ellicott Creek	33%
Tonawanda Creek (Middle Main Stem)	95%
Tonawanda Creek (Lower Main Stem)	92%
Cayuga Creek (Niagara Falls)	92%
Gill Creek	83%

*NYS DEC Part 703: Surface Water Quality Standards: 5 ntu

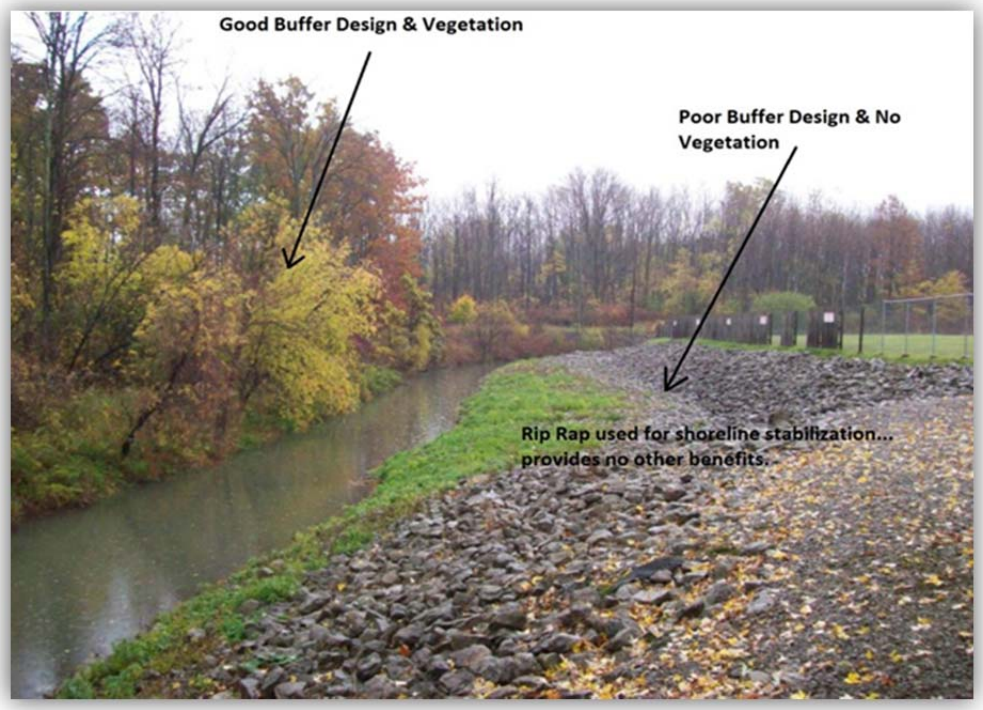
A full comprehensive erosion assessment or geomorphic assessments do not currently exist for the Niagara River Watershed. Major erosion areas are mostly known in a piecemeal fashion, from projects and requests for assistance to the Soil and Water Conservation districts, and at the municipal/county level from where erosion is threatening neighboring infrastructure (i.e. roads, bridge abutments) or private property. A GIS data set documenting high erosion shoreline areas was completed recently for the Niagara River Greenway Communities. This GIS analysis really needs expansion to the remainder of the watershed in order to outline and address erosion issues. Conducting Stream Visual Assessments are more involved than the GIS assessment and are unrealistic to utilize for all stream miles of the watershed, but SVAPing does also document shoreline erosion.

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;
- 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.

Forested Riparian Buffer in Agricultural District (USDA)

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 and commercial 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. As watershed planning continues, 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.



Riparian Areas along Cayuga Creek

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 (Tonawanda Creek) and educate the public to limit transporting it.

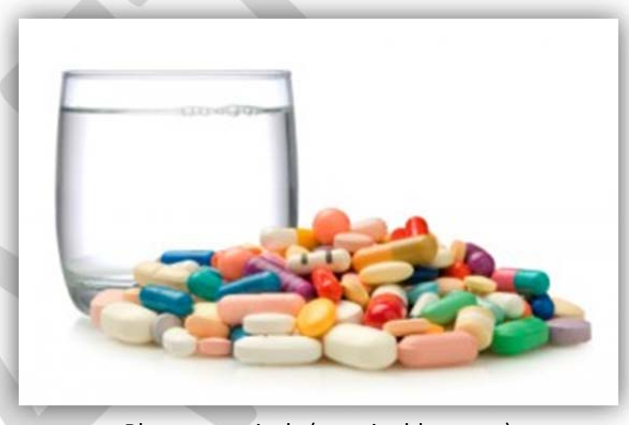
Invasive Species contribute to thermal, nutrient, and bacterial pollution.

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 invasives in the watershed is the need to comprehensively document their extent and spread in a cost-effective manner. The new iMAP Invasive website is a good start in

improving attempts to 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 shampoos, plastics, pharmaceuticals and flame retardants. 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.



Pharmaceuticals (growingblue.com)

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, and 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. 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. Addressing this issue requires more chemical research, new technology to remove more contaminants via wastewater treatment, and market place behavioral changes and policy reforms.