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October 2019

St. Lawrence River Watershed Characterization Report

Prepared for Franklin County Soil & Water Conservation District

This plan was prepared with funding provided by the New York State Department of State under Title 11 of the Environmental Protection Fund.

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ABBREVIATIONS

APA	Adirondack Park Agency
CAIR	Clean Air Interstate Rule
CCE	Cornell Cooperative Extension
CSO	Combined sewer overflow
DANC	Development Authority of the North Country
FEMA	Federal Emergency Management Agency
FCSWCD	Franklin County Soil & Water Conservation District
HUC	Hydrologic Unit Code
LCLGRPB	Lake Champlain-Lake George Regional Planning Board
NASS	National Agricultural Statistics Service
NFHP	National Fish Habitat Partnership
NO_x	Nitrogen Oxides
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resource Conservation Service
NYSDAM	New York State Department of Agriculture & Markets
NYSDEC	New York State Department of Environmental Conservation
NYNHP	New York Natural Heritage Program
NYSDOH	New York State Department of Health
NYSDOL	New York State Department of Labor
NYPA	New York Power Authority
NYSDOS	New York State Department of State
OPRHP	Office of Parks, Recreation, & Historic Preservation
PAHs	Polycyclic Aromatic Hydrocarbons
PCBs	Polychlorinated Biphenyls
PRISM	Partnership for Regional Invasive Species Management
PWL	Priority Waterbodies List
REDI	Regional Economic Development Initiative
SLRWP	St. Lawrence River Watershed Project, Inc.
SO_2	Sulfur Dioxide
SPDES	State Pollution Discharge Elimination System
SUNY	State University of New York
SWCD	Soil and Water Conservation District
TMDL	Total Maximum Daily Load
USACOE	US Army Corp of Engineers
USDA	US Department of Agriculture
USEPA	US Environmental Protection Agency
USFWS	US Fish & Wildlife Service
USGS	US Geological Survey
VOCs	Volatile Organic Carbons
WAC	Watershed Advisory Committee
WI	Waterbody Inventory
WRP	Watershed Revitalization Plan

WWTP	Wastewater Treatment Plant

1 Introduction

The St. Lawrence River watershed is the largest drainage basin in New York State, encompassing 5,600 square miles in northern New York (**Map 1**). In 2018, the St. Lawrence River Watershed Project (SLRWP) Inc. and the Franklin County Soil & Water Conservation District (FCSWCD) launched a watershed planning effort with funds from the New York State Department of State's (NYSDOS) Local Waterfront Revitalization Program. This Watershed Characterization Report has been developed as a component of the St. Lawrence River Watershed Revitalization Plan (WRP), scheduled for completion in 2020.

The St. Lawrence River Watershed Revitalization Plan will address a series of questions:

1. *Where are we now?* That is, what is the current status of the natural, cultural, and political environment within the watershed? What are the assets, existing problems, and emerging threats and opportunities?
2. *Where are we going?* What processes and programs are in place that will affect the future of the watershed?
3. *Where do we want to be?* What is the community's vision for the future of the watershed? What desirable conditions or attributes of the watershed should be enhanced, and what undesirable conditions should be minimized or eliminated?
4. *How do we get there?* What strategic actions will enable the community to achieve the goals and vision? What specific practices and projects will help restore and protect the watershed and how can funds be leveraged?
5. *When will we get there?* When will the recommended projects be advanced, and how will the priority actions be decided?
6. *How do we measure progress?* What is the plan for tracking improvement and deciding what else needs to be done?

This Watershed Characterization Report documents current conditions and trends in the watershed, providing data and information needed to address the first two questions above. Water quality is linked to conditions throughout the watershed, including its landscape (geography, soils, hydrology, habitat, and climate), land use (settlement patterns, impervious surfaces, industry and agriculture centers, and waste management practices), and conditions that alter the natural state of the land. This characterization of the environmental conditions and human activities that affect the St. Lawrence River watershed will provide a basis for recommending long-term protection and restoration strategies for the watershed.

2 Overview of the Watershed

A watershed is the land that drains, or sheds, its water to a single waterbody, such as a wetland, river, lake, coastal embayment, or ocean. The St. Lawrence River serves as the natural outlet for the Great Lakes to the Atlantic Ocean via the St. Lawrence River and Seaway, and it drains nearly 300,000 square miles from the Great Lakes Plains Region via Lake Ontario as well as the northern and western Adirondack Mountains. The river is part of the international boundary between the United States and Canada, and its shoreline abuts the Canadian provinces of Ontario and Quebec as well as northern New York.

The subject of this report is the portion of the St. Lawrence River watershed that lies within New York State. This watershed encompasses 5,600 square miles within the state's borders and spans eight counties, including all of St. Lawrence County, most of Franklin County, much of northern Jefferson, Lewis, Herkimer, and Hamilton counties, and small areas of western Essex and Clinton Counties (**Map 1**). In addition to 185 miles of St. Lawrence River shoreline, New York's St. Lawrence River watershed includes 12,030 miles of freshwater rivers and streams **(Map 11)**.

Land cover in the basin is comprised of densely forested woodlands with large peatland complexes in the southern portion of the basin along the slopes of the Adirondack Mountains; and more flat, agricultural plains along the St. Lawrence at the northern side of the basin. Developed and industrial areas include Massena, Malone, Ogdensburg, Canton, and Gouverneur.

Much of the southern and eastern portions of the watershed lie within the Adirondack Park, designated by the blue dotted line in **Map 1**. The Adirondack Park Agency oversees this area to "insure optimum overall conservation, protection, preservation, development and use of the unique scenic, aesthetic, wildlife, recreational, open space, historic, ecological and natural resources of the Adirondack Park" (APA Act, 2018).

2.1 Evolution and Current Configuration of the Basin

Melting ice, glacial debris, and changing glacial topography contributed to the formation of the St. Lawrence River basin. A quarter of a million years ago, a glacier advanced southward into the Adirondack region, creeping over hills and scraping up soil and rock from the land. Ice dams formed in river valleys due to the glacial debris, dotting the landscape with hundreds of lakes and ponds as the glacier began to melt and recede. Taking the path of least resistance, northwestern Adirondack waters drained into the St. Lawrence River, which developed approximately 10,000 years ago as a result of the rebounding continent from the Last Glacial Maximum, the Wisconsin Glaciation. The Wisconsin ice reached a thickness of more than 2 miles at its maximum extent. The glacier scoured the land depositing various thicknesses of till, significantly modifying the surface hydrology, slope, and terrain.

Today, New York's St. Lawrence River watershed extends from the northern and western slopes of the Adirondack Mountains at the southern end of the basin, to the plains along the St. Lawrence at the northern end of the basin. The river's headwaters are as far west as the northeast edge of Lake Ontario (cutting southeast between Watertown and Fort Drum) and as far east as Clinton and Essex Counties.

2.2 Subwatersheds

Watersheds are subdivided into smaller units that collectively contribute groundwater and surface water to larger watersheds or subbasins. Hydrologic units are used to create a baseline drainage boundary framework to account for all land and surface areas. Water basins in the United States are divided into hydrologic units identified by a unique hydrologic unit code (HUC) consisting of four to eight digits based on four levels of classification: region (4-digit, or HUC4), subregion (8-digit, or HUC8), accounting unit (10-digit, or HUC10), and cataloging unit (12-digit, or HUC12).

The St. Lawrence River is comprised of nine HUC8 subwatersheds, 43 HUC10 subwatersheds, and 180 HUC12 subwatersheds. The US Geological Survey's (USGS) 2016 Watershed Boundary Dataset (WBD) retired the Upper St. Lawrence subwatershed (04150301) and subdivided it into the Headwaters St. Lawrence (04150309) and Raisin River-St. Lawrence River (04150310) (**Map 2**). However, much of the data cited and presented here was collected prior to this update and will be referenced as the Upper St. Lawrence subbasin (04150301). HUC8 codes were used to characterize and assess the areas within the St. Lawrence River watershed to better address the various environments, limitations, and needs of its respective area. **Figure 1** demonstrates the percent aerial make-up of the St. Lawrence River watershed by HUC8. **Table 1** lists the HUC12s and their respective names, area, and percent make-up of the watershed for each HUC8 subregion. **Maps 3** through **10** depict each HUC8 individually and their respective HUC12 watersheds.

Figure 1
HUC8 Areas, St. Lawrence River Watershed
Source: 2011 CDL-NLCD Hybrid Land Cover dataset.

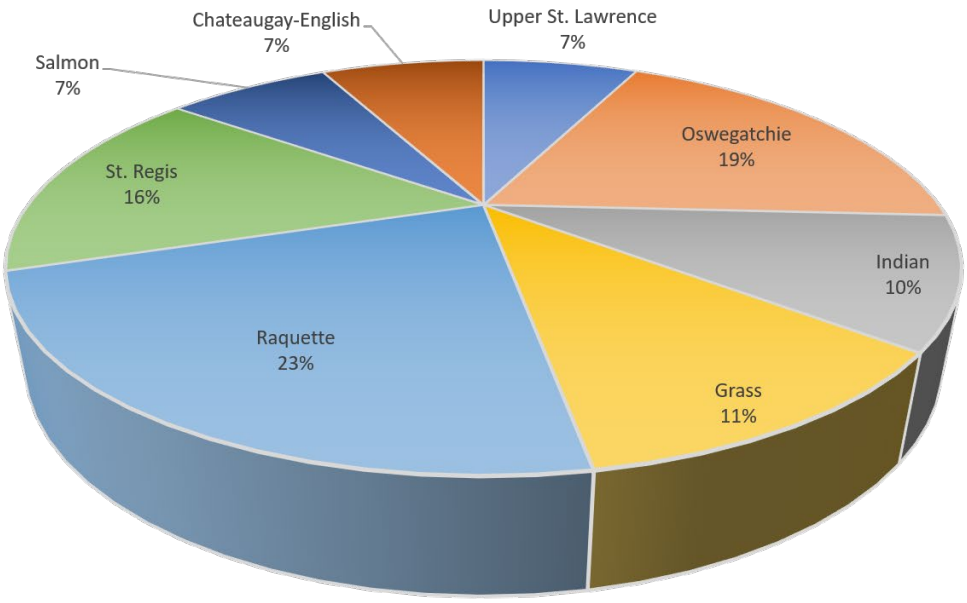


Table 1
Hydrologic Units and Area within the St. Lawrence River Watershed

HUC8	HUC12	Name HUC12 Watershed	Area (square miles)	% of HUC8
Upper St. Lawrence (04150301)	041503010101	French Creek	28.1	7.2
	041503010102	Wheeler Creek-Frontal Saint Lawrence River	35.9	9.2
	041503010103	Mullet Creek	26.1	6.7
	041503010104	Cranberry Creek-Frontal Saint Lawrence River	35.2	9.0
	041503010105	Crooked Creek-Cranberry Creek-Frontal Saint Lawrence River	20.1	5.1
	041503010106	Chippewa Creek	38.6	9.9
	041503010107	City of Morristown-Frontal Saint Lawrence River	31.1	7.9
	041503010201	Tibbits Creek	17.7	4.5

HUC8	HUC12	Name HUC12 Watershed	Area (square miles)	% of HUC8
	041503010202	Whitehouse Bay-Frontal Saint Lawrence River	29.0	7.4
	041503010203	Little Sucker Brook-Sucker Brook	46.2	11.8
	041503010204	Brandy Brook	36.3	9.3
	041503010205	Coles Creek-Frontal Saint Lawrence River	22.1	5.6
	041503010301	Dodge Creek-Frontal Saint Lawrence River	23.2	5.9
	041503010302	Raquette Creek-Frontal Saint Lawrence River	2.3	0.6
			391.9	**7.0 (of HUC6)**
Oswegatchie (04150302)	041503020101	Robinson River-Oswegatchie River	48.3	4.6
	041503020102	Buck Brook-Oswegatchie River	26.5	2.5
	041503020103	Cranberry Lake-Oswegatchie River	67.6	6.4
	041503020201	Tamarack Creek	14.5	1.4
	041503020202	Upper Little River	31.9	3.0
	041503020203	Lower Little River	27.5	2.6
	041503020301	Sand Lake Outlet-Middle Branch Oswegatchie River	26.2	2.5
	041503020302	Wolf Creek-Middle Branch Oswegatchie River	48.7	4.6
	041503020303	Fish Creek	17.4	1.7
	041503020304	Browns Creek-Middle Branch Oswegatchie River	23.3	2.2
	041503020401	Headwaters West Branch Oswegatchie River	25.8	2.5
	041503020402	Blanchard Creek-West Branch Oswegatchie River	41.2	3.9
	041503020501	Jenny Creek	17.2	1.6
	041503020502	Big Creek	35.3	3.4
	041503020503	Meadow Brook-West Branch Oswegatchie River	21.2	2.0
	041503020504	West Branch Oswegatchie River	37.5	3.6
	041503020601	Peavine Creek-Oswegatchie River	46.7	4.5
	041503020602	Stammer Creek	21.5	2.0
	041503020603	Welch Creek-Oswegatchie River	30.5	2.9
	041503020604	Pork Creek-Oswegatchie River	16.2	1.5
	041503020701	Sawyer Creek	31.5	3.0

HUC8	HUC12	Name HUC12 Watershed	Area (square miles)	% of HUC8
	041503020702	Hawkins Creek-Matoon Creek	32.3	3.1
	041503020801	Turnpike Creek-Oswegatchie River	29.0	2.8
	041503020802	Malterna Creek-Oswegatchie River	33.7	3.2
	041503020803	Boland Creek	33.9	3.2
	041503020804	Vrooman Creek-Oswegatchie River	45.0	4.3
	041503020901	Anderson Creek-Oswegatchie River	31.1	3.0
	041503020902	Indian Creek	38.6	3.7
	041503020903	Beaver Creek	47.3	4.5
	041503020904	Barter Creek-Oswegatchie River	29.8	2.8
	041503021001	Town of Flackville-Lisbon Creek	23.9	2.3
	041503021002	Village of Heuvelton-Oswegatchie River	17.9	1.7
	041503021003	Oswegatchie River	30.8	2.9
			1050.1	**18.8 (of HUC6)**
Indian (04150303)	041503030101	Weatherhead Creek-Indian River	37.9	6.7
	041503030102	Bonaparte Creek	23.0	4.1
	041503030103	Blanchard Creek-Indian River	34.0	6.0
	041503030201	Rockwell Creek-Indian River	51.3	9.1
	041503030202	West Branch Black Creek	23.4	4.2
	041503030203	Buck Creek-Black Creek	22.8	4.1
	041503030204	Beaver Meadows Creek-Black Creek	16.1	2.9
	041503030205	Hunter Creek-Indian River	21.6	3.8
	041503030301	West Creek	31.8	5.7
	041503030302	Otter Creek	24.4	4.3
	041503030303	Trout Brook-Indian River	28.9	5.1
	041503030401	Soapstone Creek-Indian River	19.7	3.5
	041503030402	Muskellunge Lake-Indian River	23.9	4.2
	041503030403	Bostwick Creek-Indian River	30.9	5.5
	041503030501	Jewett Creek	19.1	3.4
	041503030502	Butterfield Lake-Black Creek	17.9	3.2
	041503030503	Birch Creek	24.8	4.4
	041503030504	Fish Creek	36.1	6.4
	041503030505	Black Creek-Black Lake	74.9	13.3
			562.5	**10.1 (of HUC6)**

HUC8	HUC12	Name HUC12 Watershed	Area (square miles)	% of HUC8
Grasse (04150304)	041503040101	Dead Creek	24.4	3.9
	041503040102	Massawepie Lake-South Branch Grasse River	52.7	8.3
	041503040201	Pleasant Lake Stream-Middle Branch Grasse River	31.9	5.0
	041503040202	South Branch Grasse River	62.6	9.9
	041503040203	North Branch Grasse River	61.2	9.7
	041503040204	Deerskin Creek-Middle Branch Grasse River	40.3	6.4
	041503040301	Grannis Brook	35.3	5.6
	041503040302	Van Rensselaer Creek-Little River	46.7	7.4
	041503040303	Tracy Brook-Little River	17.7	2.8
	041503040401	Tanner Creek	38.1	6.0
	041503040402	Elm Creek	41.1	6.5
	041503040403	Plumb Brook-Grasse River	60.9	9.6
	041503040404	Nettle Creek	16.4	2.6
	041503040405	Line Creek	17.6	2.8
	041503040406	Harrison Creek-Grasse River	29.1	4.6
	041503040501	Town of Madrid-Grasse River	27.8	4.4
	041503040502	McConnell Creek-Grasse River	29.2	4.6
			633.0	**11.3 (of HUC6)**
Raquette (04150305)	041503050101	South Inlet	32.6	2.6
	041503050102	Marion River	33.3	2.6
	041503050103	Raquette Lake	61.8	4.9
	041503050104	Moose Pond	26.5	2.1
	041503050105	Forked Lake-Raquette River	37.6	3.0
	041503050201	Upper Cold River	40.2	3.2
	041503050202	Ermine Brook-Moose Creek	15.3	1.2
	041503050203	Lower Cold River	30.1	2.4
	041503050301	Salmon River	21.8	1.7
	041503050302	Big Brook	40.4	3.2
	041503050303	Raquette River-Long Lake	53.6	4.3
	041503050401	Moose Creek	19.0	1.5
	041503050402	Stony Creek	31.5	2.5
	041503050403	Palmer Brook-Raquette River	17.6	1.4

HUC8	HUC12	Name HUC12 Watershed	Area (square miles)	% of HUC8
	041503050404	Follensby Pond-Raquette River	38.3	3.0
	041503050405	Bog Stream	19.9	1.6
	041503050406	Round Lake Stream	56.1	4.5
	041503050407	Bog River	56.9	4.5
	041503050408	Wolf Pond	20.6	1.6
	041503050409	Jenkins Brook-Tupper Lake	58.5	4.6
	041503050501	Dead Creek	22.1	1.8
	041503050502	Mountain Brook-Raquette River	35.1	2.8
	041503050503	Willis Brook-Jordan River	19.9	1.6
	041503050504	Potter Brook-Jordan River	28.0	2.2
	041503050505	Ellis Brook-Raquette River	33.8	2.7
	041503050506	Joe Indian Inlet	21.3	1.7
	041503050507	Cold Brook-Raquette River	33.7	2.7
	041503050601	Cold Brook	20.2	1.6
	041503050602	Dead Creek-Raquette River	37.3	3.0
	041503050603	Parkhurst Brook	17.3	1.4
	041503050604	Stafford Brook-Raquette River	47.1	3.7
	041503050701	Upper Trout Brook	30.0	2.4
	041503050702	Lower Trout Brook	36.8	2.9
	041503050703	Village of Potsdam-Raquette River	34.4	2.7
	041503050704	Plum Brook	43.3	3.4
	041503050705	Squeak Brook	38.1	3.0
	041503050706	Hutchins Creek-Raquette River	49.8	4.0
			1259.6	**22.6 (of HUC6)**
St. Regis (04150306)	041503060101	Hays Brook	16.1	1.9
	041503060102	Osgood River	28.2	3.3
	041503060103	Pleasant Brook-East Branch Saint Regis River	55.7	6.5
	041503060201	Windfall Brook-West Branch Saint Regis River	52.7	6.1
	041503060202	Long Pond Outlet	42.7	5.0
	041503060203	Black Brook-West Branch Saint Regis River	24.3	2.8
	041503060204	Stony Brook	26.4	3.1
	041503060205	Alder Meadow Brook-West Branch Saint Regis River	53.5	6.2

HUC8	HUC12	Name HUC12 Watershed	Area (square miles)	% of HUC8
	041503060206	Dan Wright Brook-Trout Brook	43.9	5.1
	041503060207	Tucker Brook-West Branch Saint Regis River	26.2	3.0
	041503060301	Mile Brook-Deer River	37.1	4.3
	041503060302	Trout Brook	37.3	4.3
	041503060303	Kingston Brook-Deer River	58.3	6.8
	041503060304	Lawrence Brook	35.2	4.1
	041503060305	Redwater Brook-Deer River	29.0	3.4
	041503060401	Headwaters Saint Regis River	35.0	4.1
	041503060402	Quebec Brook-Saint Regis River	32.8	3.8
	041503060403	Goose Pond Brook-Saint Regis River	55.1	6.4
	041503060404	Lake Ozonia Outlet	29.0	3.4
	041503060405	Long Pond-Saint Regis River	19.8	2.3
	041503060406	Hopkinton Brook	20.5	2.4
	041503060407	Miller Brook-Saint Regis River	38.1	4.4
	041503060408	Bell Brook-Saint Regis River	30.6	3.5
	041503060409	Town of Hogansburg-Saint Regis River	35.5	4.1
			863.2	**15.5 (of HUC6)**
Salmon (04150307)	041503070101	Hatch Brook	39.9	9.8
	041503070102	Ingraham Stream-Salmon River	62.4	15.4
	041503070103	Duane Stream	21.9	5.4
	041503070104	Winslow Brook-Salmon River	36.2	8.9
	041503070201	Headwaters Little Salmon River	15.4	3.8
	041503070202	East Branch Little Salmon River	16.6	4.1
	041503070203	Develin Brook-Little Salmon River	24.1	5.9
	041503070204	Farrington Brook	24.0	5.9
	041503070205	Town of Bombay-Little Salmon River	20.2	5.0
	041503070301	Branch Brook	19.1	4.7
	041503070302	Plum Brook-Salmon River	30.3	7.5
	041503070303	East Branch Deer Creek	24.7	6.1
	041503070304	West Branch Deer Creek	33.4	8.2
	041503070305	Pike Creek	28.0	6.9
	041503070306	Town of Fort Covington-Salmon River	9.4	2.3
			405.6	**7.3 (of HUC6)**

HUC8	HUC12	Name HUC12 Watershed	Area (square miles)	% of HUC8
Chateaugay-English (04150308)	041503080101	Middle Kiln Brook	30.1	7.3
	041503080102	Separator Brook	15.0	3.6
	041503080103	Mountain Pond Stream-Upper Chateaugay Lake	36.1	8.8
	041503080104	Bailey Brook-Chateaugay River	37.2	9.0
	041503080201	Marble River	33.3	8.1
	041503080202	Hinchinbrook Brook	19.9	4.8
	041503080203	Collins Brook	8.3	2.0
	041503080204	Allen Brook-Chateaugay River	15.4	3.7
	041503080205	Beaver Pond Brook-Chateaugay River	19.2	4.7
	041503080301	Collins Brook-Trout River	57.6	14.0
	041503080302	Little Trout River	40.0	9.7
	041503080303	Briggs Creek	14.7	3.6
	041503080304	Town of Trout River-Trout River	8.9	2.2
	041503080401	Crystal Creek	14.5	3.5
	041503080402	Taylor Brook-English River	26.8	6.5
	041503080403	Allen Brook	5.5	1.3
	041503080404	Kellas Creek-English River	9.9	2.4
	041503080406	Ruisseau Norton	2.7	0.7
	041503080501	Ruisseau Noir	11.2	2.7
	041503080502	Riviere aux Outardes Est	3.2	0.8
	041503080503	Riviere aux Outardes	2.0	0.5
			411.6	**7.4 (of HUC6)**
			5577.7	

SOURCE: 2011 CDL-NLCD Hybrid Land Cover dataset.

2.3 Settlement and Development in the Watershed

The St. Lawrence River basin is home to the Mohawks of the Iroquois Confederation, who call the river *Kaniatarowanenneh*, meaning "big waterway." Original Mohawk territory extended from Schoharie Creek upriver to east Canada Creek. Today, the St. Regis Mohawk Reservation at Akwesasne covers 14,000 acres in Franklin and St. Lawrence Counties at the confluence the St. Regis, Raquette, Grasse, and St. Lawrence Rivers. The St. Regis Mohawk Nation is the only Mohawk community officially recognized by the United States.

Settlers of European descent began to flock to upstate New York after the War of 1812, drawn by the "curative" properties of sulfur mineral springs located on the Raquette River, which became the basis of the local economy. During the late 19th century, the Irish and French Canadians built settlements southeast of Massena and along the Franklin and St. Lawrence County border, respectively. Wealth in this region was primarily derived from mining, farming, and logging. Lead, iron, tremolite, zinc, feldspar, talc, and marble were mined from the land, leaving disturbed ground cover, open pits, and ruins. Today, marble, zinc, and tremolite mining is still integral to the towns of Fowler, Pierrepont, and Ogdensburg.

In 1902, the Massena Power Canal was constructed, allowing for an abundant hydroelectric energy supply in the area, which in turn brought more industry to the region (e.g., Pittsburgh Reduction Company, an aluminum producer). In the late 1950s, FDR's Power Project brought additional low-cost electricity to the area followed by new industries in Massena, such as Reynolds Metals Company and General Motors.

The St. Lawrence Seaway opened in April 1959, allowing transatlantic trade and access for ocean vessels and lake boaters to the Great Lakes. The Seaway System has been integral not only to local economies but to the US economy as a whole, generating more than $4.3 billion in personal income, $3.4 billion in transportation-related business revenue, and $1.3 billion in federal, state, and local taxes (IJC 2014). In addition to commercial goods, dominant commodities shipped along the St. Lawrence Seaway include iron ore for the steel industry, coal for power generation, and limestone for construction and steel industries.

The waters of the St. Lawrence River watershed have various designated use dependent on their water quality. Some waters are used as a source of drinking water, while others are primarily for recreation and aquatic life. The watershed's mix of abundant surface water, rugged peaks, rolling hills, expansive wetlands, and flat plains makes it a major destination for scenic viewing, hiking, fishing, kayaking, boating, snowmobiling and other recreational pursuits. Fifty percent of lakes have been identified as having poor water quality (NYSDEC 2016a). This is in part due to atmospheric deposition of pollutants (acid and mercury) originating outside the basin. In addition, the growth of agriculture and industry in the region since the 19th century has also had a lasting adverse impact on water quality in the watershed. In the late 1900s and early 2000s, Superfund sites were established at Grasse River in Massena, NY (Alcoa, Inc.), the St. Lawrence River in Massena, NY (General Motors), and at Sealand Restoration, Inc. (disposal facility) in Lisbon, NY, where industrial activity had contaminated sediments and groundwater with polychlorinated biphenyls (PCBs), volatile organic carbons (VOCs), and polycyclic aromatic hydrocarbons (PAHs).

Today, citizens of the St. Lawrence River watershed are proactively working toward reducing pollution to protect and restore valuable water resources. Taking action to improve and protect

water quality will allow communities and economies to thrive and enjoy a sustainable future for years to come.

2.4 Existing Plans and Initiatives Related to Water Resources in the Study Area

Appendix A provides an overview of the institutional framework for local laws, programs, and practices affecting water quality in the watershed, as well as an assessment of the ability of local laws and programs to implement best management practices that would protect water quality.

Several federal and state regulatory and advisory programs are already in place to advance watershed planning within the St. Lawrence River watershed. Examples include:

- Great Lakes Focus
  - Lake Ontario Lake-wide Action and Management Plan (2018-2022)
  - Great Lakes St. Lawrence Seaway Study (2007)
  - New York's Great Lakes Basin: Interim Action Agenda (Ongoing effort)
- NY Statewide Plans of Interest
  - St. Lawrence River Basin Waterbody Inventory and Priority Waterbodies List (2014)
  - New York State Riparian Opportunity Assessment (January 2018)
  - New York State Invasive Species Comprehensive Management Plan (Nov 2018)
  - New York State Wildlife Action Plan (September 2015)
- IJC Climate-Related Plans and Guidance
  - Lake Ontario – St. Lawrence River Plan (2014)
  - Climate Change Guidance Framework for IJC Boards, A Highlights Report (2018)
- Akwesasne Climate Change Adaptation Plan (2013)
- Subwatershed Research
  - Watershed Protection of the St. Lawrence – Raquette River Watershed with Special Consideration to Large Wetlands and Large Landownership; Part One: The St. Regis River Basin
  - St. Regis Chain Limnology and Water Quality Report (2017)
  - Blue Mountain Lake Watershed Monitoring Program (2016)
  - Salmon River Watershed Management Plan, Phase I (2016)
  - Canton Grasse River Waterfront Revitalization Plan (March 2018)
  - Adirondack Lake Assessment Report (2018)
- Local Waterfront Revitalization Plans
  - Town and Village of Alexandria Bay (Draft, 2019)
  - Village of Cape Vincent (1988)
  - Town and Village of Clayton (July 2013)
  - Town of Essex (2003)
  - Town and Village of Malone (2012)

  - Town and Village of Morristown (1991)
  - City of Ogdensburg (1987)
  - Town and Village of Waddington (1991)
- Adirondack Forest Preserve Unit Management Plans
  - St. Lawrence Foothills (2015)
  - Cranberry Lake Wild Forest (1984)
  - Debar Mountain Wild Forest (2017)

The monitoring programs and watershed management plans provide key data and insights to inform the analysis of water quality and the environmental setting. The local watershed management plans, although specific to their locality, also address similar critical issues facing the St. Lawrence River watershed.

In 2019, Governor Andrew Cuomo announced the formation of the Lake Ontario Resiliency and Economic Development Initiative (REDI) commission. This multiagency task force is charged with developing a plan to harden infrastructure in flood prone regions along Lake Ontario's waterfront while strengthening the region's local economies, which are heavily dependent on summer tourism. The REDI encompassed eight counties along Lake Ontario and the St. Lawrence River including Jefferson and St. Lawrence counties. These counties encompass most of the land area within the St. Lawrence watershed. While each region has a unique strategic plan and set of goals, there are common themes that relate directly to the priorities and approach of the watershed planning process applied here:

- commitment to a regional approach to identifying challenges and finding solutions;
- recognition of the need to invest in infrastructure;
- an embrace of smart growth concepts;
- reclamation of waterfront assets for community and economic development;
- recognition of the need to strengthen the effectiveness of government and civic institutions in order to improve the quality of life for all.

3 Environmental Setting

3.1 Water Resources

Water resources within the St. Lawrence River watershed support its multiple human uses, which include recreation, shipping, transportation, infrastructure, tourism, agriculture, and hydroelectric power generation.

3.1.1 Surface Water

Nineteen percent (19%) of the area in New York's St. Lawrence River watershed is surface water (**Map 11**). In addition to 185 miles of St. Lawrence River shoreline, this includes 12,030 miles of freshwater rivers and streams. Major tributaries include the Oswegatchie River (3,590 miles), Raquette River (2,016 miles), St. Regis River (1,734), Grasse River (1,607 miles), and Indian River (1,222 miles), which drain the northwestern Adirondack Mountains and together comprise 89% of total stream and river miles in the watershed. There are 376 significant freshwater lakes, ponds, and reservoirs covering 104,125 acres, the largest being Black Lake (7,754 acres), Cranberry Lake (6,795 acres), Raquette Lake (5,194 acres), Tupper Lake (4,858 acres), and Long Lake (4,094 acres), which together account for 33% of lake acres in the watershed.

Many of the streams originate as cold headwaters in the hills of the northern Adirondack region (Oswegatchie and Raquette Rivers) and flow to the St. Lawrence River across broad flat plains of lacustrine sands, clays, and peat deposits. Waterfalls and rapids are typical features of the major tributaries as these rivers pass through the mountains along steep gradients. In many places, the natural energy of this process is harnessed by hydroelectric dams.

Fifty percent of lakes in the watershed have been identified as having poor water quality (NYSDEC 2016a), with 18% being good or satisfactory, and 32% without sufficient data for assessment (NYSDEC 2018). Sixty percent (60%) of the rivers in the watershed remain largely unassessed; of those rivers that have been assessed, 36% are classified as having good or satisfactory water quality and 5% are considered to have poor water quality. Details about existing water quality conditions are presented in section 5.

3.1.2 Wetlands

Wetlands, delineated in **Map 12**, comprise approximately 14% of the watershed area with the St. Regis (84,000 acres) and Oswegatchie (81,000 acres) subbasins including the highest concentration of wetland area. Wetlands are sensitive, productive ecosystems that serve several ecosystem functions including flood storage and shoreline erosion protection. Hydrology varies seasonally and episodically in wetlands due to periodic inundation and saturation of soils. NYSDEC identifies and regulates all freshwater wetlands greater than 12.4 acres in size. The St. Regis (84,000 acres, 15%), Oswegatchie (81,000 acres, 12%), and Raquette (71,000 acres, 9%) have the most wetland area.

Wetlands are threatened by encroachment for residential use, eutrophication, and alterations in hydrology that can convert them to uplands.

3.1.3 Precipitation Patterns and Flooding

The St. Lawrence River watershed is home to long, frigid winters and short, relatively cool summers. The average annual precipitation ranges from 35 to 62 inches per year (National Climatic Data Center, data from 1981-2010, in Arguez et al. 2010) (**Map 13**), largely dependent on elevation (**Map 14**). This rate is among the highest annual precipitation rates in New York State. The most precipitation occurs at the southeastern edges of the Raquette subbasin and southern edge of the Oswegatchie subbasin, with the lowest precipitation rates concentrated on areas adjacent to the St. Lawrence River. At the subwatershed level, the mean annual precipitation varies from a low of 37.6 inches in the Upper St. Lawrence to 43.9 inches in the Raquette (US EPA, Average Annual Precipitation 1981–2010). The National Oceanic and Atmospheric Administration (NOAA) operates seven climate monitoring stations throughout the watershed to continuously measure temperature and precipitation. Annual and seasonal normals collected by these stations are listed in **Table 2**. The watershed has a fairly consistent distribution of precipitation throughout the year, although most areas experience slightly higher precipitation rates (approximately 3.5–4.5 inches/month) in autumn and lower rates in the winter (approximately 2–3 inches/month) according to NOAA climatic data collected from 1981–2010 (Arguez et al. 2010). Snowfall averages increase with elevation; highlands see upward of 100 inches of snowfall annually. It is typical to still have snowpack in the Adirondacks in mid-March. The additional snowpack can be rapidly melted by warm spring rains, contributing to the potential for flooding and episodes of significant runoff.

Table 2
Climate Data, 2010

Climate Monitoring Station	Elevation	Temperature (F°)		Precipitation (inches)	
		Winter	Summer	Annual Average	Annual Average Snowfall
Wanakena Ranger School	460.2	19.8	66	44.18	114.2
Malone, NY	268.2	17.2	65.4	38.86	95.3
Canton 4SE, NY	136.6	19.4	66.6	37.34	79.6
Colton 2 N, NY	176.8			42.45	
Gouverneur 3 NW, NY	128	18.2	65.6	37.61	85.2
Tupper Lake Sunmount, NY	512.1	17.1	63.2	44.82	
Massena International Airport, NY	65.2	18.1	66.6	34.96	69.4

SOURCE: Annual/Seasonal Normals, 2010, NOAA Climatic Data

Flooding in the St. Lawrence River watershed is a significant issue, especially in recent years, due to ongoing above average precipitation and snow melt in the Great Lakes Basin. Flooding occurs when heavy or continuous rainfall exceeds the soil's absorptive capacity and flow capacity of local rivers and streams. Thirty-nine percent of the watershed's area is comprised of wet areas with high runoff potential contiguous to surface water, also known as the hydrologically connected zone (HCZ). Major flooding has occurred in the years 2018 and 2019, resulting in millions of dollars' worth of damages. Ongoing efforts through programs such as the Lake Ontario Resiliency and Economic Development Initiative aim to help communities adapt to this new normal of flooding in the area through hardening key infrastructure and smart growth principles.

Floodplains are typically found in low areas adjacent to streams, rivers, and lakes that are prone to periodic flooding. In undeveloped areas, floodplains provide diverse habitat and an opportunity for groundwater recharge. Flood Insurance Rate Maps were sourced from the Federal Emergency Management Agency (FEMA) to determine the locations of floodplains within the watershed (**Map 15**). However, much of the floodplain data is lacking and therefore an analysis at the watershed and subwatershed levels was not feasible. Therefore, other factors such as slope, soil type, drainage area and other water hydrology characteristics must be used to determine areas at risk of flooding.

3.2 Topography and Geology

In general, the topography can be surveyed as mountainous terrain in the southwestern area with lowland, agricultural plains lying inland from the St. Lawrence River within the eastern and northern region of the watershed. Defining ridgelines of the western Adirondack mountains have the highest elevation, exceeding 4,000 ft above mean sea level, with the highest elevations found along the southwestern edge and southern edge of the Raquette and Oswegatchie subbasins (**Map 14**).

The surficial material throughout the basin was deposited during the Last Glacial Maximum, approximately 26,500 years ago. **Map 16** maps the surficial material of the St. Lawrence River watershed. Till and kame deposits in the Adirondack region is sand-rich and of metamorphic origin. It has poorly sorted, variable texture, from boulders to silt with permeability varying with thickness and compaction of the material due to deposition from a melting ice sheet. The Upper St. Lawrence, Indian, and western portion of the Oswegatchie subbasin are dominated by lacustrine silt and clay deposits that are generally calcareous. This material has low permeability and potential for land instability. The northern central and western areas of the watershed primarily consist of till, marine and lacustrine silt and clay, and sand which are typical of near-shore deposits in brackish water resulting in intermediate permeability.

Map 17 shows the bedrock geology of the St. Lawrence River watershed which predominantly consists of carbonate, sandstone, crystalline and metamorphosed rocks. A large band of carbonates extends from the west to east along the St. Lawrence River shoreline adjacent to a thinner band of

sandstone. The plains of the Upper St. Lawrence, Indian, and Oswegatchie subbasins are a conglomerate of glacial/alluvial deposits, carbonates, crystalline and sandstone. Crystalline rocks are the most dominant bedrock within the Adirondack region with some glacial deposits, metamorphosed clastic and crystalline, and shale and carbonate bedrock spreading throughout the range.

3.3 Soils

Soils are involved in many critical functions affecting the environment and water quality; they provide habitat to plants, animals, fungi, and microbes that contribute to nutrient and carbon cycling, filter water before it enters an aquifer, and moderate the supply of essential nutrients for agricultural production. Soils differ from place to place based on parent material, climate, organisms present, topography, and age. By characterizing soils based on their chemical, physical, and biological properties, we can predict the fate and transport of contaminants and a soils' erosion potential, which both affect the quality of our waters.

The Natural Resource Conservation Service (NRCS) classifies soils into four hydrologic soil groups (A, B, C, D) based on the soil's runoff potential. Runoff potential generally increases from Group A to D. A's are typically sand, loamy sand, or sandy loam soils with high infiltration rates. B's are usually silt loam or loam soils with a moderate infiltration rate when thoroughly wetted with a fine to moderately coarse texture. Sandy clay loams are representative of C soils, having a low infiltration rate and a moderately fine to fine structure. D soils are typically clay loam, silty clay loam, sandy clay, silty clay, or clay having a high runoff potential and very low infiltration rates due to its high swelling potential. The hydrologic soil groups throughout the basin are shown in **Map 18**. The western areas of the watershed along the St. Lawrence River, including the Upper St. Lawrence, Indian, and Oswegatchie subbasins, are dominated by class C and D soils classifying them as soils with high runoff potentials and low infiltration rates. These soils pose a greater risk concerning flooding potential. Other C and D soils lie along the St. Lawrence River across the northern portions of the Raisin, Raquette, St. Regis, and Salmon River subbasins. The mountainous regions within the mid-southern area of the watershed is varied in hydrologic soil composition likely due to its rapidly changing topography and abundant water resources in the area.

The potential for soil erosion by runoff and raindrop impact is measured by the soil erodibility k-factor. The NRCS developed this factor to estimate soil losses based on a soil's physical and chemical characteristics, with the value ranging from 0.02-0.69. A higher k-value represents greater susceptibility of the soil to rill and sheet erosion by rainfall. Typically, soils with greater permeability have a greater resistance to erosion and, therefore, a lower k-value. The erosion potential for the St. Lawrence River watershed is shown in **Map 19**, with erosion potential increasing as colors darken to deeper red. The watershed has an average k-factor of 0.29 with the highest average k-factor of the subbasins being in the Upper St. Lawrence. However, areas with the highest k-factor locally lie within

the mountainous areas of the Adirondack State Park that contain steep slopes and high annual precipitation.

3.4 Habitat

The St. Lawrence River watershed is within the most un-populated, rural areas of New York State. Its diverse vegetation and waterbodies within the St. Lawrence River watershed provide habitat to various terrestrial and aquatic species. The landcover map, **Map 20**, illustrates the diversity of habitats throughout the watershed. A wide range of terrestrial habitats such as forests in the Adirondack region, wetlands, and agricultural lands serve as refuge for important bird, reptile, amphibian and mammal populations. These regional differences have been characterized into distinct ecological zones. Each zone, mapped in **Map 21,** represents an assemblage of interacting plant and animal populations that share a common environment. A description of the major zones present is given below.

Central Adirondacks. Most of this zone is within the southern half of the Raquette River subwatershed. It is characterized by boreal heath barrens, or shrubland that occurs at the outwash plains of the Adirondacks. Soils are sandy, dry, and poor in nutrients and may become seasonally flooded due to a discontinuous subsurface layer of podzolized soil that impairs water drainage. The area is characterized by various coniferous communities at higher elevations and mixed forests at lower elevations. A large proportion of this area is under public ownership, the Adirondack Park Agency, and is NYSDEC Forest Preserve.

Champlain Transition. This zone is confined to the Chateaugay-English subbasin at its eastern end along the St. Lawrence River within Clinton County. It is characterized by a mix of perched bogs of acidic, shallow peat, heath shrubland with well-drained, sandy soils, and open canopy woodlands with very shallow acidic soils over sandstone bedrock. Jack and pitch pines are dominant tree species in this zone.

Eastern Ontario Plains. This zone extends from the southwestern portions of the Upper St. Lawrence and Indian subwatersheds approximately to the St. Lawrence County line. This area consists of low elevation plains over limestone bedrock. It contains wetlands, grass- and shrublands which now has largely been transitioned for agricultural use as pastures for the dairy industry. This area supports alvar communities, a globally rare group found among the characteristic limestone bedrock. Soils of typically very shallow loams over limestone or dolostone bedrock.

St. Lawrence Plains. The Upper St. Lawrence, Oswegatchie, and northern tips of the Raquette, St. Regis, and Salmon River subwatersheds fall within the St. Lawrence Plains ecozone. This area is characterized by riverside meadows with gently sloping cobble shores, sparse or patchy vegetation dominated by scrub oak or heath shrubs, and small wetland areas rich in organic matter or clay. Water levels and soil saturation fluctuate seasonally and ice from the St. Lawrence River scours the

meadow, cutting back woody plants along its shoreline. The area has a cool microclimate. The forested areas are dominated by pitch pine, chestnut and red oak, red maple, American elm, and green and white ash. Grazing and other agricultural practices have altered the ecological zone.

Western Adirondack Foothills. The Western Adirondack Foothills is the dominant ecological zone of the St. Lawrence River watershed. The band extends from the southwestern edge of the Oswegatchie and diagonally stretches to the southern half of the Chateaugay-English subwatershed, traversing the bulk of the Grasse, the narrow, middle stretch of the Raquette, the southern half of the St. Regis, and the central Salmon River subwatersheds. Sandy, low fertility soils derived from glacial outwash deposits lie on the foothills. The area contains many seasonally fluctuating, groundwater-fed ponds and associated wetlands that typically occur in pine barrens. Peatlands and bogs occur along the gentle slopes of the foothills. The landscape is covered with extensive hardwood forests and supports similar communities to those contained within the higher elevations of the Adirondacks.

The St. Lawrence River is home to a wide variety of warm water fish species including small- and largemouth bass, northern pike, walleye, yellow perch, bullheads and various panfish. Streams, rivers, and lakes of the Adirondack region host both warm- and cold-water fisheries providing diverse habitats from deep, clear waters to rushing rapids and swirling pools. Species such as Lake, Brown, Brook, and Rainbow Trout, large- and smallmouth bass, land-locked salmon, walleye, perch, northern pike, and chain pickerel can be found in these waters.

The New York Natural Heritage Program (NYNHP) aims to facilitate conservation and biodiversity by providing information and expertise on rare species and natural ecosystems within NYS. The Upper St. Lawrence has the highest total count of at-risk species at 53, followed by the Raquette River at 48. The majority of these counts are characterized as flowering plant species within these counts are characterized as flowering plant species with the second highest at-risk group being birds. A full list of rare, threatened, and endangered species of the St. Lawrence River watershed can be found at New York Nature Explorer (NYSDEC 2014).

Habitat quality is directly related to landscape condition and use, as well as hydrologic and biogeochemical processes. A habitat condition index was developed by the National Fish Habitat Partnership (NFHP, 2015 National Assessment) to score habitats on their likelihood of aquatic habitat degradation with a score range of 1 for high likelihood of aquatic habitat degradation, to 5 for low likelihood of aquatic habitat degradation. This score is dependent on land use, population density, roads, dams, mines, and point-source pollution sites. The habitat condition index for the entire watershed was calculated as 4.4, inferring that there is a low likelihood of aquatic habitat degradation.

3.5 Land Cover and Land Use

Both land cover and land use can impact water quality in a watershed. Land cover refers to how much of a region is covered by forests, wetlands, agriculture, open water, and other natural features. Land use refers to how the landscape is utilized by humans, such as for farming, conservation, residential, or commercial purposes. Land cover can function as a buffer against environmental impacts; for example, wetlands provide a buffer against flooding, woodlands buffer waterbodies from runoff, and vegetation can stabilize steep slopes prone to erosion. Land use information helps determine which types of pollutants may be present and how much could potentially be released.

Land cover within the S. Lawrence River watershed (**Map 20**, **Table 3**) is dominated by forested woodlands, encompassing roughly 59% of the total area. The Raquette River subbasin has the most acreage dedicated to forests at 619,000 acres, making up 77% of its total area. The region lost about 14,000 acres of its forests from 2001 to 2011 while areas classified as wetlands increased by 350 acres during this period. Agriculture occupies about 17% (616,000 acres) of the watersheds' landscape with the remainder in wetlands (14%), open water (3%), urban development (3%), shrub/scrub (2%), and grasslands (1%).

Table 3
Land Cover, St. Lawrence River Watershed

HUC10	Forest (acres)	Scrubland (acres)	Grassland (acres)	Wetlands (acres)	Urban (acres)	Agriculture (acres)
Upper St. Lawrence	89166	7145	4758	37537	18116	86806
Oswegatchie	446827	10064	4245	81473	12560	93025
Indian	177609	11313	7714	53231	15768	77481
Grasse	260231	6824	2590	48455	12460	65046
Raquette	619203	17890	3712	70860	13269	27824
St. Regis	389709	16222	3104	83969	7628	34845
Salmon	145666	4884	2194	35512	8212	59140
Chateaugay-English	140762	7355	2443	52096	5158	51759
Watershed	2108346	84789	36167	496538	110193	616731
	% Forest	**% Scrubland**	**% Grassland**	**% Wetlands**	**% Urban**	**% Agriculture**
Upper St. Lawrence	36	3	2	15	7	35
Oswegatchie	66	1	1	12	2	14
Indian	49	3	2	15	4	22
Grasse	64	2	1	12	3	16
Raquette	77	2	0	9	2	3
St. Regis	71	3	1	15	1	6
Salmon	56	2	1	14	3	23
Chateaugay-English	53	3	1	20	2	20
Watershed	59	2	1	14	3	17

SOURCE: 2011 CDL-NLCD Hybrid Land Cover dataset.

The riparian zone of a landscape influences the water quality within, and downstream from, surrounding waterbodies. Identifying riparian zones in need of improvement and maintenance will enhance retainment of excess nutrients and sediments and perform other critical hydrologic, geomorphic, and biological functions that improve a watershed's health.

Agriculture is a leading industry and use of land in the area, as the northern skirt of the St. Lawrence River water basin is host to rich soils and flat plains suitable for farming (**Maps 14** and **18**). Agricultural districts are outlined in **Map 22**. According to the 2017 Census of Agriculture from the USDA National Agricultural Statistics Service (NASS), land dedicated to farming has decreased by approximately 7% since 2012 within the watershed. In 2017, 620,714 acres were dedicated to farming, hosting 2,344 farms, a decrease of 144 farms since the 2012 census. In 2017, cropland, pasture/grazing land, and woodlands occupied 333,350, 14,523, and 163,308 acres, respectively. Approximately 18,000 acres of cropland were idle or used for cover crops or soil-improvement but not harvested and not pastured or grazed. No-till practices are used on 191 farms occupying 21,377

acres (up from 173 farms holding 13,032 acres in 2012), and reduced tillage is practiced on 182 farms covering 33,508 acres (up from the 92 farms covering 15,543 acres). Manure is spread across 104,000 acres in the watershed, and 129,000 acres are treated with commercial fertilizers, lime, or soil conditioners. **Table 4** lists the harvested crops and livestock and poultry headcounts for the watershed. Agriculture census data can also be found for each county within the watershed.

Table 4
Crops and Livestock, St. Lawrence River Watershed

Selected Crop	Farms	Acres	% Harvested Cropland	Change in # of Farms since 2012	Change in Farmed Acres since 2012
Corn	398	74178	26.49	-54	-2615
Soybeans	62	8284	2.96	-11	1054
Small grains (wheat, oats, barley, rye)	117	4109	1.47	-10	625
Vegetables	170	1128	0.40	-33	-473
Orchards	91	296	0.11	-18	-265
Nursery, greenhouse, floriculture, and sod	71	77	0.03	-18	-68
All other crops	1710	191949	68.55	-93	-11897
Total	**2619**	**280021**	**100**	**-237**	**-13639**
Livestock/Poultry	**Farms (2017)**	**Acres (2017)**	**% of Livestock Acres**	**Change in Farms since 2012**	**Change in Farmed Acres since 2012**
Cattle and calves	1173	135567	55.64	-142	-1137
Hogs and pigs	148	1045	0.43	-42	-964
Sheep and lambs	120	3369	1.38	5	-1685
Horses and ponies	622	3753	1.54	-43	-728
Goats	125	1153	0.47	-12	151
Chickens	441	98758	40.53	-8	76936
Total	**2629**	**243645**	**100**	**-242**	**72573**

SOURCE: 2017 Agriculture Census, USDA, National Agricultural Statistics Service.

The Upper St. Lawrence is the most agriculturally intensive subbasin, dedicating 35% of its land to agricultural activities (87,000 acres). The Oswegatchie and Indian subbasins farm an additional 93,000 and 77,000 acres each, constituting 14% and 22% of their total area, respectively. The Oswegatchie and Indian subbasins have the highest count of surface water segments listed as impaired due to nutrients and requiring a TMDL under Section 303(d) of the Clean Water Act (CWA). The counts include state-assigned pollutants/causes identified as nutrients, organic enrichment/oxygen

depletion, algal growth, or noxious aquatic plants. These IDs are associated with excess nutrients and sediment transport via agricultural runoff. From 2001 to 2011, the St. Lawrence River watershed increased its agricultural lands by 1,100 acres with approximately 70% of those being in hydrologically connected zones that are comprised of wet areas with high runoff potential, causing concern for future impairment of adjacent waterbodies.

Only 3% of the St. Lawrence watershed area is classified as urban; this region is among the least populated areas of NYS. With the low population density, impervious cover occupies a low 0.7% of the area (**Map 23**). The highest percentage of impervious surfaces (2%) is within the Upper St. Lawrence subbasin.

The Adirondack Park is the governing authority of much of the area (44%) of the St. Lawrence River watershed (**Map1**). The Adirondack Park is a six-million-acre patchwork of public and private lands in northeastern New York. It cuts northeast from the southwestern corner of the Oswegatchie subbasin up to the middle of the Chateaugay-English subbasin. A significant proportion of this land is part of the Adirondack Forest Preserve, afforded constitutional protections that prevent the removal of timber. These lands are rich in both recreational opportunity and ecological significance.

4 Community Characteristics

4.1 Municipalities and Population

In all, one Indian territory (Saint Regis Mohawk Indian Territory), one city (Ogdensburg), 22 villages, and 76 towns are wholly or partially within New York's St. Lawrence River watershed (**Map 24**, **Table 5**). The population density within the St. Lawrence River watershed is displayed in **Map 25**. The total watershed population in 2010 was 196,503, the most populous areas being Potsdam (16,075), Malone (14,799), Fort Drum (12,955), and Massena (12,245) (US Census Bureau 2010). The Upper St. Lawrence subbasin has the highest population density, but the Raquette subbasin hosts the largest population at 10,831 persons.

Table 5
Municipalities within the St. Lawrence River Watershed

Civil Boundary Type	Primary HUC8	Name	Population*	County
City	Upper St. Lawrence (04150301)	Ogdensburg	11,128	St. Lawrence
Village	Upper St. Lawrence (04150301)	Cape Vincent	726	Jefferson
		Clayton	1978	Jefferson
		Alexandria Bay	1,078	Jefferson
		Morristown	395	St. Lawrence
		Waddington	972	St. Lawrence
	Oswegatchie (04150302)	Antwerp	686	Jefferson
		Gouverneur	3,949	St. Lawrence
		Richville	323	St. Lawrence
		Rensselaer Falls	332	St. Lawrence
		Huevelton	714	St. Lawrence
	Indian (04150303)	Antwerp	686	Jefferson
		Philadelphia	1,252	Jefferson
		Evans Mills	621	Jefferson
		Theresa	863	Jefferson
		Hammond	280	St. Lawrence
	Grasse (04150304)	Canton	6,314	St. Lawrence
		Massena	10,936	St. Lawrence
	Raquette (04150305)	Speculator	324	Hamilton
		Tupper Lake	3,667	Franklin
		Norwood	1,657	St. Lawrence
		Potsdam	9,428	St. Lawrence

Civil Boundary Type	Primary HUC8	Name	Population*	County
	Salmon (04150307)	Brushton	474	Franklin
		Malone	5,911	Franklin
	Chateaugay-English (04150308)	Chateaugay	833	Franklin
		Burke	211	Franklin
Town	Upper St. Lawrence (04150301)	Cape Vincent	2,777	Jefferson
		Orleans	2,789	Jefferson
		Alexandria	4,061	Jefferson
		Hammond	1,191	St. Lawrence
		Morristown	1,974	St. Lawrence
		Clayton	5,153	Jefferson
		Lisbon	4,102	St. Lawrence
		Waddington	2,266	St. Lawrence
	Oswegatchie (04150302)	Fine	1,512	St. Lawrence
		Clifton	751	St. Lawrence
		Pitcairn	846	St. Lawrence
		Edwards	1,156	St. Lawrence
		Fowler	2,202	St. Lawrence
		Gouverneur	7,085	St. Lawrence
		De Kalb	2,434	St. Lawrence
		Oswegatchie	4,397	St. Lawrence
	Indian (04150303)	Theresa	2,905	Jefferson
		Antwerp	1,846	Jefferson
		Philadelphia	1,947	Jefferson
		Le Ray	21,782	Jefferson
		Wilna	6,427	Jefferson
		Croghan	3,093	Lewis
		Diana	1,709	Lewis
		Rossie	877	St. Lawrence
		Macomb	906	St. Lawrence
		De Peyster	998	St. Lawrence
	Grasse (04150304)	Colton	1,451	St. Lawrence
		Hermon	1,108	St. Lawrence
		Canton	10,995	St. Lawrence
		Russell	1,856	St. Lawrence
		Clare	105	St. Lawrence
		Pierrepont	2,589	St. Lawrence
		Madrid	1,735	St. Lawrence

Civil Boundary Type	Primary HUC8	Name	Population*	County
		Louisville	3,145	St. Lawrence
	Raquette (04150305)	Webb	1,807	Herkimer
		Long Lake	711	Hamilton
		Arietta	304	Hamilton
		Inlet	333	Hamilton
		Indian Lake	1,342	Hamilton
		Newcomb	436	Essex
		North Elba	8,957	Essex
		Harrietstown	5,709	Franklin
		Tupper Lake	5,971	Franklin
		Piercefield	310	St. Lawrence
		Arietta	304	Hamilton
		Parishville	2,153	St. Lawrence
		Potsdam	16,041	St. Lawrence
		Norfolk	4,668	St. Lawrence
		Massena	12,883	St. Lawrence
	St. Regis (04150306)	Santa Clara	345	Franklin
		Hopkinton	1,077	St. Lawrence
		Waverly	1,022	Franklin
		Brighton	1,435	Franklin
		Duane	174	Franklin
		Brandon	577	Franklin
		Dickinson	823	Franklin
		Lawrence	1,826	St. Lawrence
		Moira	2,934	Franklin
		Brasher	2,512	St. Lawrence
		Stockholm	3,665	St. Lawrence
	Salmon (04150307)	Franklin	1,140	Franklin
		Malone	14,545	Franklin
		Bangor	2,224	Franklin
		Bombay	1,357	Franklin
		Fort Covington	1,676	Franklin
		Westville	1,819	Franklin
	Chateaugay-English (04150308)	Bellmont	1,434	Franklin
		Dannemora	4,898	Clinton
		Ellenburg	1,743	Clinton
		Constable	1,566	Franklin

Civil Boundary Type	Primary HUC8	Name	Population*	County
		Burke	1,465	Franklin
		Chateaugay	2,155	Franklin
		Clinton	737	Clinton
		Mooers	3,592	Clinton

SOURCE: New York State Civil Boundaries, NYS GIS Clearing House (June 2019).

* In some cases, only a portion of villages and towns lie within the watershed, so populations shown in the table cannot be summed to give the watershed population.

4.2 Regulatory and Programmatic Environment

The St. Lawrence River watershed is affected by regulations, plans, and programs at the federal, state, regional, county, and local level, as well as by collaborations involving nonprofit organizations and academic institutions, that are designed to help protect and maintain water quality and aquatic habitat within the St. Lawrence River watershed. The Project Team worked with a consultant (Rootz) to compile and review the local laws of the watershed municipalities and evaluate their effectiveness in protecting water quality and habitat from point- and nonpoint-source pollution.

4.2.1 Approach to Reviewing Local Laws, Plans, and Programs

The inventory and assessment of municipal measures to protect water resources in the St. Lawrence River watershed were based on a modified version of the process outlined by the Genesee/Finger Lakes Regional Planning Council (2006). Due to the extensive size of the watershed, a rigorous assessment on individual municipalities was not feasible, and therefore the regulatory environment was assessed at the County level. Existing local laws and tools that guide land use were identified by municipal nonpoint assessment forms completed by County Department of Planning and/or SWCD professional staff. The review of existing documents included:

- Comprehensive Plans/Land Use Plans/Rural Development Plans/Waterfront Revitalization Plans;
- Zoning, Site Plan Review and Subdivision Regulations; and
- Water Quality Protection Programs/Measures
- Waterbody/Shore Protection
- Floodplain Protection
- Waste Management
- Wastewater/On-site Septic
- Stormwater
- Agriculture

The resulting product is the St. Lawrence River Watershed Local Laws and Programs Affecting Water Quality (**Appendix A**). This document evaluates the current regulatory environment with respect to water quality and identifies improvements to local codes that would address water quality impacts from developmental activities more effectively.

4.2.2 Gap Assessment as Related to the Desired State

Within the St. Lawrence River watershed, multiple municipalities with several regulatory entities exist, which results in significant variation in regulatory tools and laws that address watershed resource protection. Some municipalities have greater resources available to them, regarding staffing, resources, and regulatory tools, while others are more vulnerable offering few local laws to manage water quality challenges. This variation is, in part, influenced by location within the Adirondack Park boundary. The APA is an important regulatory body, encompassing 44% of the watershed, and is responsible for maintaining protection of the forest preserve and regulating development on privately owned lands. This involves shoreline restrictions, tree removal, and protection of river systems and adjoining land.

Based on the results of the evaluation, most municipalities do not adequately address the comprehensive protection and preservation of water quality in their regulatory programs. At the time of local law assessment inventory, only 32%, 26%, and 29% of municipalities utilize land use planning tools and regulations to target waterbody/shoreline protection, on-site septic systems, and agriculture, throughout the watershed, respectively. On the contrary, waste and junkyard management (83%) and floodplain protection measures (66%) are most consistently addressed within the watershed. The St. Lawrence River Watershed Revitalization Plan will build upon the identified regulatory and programmatic gaps in local laws and programs to recommend laws and practices that could enhance sustainable land use and natural resource protection and future livelihood of the watershed.

4.3 Water Use

Water use in the St. Lawrence River watershed is divided among four predominant sectors; thermoelectric (59%, 25 MGD), domestic (42%, 14 MGD), industrial (7%, 3 MGD), and agricultural (<1%, 0.013 MGD, 12,500 gallons per day) (USEPA, Watershed Index Online, 2019; USEPA EnviroAtlas, 2015). **Map 26** shows the locations of water withdrawals throughout the watershed and the sector associated with the withdrawal. NYS has the highest thermoelectric power water withdrawals in the northeastern United States (USGS 2015). Water for thermoelectric power is used to cool power-producing equipment. **Map 27** depicts hydroelectric, thermoelectric, solar, and biomass energy generation plants within the watershed.

4.3.1 Drinking Water Sources

The St. Lawrence River provides drinking water to approximately four million people in the United States and Canada; in New York State, the river serves as public water supply for the City of Ogdensburg, Town of Louisville, and Villages of Massena, Clayton, and Alexandria Bay. The Oswegatchie River serves 3,949 residents in the town of Gouverneur. Surface waters from Lake Eaton, Tupper, Blue Mountain, Raquette, Cranberry and Star Lakes are used as municipal drinking water supplies for their surrounding municipalities (Annual Drinking Water Quality Reports, 2018).

Groundwater aquifers are the main source of drinking water in the region. Public water works utilize groundwater and surface water to serve 65% (128,897 individuals, 2014 SWDIS data) and 44% (86,011 individuals, 2014 SWDIS data) of the watershed's population, respectively. Rural residents obtain potable water from deep wells drilled into bedrock. The NYSDEC Water Well Program mapped 973 water wells within the St. Lawrence River watershed, as depicted in the Water Wells map from the NYS GIS Clearinghouse (NYSDEC Division of Water 2016). This data represents only about 20% of private wells in NYS with records beginning post-2000.

Municipal water supplies from major aquifers, lakes and reservoirs, and wellheads are depicted in **Map 26**. The red dots on **Map 26** refer to withdrawals for public water via publicly owned water utilities. The mapped water wells, shown as Xs, are designated community water systems—those that either serve at least 15 service connections used by year-round residents or regularly serve at least 25 year-round residents, such as local town and village water districts. A comprehensive list of Public Water Systems by county is maintained by the NYS Department of Health (NYSDOH, 2018).

The NYSDEC Water Quality Standards Program classifies surface waters for their best use, including water supply. Class A and AA waters are waterbodies classified as suitable for drinking and culinary purposes, as well as primary and secondary contact recreation and fishing. **Table 6** summarizes Class A and AA surface waters of the St. Lawrence River watershed. A full list of assigned classifications to fresh surface waters within the St. Lawrence River watershed can be found in the New York Codes, Rules, and Regulations, Division of Water (6 CRR-NY 910.6).[1]

[1] NYSDEC is planning a reclassification of some St Lawrence basin surface waters: "The Division of Water expects to propose upgrades to the classifications of certain surface waters in 6 NYCRR Part 910 (St. Lawrence River drainage basin). These reclassifications are necessary to meet federal Clean Water Act (CWA) goals for water quality and, if adopted, would result in higher classifications (and thus more stringent water quality standards) for some waters in this drainage basin. Numerous Class D surface waters, which only provide protection for fish survival, would be proposed to be upgraded to higher classifications (Class C or higher)" (NYSDEC 2019a).

Table 6
Class A and AA Waterbodies

Waterbody Name	HUC12	Class A Stream Miles	Class A Lake Acres	Class AA Stream Miles	Class AA Lake Acres	% of HUC8 Streams	% of HUC8 Lake Acres
Upper St. Lawrence							
Saint Lawrence River, Main Stem (0901-0004)	0415030101	100	--	--	--	30%	--
Saint Lawrence River, Main Stem (0901-0015)	0415030102	31	--	--	--		
Saint Lawrence River, Main Stem (0901-0002)	0415030103	11	--	--	--		
Saint Lawrence River, Main Stem (0901-0001)	0415030103	43	--	--	--		
Oswegatchie							
Cranberry Lake (0905-0007)	0415030201	--	6795	--	--	9%	39%
Star Lake (0905-0180)	0415030202	--	--	--	205		
Oswegatchie River, Middle, and tribs (0905-0101)	0415030206	199	--	--	--		
Oswegatchie River, Middle, Main Stem (0905-0096)	0415030208	28	--	--	--		
Indian							
West Creek, Upper, and tribs (0906-0043)	0415030303	14	--	--	--	1%	--
Grasse							
Little River, Upper, and tribs (0904-0019)	0415030403	--	--	58	--	4%	--
Raquette							
Blue Mountain Lake (0903-0204)	0415030501	--	1235	--	--	2%	25%
Raquette Lake (0903-0081)	0415030501	--	--	--	5197		
Lake Eaton (0903-0056)	0415030503	--	--	--	568		
Tupper Lake (0903-0076)	0415030504	--	4858	--	--		
Piercefield Flow (0903-0075)	0415030505	--	471	--	--		
Eagle Crag Lake, more (0903-0114)	0415030505	--	144	--	--		
Trib to Upper Dead Creek and tribs (0903-0113)	0415030505	--	--	7	--		
Raquette River, Middle, and tribs (0903-0064)	0415030507	40	--	--	--		
St. Regis							
Osgood Pond (0902-0148)	0415030601	--	--	--	512	--	16%
Spitfire Lake, Upper Saint Regis Lake (0902-0159)	0415030604	--	--	--	978	--	--
Chateaugay-English							

Waterbody Name	HUC12	Class A Stream Miles	Class A Lake Acres	Class AA Stream Miles	Class AA Lake Acres	% of HUC8 Streams	% of HUC8 Lake Acres
Standish Brook, Upper, and tribs (0902-0062)	0415030801	--	--	7	--	1%	--

SOURCE: 6 CRR-NY 910.6

Public utilities treat most water used for public drinking water supplies, but protecting source water from contamination can reduce treatment costs and risks to public health. Source water assessments provide water utilities with information to help them identify potential sources of contamination and implement management measures to prevent, reduce, or eliminate risks to the drinking water supply. Source water assessments have identified 503,000 acres in the watershed as Source Water Protection Areas, areas of increased susceptibility to contamination (EPA Safe Drinking Water Information Systems, SDWIS, 2014 geospatial data).

4.4 Public Access and Recreation

Residents of, and visitors to, the St. Lawrence River watershed have diverse opportunities to enjoy water-related recreational activities including boating, swimming, hunting, fishing, and nature observation. Public lands within the Adirondack State Park are managed by NYSDEC. **Map 28** depicts NYSDEC recreational public access points that support activities such as boating, camping, canoeing, fishing, hiking, and nature observation. Late spring and summer months are typically when recreational demand is highest. Recreational freshwater fishing demand is highest for the Raquette (81,600 fishing day trips/year), Oswegatchie (69,300 fishing day trips/year), and St. Regis (55,900 fishing day trips/year) subbasins.

Most of the shoreline along the St. Lawrence is privately owned with a few recreational state parks managed by the Office of Parks, Recreation, and Historic Preservation (OPRHP). Surface water access to the St. Lawrence River is predominantly provided by privately owned sites such as recreational clubs, marinas, restaurants, motels, and residential properties. However, demand for improving and enhancing opportunities for public access to swimming, fishing, and boating has increased throughout the watershed.

4.5 Infrastructure

4.5.1 Dams

Dams serve many purposes within the St. Lawrence River watershed including recreation, flood control and storm management, navigation, water supply, and hydroelectric power generation. There is a total of 190 dams in the St. Lawrence River watershed with the most being in the Raquette and Oswegatchie subbasins (**Map 27**). **Table 7** lists the number of dams within each HUC10 of the St. Lawrence River watershed.

The NYS Dam Inventory assigns a hazard classification to each dam structure based on the height of the dam, maximum capacity, physical characteristics, and downstream land use. A dam would be considered a high hazard dam (Class C) when in the case that it was to fail, loss of life and significant damage to homes, commercial buildings, public utilities, highways and roads would be expected to occur. Moderate hazard dams (Class B) would result in some damage to homes, buildings, infrastructure, and public utilities in the circumstance of a dam failure. Low hazard (Class A) dams would be expected to only damage isolated buildings, vacant lands, or rural roads in the event of failure. **Table 8** lists the 21 high hazard dams, designated Class C by NYSDEC and their respective subwatershed.

Table 7
New York State Dam Classifications, St. Lawrence River Watershed

HUC10	Low Hazard (A)	Moderate Hazard (B)	High Hazard (C)	Total Dams
Upper St. Lawrence	0	0	4	4
Oswegatchie	21	10	6	37
Indian	24	2	0	26
Grasse	12	0	0	12
Raquette	44	6	10	60
St. Regis	23	1	1	25
Salmon	13	3	0	16
Chateaugay-English	8	2	0	10
St. Lawrence River Watershed	**145**	**24**	**21**	**190**

SOURCE: NYS Dam Inventory

Table 8
High Hazard (Class C) Dams in the St. Lawrence River Watershed

Dam Name	Length (ft)	Height (ft)	Max Discharge (cubic ft/s)	Max Storage (acre-ft)	Basin
Long Sault Dam	2960	132	873000	2000000	Upper St. Lawrence
Robert Moses/Robert H Saunders Dam	3200	167	873000	2000000	Upper St. Lawrence
Massena Intake Dam	4000	75	0	5000	Upper St. Lawrence
Iroquois Dam	1980	72	310000	50	Upper St. Lawrence
Cranberry Lake Dam	360	24	14220	57400	Oswegatchie
Newton Falls Dam	640	40	1331	16000	Oswegatchie
Flat Rock Dam	680	80	10500	5020	Oswegatchie
Ogdensburg Water-Power Company Dam	400	19	26600	4175	Oswegatchie
Browns Falls Dam	870	70	8900	3593	Oswegatchie

Dam Name	Length (ft)	Height (ft)	Max Discharge (cubic ft/s)	Max Storage (acre-ft)	Basin
Eel Weir Dam	1020	30	52120	810	Oswegatchie
Carry Falls Dam	623	66	31800	117595	Raquette
Blake Falls Dam	1593	70	50000	37800	Raquette
Rainbow Falls Dam	2420	91	62800	25800	Raquette
Higley Falls Power Dam	435	50	16540	13960	Raquette
South Colton Dam	877	50	50300	4500	Raquette
Norwood Dam	910	30	17800	4080	Raquette
Five Falls Dam	1655	60	45400	3090	Raquette
Colton Dam	465	27	31770	2310	Raquette
Norfolk Dam	500	29	22030	108	Raquette
East Norfolk Dam	423	20	16530	94	Raquette
Allen Falls Development Dam	766	40	25400	1780	St. Regis

SOURCE: NYS Dam Inventory

Dams serve as a major component of the watersheds' energy supply. Hydroelectric plants are reliable, cost-effective and support less-flexible sources of renewable energy. The Robert Moses-Robert H. Saunders Power dam first generated power in 1958 as part of the St. Lawrence-FDR project. It has 32 turbine-generators divided equally by the international border between the New York Power Authority (NYPA) and Canada's Ontario Hydro. The NYPA's 16 generating units can produce 800,000 kilowatts of electricity, more than enough energy to light a city the size of Washington, D.C. The Long Sault and Iroquois dams were also built as part of the St. Lawrence-FDR project.

4.5.2 Roads, Highways, and Railways

Roads, highways, and railways are shown on **Map 29**. The primary east-west highways are State Route 11 and 37, which runs parallel to the St. Lawrence River, and Highway 30, which runs north to south through Malone. The watershed includes over 450 miles of railways with track CSXT crossing through Gouverneur up to Massena and track ADCX traversing through the Adirondacks passing through Tupper Lake.

Roads, highways, and related infrastructure such as parking lots contribute to the amount of impervious area in a watershed. The St. Lawrence River watershed contains a small amount of impervious cover at 0.67%, covering a total area of approximately 24,000 acres (**Map 23**). The greatest concentration of impervious cover lies within the Upper St. Lawrence and Indian River subbasins due to developed centers of Ogdensburg and Fort Drum.

4.6 Industries and Employment

Significant industries within the counties of the St. Lawrence River watershed include manufacturing, educational services, health care, leisure and hospitality, public administration/government, and trade, transportation, and utilities (NYSDOL, 2015). The public sector employs nearly 20,000 people with an average annual wage of $53,300, making it the largest employment sector of the North Country. The educational services sector, carrying 19,000 jobs and an average annual wage of $43,400 in 2015, lost hundreds of jobs between 2009 and 2014 due to declines in primary and secondary schools. The hospitality sector employs the third most workers of any sector in the North Country economy with more than 11,400 workers and average annual wages of $14,500. The North Country region has an average annual unemployment rate of 5.3%, ranging from 4-7.5% throughout the year due to seasonal employment (NYSDOL, 2018).

5 Existing Water Quality Conditions

The NYSDEC Division of Water conducts regular, periodic assessments of waterbodies in the state to fulfill certain requirements of the Federal Clean Water Act (CWA). Waters are assessed according to their designated best use (defined by 6 CRR-NY 910.6) and compiled in an inventory database called the Waterbody Inventory/Priority Waterbodies List (WI/PWL). For waters classified as impaired, the Clean Water Act also requires states to consider a strategy, such as the development of a Total Maximum Daily Load (TMDL), to reduce the input of specific pollutant(s) restricting waterbody use. Impaired waterbodies are listed on the Section 303(d) list.

5.1 Waterbody Inventory and Priority Waterbodies

The Division of Water's WI/PWL database documents current water quality information, characterizes known or suspected water quality problems and issues, and tracks progress toward their resolution. A major source of data used to characterize waterbodies in the WI/PWL about is NYSDEC's Rotating Integrated Basin Studies (RIBS), which sample water quality and macroinvertebrates in various regions on a five-year rotating basis. The WI/PWL assessments used here for the St. Lawrence River are based primarily on data collected through the 2014 NYSDEC sampling season, though some records are dated 2016.

The PWL identifies seven assessment classifications:

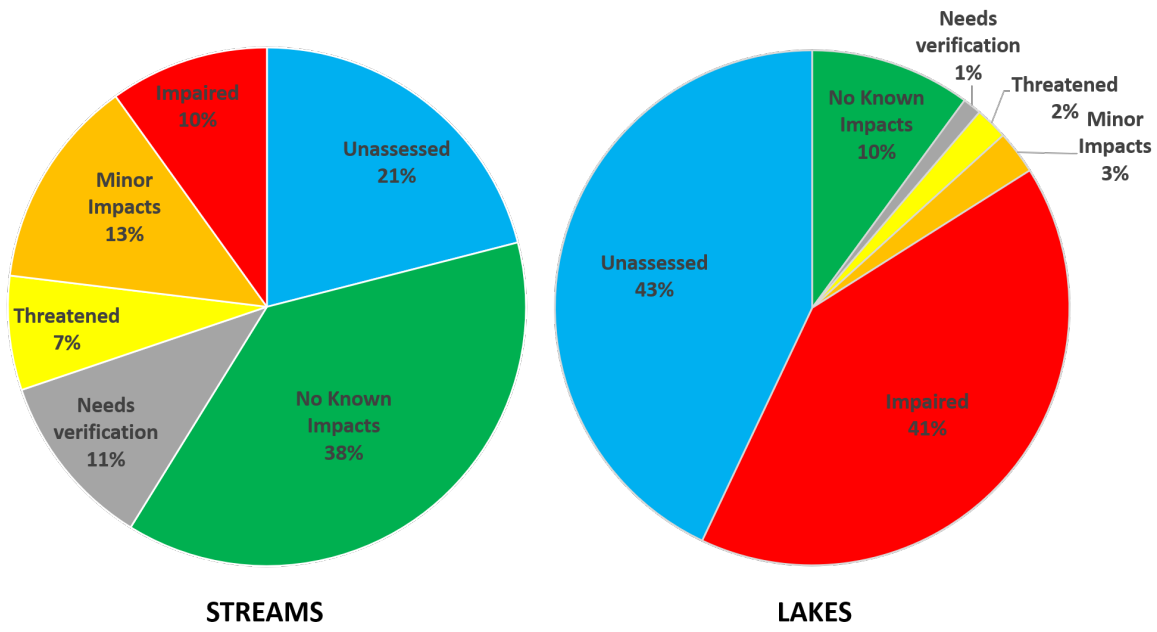
- *Impaired:* Waterbodies with well documented water quality problems that result in precluded or impaired uses
- *Minor impacts:* Waterbodies where less severe water quality impacts are apparent but uses are still considered fully supported
- *Needs verification:* Segments that are thought to have water quality problems or impact but for which there is not sufficient of definitive documentation
- *Threatened:* Waterbodies for which uses are not restricted and no water quality problems currently exist, but where specific land use or other changes in the surrounding watershed are known or strongly suspected of threatening water quality
- *Threatened (possible):* Waterbodies for which uses are not restricted and no water quality problems currently exist, but where waterbody classification, distinct uses, or other considerations make the water more susceptible to threats and additional protection efforts are warranted
- *No known impact:* Segments where monitoring data and information indicate that there are no use restrictions or other water quality impacts/issues
- *Unassessed:* Segments where there is no available water quality information to assess the support of designated uses

An overview of the PWL status for waterbodies in the St. Lawrence River watershed is presented in **Figure 2**. The WI/PWL assessed 52% (6,212 miles) of the total 12,030 miles of streams and rivers within the St. Lawrence River drainage basin. About 38% of the assessed stream miles are characterized as impaired, minorly impacted, or threatened. Thirteen (13%, 781 miles) of assessed stream miles were classified as impaired, signifying that the waters do not fully support their designated uses.

The 2016 WI/PWL assessed 57% of total lake acres within the watershed. Eighty percent (80%, 47,654 lake acres) of assessed (59,386) lake acres within the St. Lawrence River watershed were found to be impaired, minorly impacted, or threatened. About 72% of lake acres were found to be impaired and not supporting their designated use.

WI/PWL characterizations of lakes and streams in specific subwatersheds are shown in **Table 9** and **Map 30.**

Figure 2
WI/PWL Status of St. Lawrence River Watershed Waterbodies



SOURCE: NYSDEC, WI/PWL 2016

Table 9
Priority Waterbodies Assessment of St. Lawrence River Streams and Lakes

Streams (miles)						
Subwatershed	**Impaired**	**Minor Impacts**	**Threatened**	**No Known Impacts**	**Unassessed**	**Assessed Impacted (%)**
Upper St. Lawrence	254	204	--	--	166	100
Oswegatchie	298	181	265	157	1266	57
Indian	56	182	--	115	683	50
Grasse	30	175	--	707	548	19
Raquette	142	48	--	539	1677	26
St. Regis	--	58	--	841	722	5
Salmon	--	102	264	218	332	63
Chateaugay-English	--	84	32	398	423	22
Watershed	**781**	**1034**	**560**	**2974**	**5818**	**38**
Lakes (acres)						
Subwatershed	**Impaired**	**Minor Impacts**	**Threatened**	**No Known Impacts**	**Unassessed**	**Assessed Impacted (%)**
Upper St. Lawrence	--	--	--	--	1736	--
Oswegatchie	8581	--	--	638	8457	92
Indian	8487	2263	474	292	4998	97
Grasse	56	--	--	1294	2248	4
Raquette	21157	225	--	6220	21167	76
St. Regis	1782	356	1656	850	4568	82
Salmon	54	--	--	667	1174	4
Chateaugay-English	2564	--	--	543	390	83
Watershed	**42681**	**2843**	**2129**	**10505**	**44739**	**80**

SOURCE: NYSDEC WI/PWL 2016a

5.2 Section 303(d) List

Forty-three waterbodies in the St. Lawrence River watershed are classified as impaired and are therefore included on the Final NYS 2016 303(d) list. These waterbodies are listed in **Table 10**, which also indicates the specific pollutants causing impairment and their sources. Data reported in this document is from NYS's Final 2016 Section 303(d) List (NYSDEC 2016b).

The St. Lawrence River drainage basin lists four waterbodies under Section 303(d) Part 1, classifying them as waters with impairment requiring development of a total maximum daily load. A TMDL identifies the maximum amount of a pollutant that a waterbody can receive and specifies reductions needed to meet water quality standards. Waterbodies in need of a TMDL include the Lower Raquette River and minor tributaries (pathogens from onsite waste treatment systems), Black Lake Outlet -

Black Lake (phosphorus from agricultural runoff), Fish Creek and minor tributaries (phosphorus from on-site waste treatment systems), and Little River and tributaries (priority organics from industrial waste disposal).

Twenty-six waterbodies in the watershed are listed under Section 303(d) Part 2a, which means they are impaired by atmospheric deposition, or acid rain. In 2006, the NYSDEC completed TMDLs for 143 acid-impaired lakes within the New York's Forest Preserve, the majority of which had been added to Section 303(d) in 1998. The Forest Preserve has expanded in recent years, and the current TMDL is focused on the remaining affected lakes on the 2012 Section 303(d) list.

Thirteen of the St. Lawrence River drainage basin's waterbodies are listed under Part 2b, meaning they are subject to fish consumption advisories due to contamination with dioxin, pesticides, PCBs, and mercury. Note that Stark Fall Reservoir (0903-0073) and Willis Pond (0903-0105) have been added to the Draft 2018 303(d) List under Part 2b. A TMDL was developed to target mercury pollution in the Northeast Region in 2007.

In addition to the classifications shown in Table 10, Appendix A of Section 303(d) lists thirty-four waterbodies in the watershed that are classified as smaller lakes impaired by atmospheric deposition of acid rain.

Table 10
NYS 303(d) Listed Waterbodies in the St. Lawrence River Watershed

Subwatershed	Waterbody Name	Type	Class	Cause/Pollutant	Source
Part 1—Requiring TMDL Development					
Raquette	Raquette River, Lower, and minor tribs (0903-0059)	River	B	Pathogens	Onsite WTS
Indian	Black Lake Outlet, Black Lake (0906-0001)	Lake	B	Nutrients (P)	Agriculture
	Fish Creek and minor tribs (0906-0026)	River	C	Nutrients (P)	Onsite WTS
Oswegatchie	Little River and tribs (0905-0090)	River	C(T)	Priority Organics	Industry/Landfill
Part 2a—Impaired due to atmospheric deposition					
Grasse	Len, Wolf, Beaver Ponds (0904-0002)	Lake	C(T)	Acid/Base (pH)	Atmospheric Deposition
Salmon	Wolf Pond (0902-0006)	Lake	B	Acid/Base (pH)	Atmospheric Deposition
	Catamount Pond (0902-0092)	Lake	C(T)	Acid/Base (pH)	Atmospheric Deposition
St. Regis	Lower, Upper Twin Ponds, more (0902-0045)	Lake	C(T)	Acid/Base (pH)	Atmospheric Deposition

Subwatershed	Waterbody Name	Type	Class	Cause/Pollutant	Source
	Duck Pond, Benz Pond (0902-0021)	Lake	D	Acid/Base (pH)	Atmospheric Deposition
	Diamond Lake (0902-0011)	Lake	D	Acid/Base (pH)	Atmospheric Deposition
Raquette	Rock Pond (0903-0001)	Lake	B(T)	Acid/Base (pH)	Atmospheric Deposition
	High Pond (0903-0001)	Lake	C(T)	Acid/Base (pH)	Atmospheric Deposition
	Little Pine Pond (0903-0028)	Lake	D	Acid/Base (pH)	Atmospheric Deposition
	Spruce Crouse, Spring, Graves Ponds (0903-0041)	Lake	C(T)	Acid/Base (pH)	Atmospheric Deposition
	Halfmoon Pond (0903-0032)	Lake	C(T)	Acid/Base (pH)	Atmospheric Deposition
	South Pond (0903-0005)	Lake	C(T)	Acid/Base (pH)	Atmospheric Deposition
	Salmon Pond (0903-0004)	Lake	C(T)	Acid/Base (pH)	Atmospheric Deposition
	Pilgrim Pond (0903-0043)	Lake	D	Acid/Base (pH)	Atmospheric Deposition
	Haymarsh Ponds, Lone Pond (0903-0017)	Lake	D	Acid/Base (pH)	Atmospheric Deposition
	Lost Pond (0903-0057)	Lake	D	Acid/Base (pH)	Atmospheric Deposition
Oswegatchie	W. Br. Oswegatchie (0905-0003)	River	FP	Acid/Base (pH)	Atmospheric Deposition
	Dry Timber Lake	Lake	C(T)	Acid/Base (pH)	Atmospheric Deposition
	Gregg Lake, Green, Twin, Loon Hollow Ponds (0905-0035)	Lake	D	Acid/Base (pH)	Atmospheric Deposition
	Muskrat Pond (0905-0062)	Lake	D	Acid/Base (pH)	Atmospheric Deposition
	Bear Pond, Diana Pond (0905-0062)	Lake	D	Acid/Base (pH)	Atmospheric Deposition
	Lower, Middle, Upper South Pond (0905-0012)	Lake	D	Acid/Base (pH)	Atmospheric Deposition
	Desert, Jakes, Buck, Hog Ponds (0905-0038)	Lake	C(T)	Acid/Base (pH)	Atmospheric Deposition
	Crystal Lake (0905-0030)	Lake	C(T)	Acid/Base (pH)	Atmospheric Deposition
	Minor Lake Trib to Upper Oswegatchie (0905-0005)	Lake	C(T)	Acid/Base (pH)	Atmospheric Deposition

Subwatershed	Waterbody Name	Type	Class	Cause/Pollutant	Source
	Gull Lake (0905-0072)	Lake	C(T)	Acid/Base (pH)	Atmospheric Deposition
Part 2b—Impaired with respect to fish consumption					
Upper St. Lawrence	St Lawrence River (0901-0001)	River	A	Dioxin	Contaminated Sediment
				Mirex	Contaminated Sediment
				PCBs	Contaminated Sediment
	St Lawrence River (0901-0002)	River	A	Dioxin	Contaminated Sediment
				Mirex	Contaminated Sediment
				PCBs	Contaminated Sediment
	St Lawrence River (0901-0015)	River	A	Dioxin	Contaminated Sediment
				Mirex	Contaminated Sediment
				PCBs	Contaminated Sediment
	St Lawrence River (0901-0004)	River	A	Dioxin	Contaminated Sediment
				Mirex	Contaminated Sediment
				PCBs	Industr, Contam Sed
	Massena Power Canal (0904-0012)	River	D	PCBs	Industr, Contam Sed
Grasse	Grasse River (0904-0009)	River	B	PCBs	Industr, Contam Sed

SOURCE: NYS 303(d) list (2016)

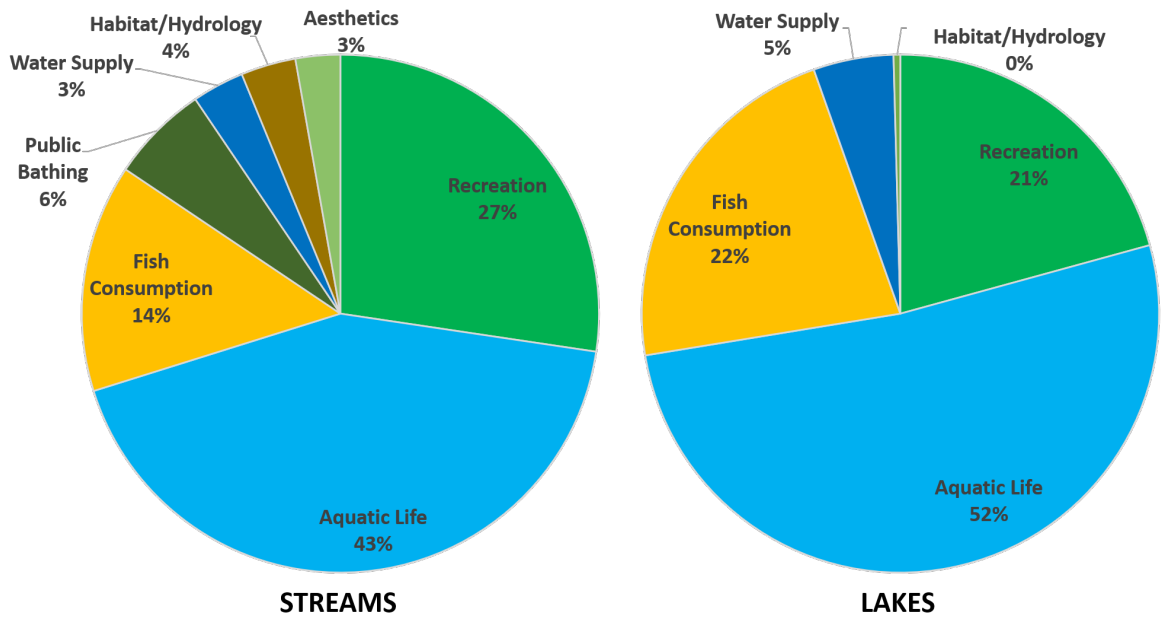
6 Waterbody Impairments and Potential Sources of Pollution

This section begins with an overview of known impairments and stresses to waterbodies in the St. Lawrence River watershed, and then summarizes potential sources of pollution that may contribute to those impairments and stresses.

6.1 Impairments to Designated Best Use

NYSDEC assesses impacts to waterbodies based on their designated best use and characterizes them as impaired or stressed if their best use is not being met, as was discussed in section 5. Waters of the St. Lawrence River watershed are best used for fishing, recreation, swimming, and potable water. **Figure 3** summarizes the percentage of streams and lakes in the watershed that do not meet their designated best use (including waterbodies found to be impaired, displaying minor impacts, threatened, and/or needing verification).

Figure 3
Impairments or Stresses Impacting the Designated Best Use of Streams and Lakes



SOURCE: NYSDEC, WI/PWL (2016)

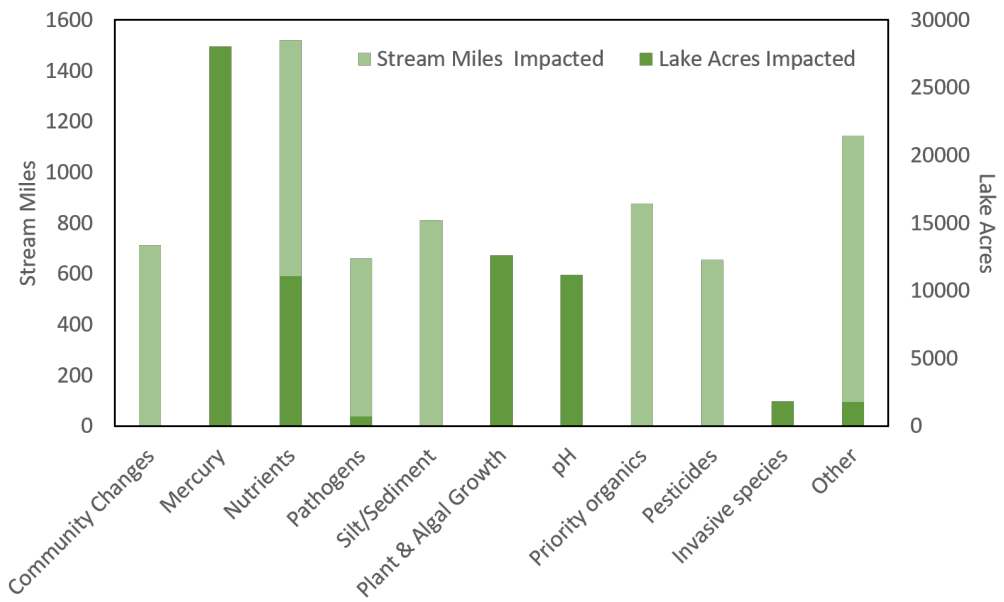
Aquatic life is "stressed" in 43% and 52% of impacted streams and lakes, respectively. The mountain and wilderness areas are host to cold-water fisheries, while lakes and streams in the open and wooded lowlands support warmwater fisheries. Fish consumption is affected in 14% of streams and 22% of lakes in the watershed. Use of 33% of streams and 21% of lakes are impacted in ways that affect recreation and swimming.

6.2 Impacts and Stressors Preventing Waterbodies from Meeting Their Best Uses

The St. Lawrence River watershed has experienced numerous ecological impacts associated with the stresses brought on by such human activities as industry, commercial and recreational navigation, agriculture, and development. **Figure 4** characterizes the most frequently cited pollutants and stressors affecting water quality according to the 2016 NYSDEC WI/PWL and 303(d) List.

Pollutants and sources affecting water quality in the basin differ in streams and lakes. Nutrients (25% of assessed stream miles, 1,500 miles), priority organics such as PCBs, dioxins and PAHs (14%, 875 miles), and sediment (13%, 810 miles) are the most common pollutants of streams. Lakes in the watershed are primarily impacted by mercury (47%, 28,000 acres), excessive algal and plant growth (21%, 12,600 acres), and acidic waters (19%, 11,200 acres). Other threats to water quality in the watershed include community composition changes and invasive species, silt/sediment transport, salinization, and pathogens.

Figure 4
Pollutants and Stressors of Waterbodies



SOURCE: NYS WI/PWL & 303(d) List, (2016)

The subsections below discuss causes for impairment in lakes and streams that are not meeting their designated best uses of fish consumption, aquatic life, recreation, and water supply.

6.2.1 Mercury

Impaired Use: Fish Consumption

Fish consumption advisories have been issued due to elevated levels of mercury in certain fish species and sediments of the St. Lawrence River watershed. In the aquatic environment, microbial processes can metabolize mercury into its organic form, methylmercury. Acidic lake conditions have been shown to stimulate this conversion. Methylmercury is a potent neurotoxin that bioaccumulates in fish and aquatic organisms. Human exposure to mercury is largely through consumption of contaminated fish, where developing fetuses and young children are the most sensitive populations. Approximately 47% of assessed lake acres in the watershed are threatened, stressed, or impaired due to mercury found in sediments, waters, and fish. NYS has issued blanket and regional advisories for all waters in the Adirondack region concerning consumption of specific species. The advisories include additional limits on fish consumption for women of child-bearing age and all children.

6.2.2 Contaminated Sediment

Impaired Use: Fish Consumption

As a result of historical industrial practices and improper waste disposal, stream bottom sediments in portions of the St. Lawrence River watershed have been contaminated by priority organics (14% of assessed streams, 876 miles) and pesticides (11%, 656 miles). The Upper St. Lawrence subbasin at the St. Lawrence River and Massena Power Canal, the Oswegatchie subbasin at Little River and tributaries, and the Grasse subbasin at a section of the Grasse River are listed on the 2016 303(d) list due to priority organics contamination of sediment. The pollutants are dioxins, PCBs, and Mirex (an organochlorine insecticide), known to be bioaccumulative and carcinogenic. Benthic organisms exposed to contaminated sediment can accumulate these compounds through oral exposure. These compounds bioaccumulate to high concentrations along the food chain, making some species of fish unsuitable for human consumption.

6.2.3 Acidic Waters

Impaired Use: Aquatic Life

Acidic waters are the third leading pollutant of lakes of the St. Lawrence River watershed, affecting 19% (11,167 lake acres) of assessed lake acres and an additional 400 stream miles (WI/PWL, 2016). Acidified waters have many ecological effects, especially on aquatic life. These waters leach nutrients and metals (e.g., calcium, aluminum) from soil clay minerals, which then flow across the surface as runoff water into streams and lakes or sink into the soil. Aluminum is toxic to vegetation at high levels and impairs a plant's ability to take up water and withstand environmental stressors, while the loss of soil nutrients can stunt plant growth and productivity. Leached aluminum can interfere with ion regulation in aquatic animals and can accumulate on the surface of fish gills, leading to respiratory dysfunction. In addition, low pH and increased aluminum levels have been shown to

cause chronic stress to fish, resulting in lower body weight and size that makes them less capable of competing for food and habitat. Fish reproduction is adversely impacted by acidic waters; calcium levels in female fish become lower to the point where egg production or pass is not viable, or larvae development is abnormal. Aquatic community composition changes and biodiversity decreases as lakes and streams become more acidic and viable only for fish and plant species that can tolerate lower pH levels. Even fish species that are more tolerant of acidic waters may suffer population impacts due to decreased food supply.

6.2.4 Invasive Species

Impaired Uses: Aquatic Life, Recreation

Native aquatic species in the St. Lawrence River watershed are vulnerable to the presence of invasive species—nonnative organisms, such as rooted, aquatic plants, algae, animals, bacteria, viruses, and insects, that can harm humans or the environment. Invasive species pose a threat to aquatic habitat, nutrient cycling, and a lake or stream's capacity to fully support its designated uses. **Table 11** lists known invasive species and "watch" or "prevention" species referenced by the Partnerships for Regional Invasive Species Management (PRISMs), which coordinate invasive species management and monitoring efforts. Although the 2016 WI/PWL (2016) listed only three St. Lawrence River watershed waterbodies as impacted by invasive species (1,767 acres, 3%), research by the St. Lawrence-Eastern Lake Ontario (SLELO) Partnership, and Adirondack Park Invasive Plant Program (APIPP), and the Adirondack Watershed Institute has documented the widespread scale of invasives.

Typically, invasives grow and reproduce quickly and spread aggressively, altering community dynamics, decreasing biodiversity, and threatening native wildlife. For example, zebra and quagga mussels blanket the bottoms of many waters in the St. Lawrence River watershed, filtering water and increasing water clarity as they consume plankton that serve as a food source for native populations. Increased clarity allows more sunlight to penetrate the water column, which creates ideal conditions for algae to grow and thus can contribute to algal blooms. Zebra and quagga mussels also impact recreation; beach areas that have been inhabited by the mussels provide a rough and sharp blanket on the bottom creating a hazard and unpleasant experience for swimmers. Pipes, boats, and water intake structures often become coated with zebra and quagga mussels causing severe impacts on the functionality of the pipes or structure.

Two especially significant invasive species have been the target of management efforts in the watershed. Water chestnut (*Trapa natans*) has clogged waterways by forming dense mats that limit light penetration into the water and impact native aquatic plants beneath the canopy. The reduced plant growth underneath, combined with the dieback and decomposition of water chestnut each year, can lead to reduced dissolved oxygen levels that affect aquatic life and can potentially lead to fish kills. Boaters and other recreationists also find water chestnut to be a nuisance and a hazard.

Eurasian milfoil (*Myriophyllum spicatum)* competes aggressively with native aquatic plants, growing in dense mats that interfere with fishing, swimming, and recreation access. This plant can grow in a variety of environments and sediment types, contributing to its widespread distribution. The Adirondack Park and lake associations are actively working to reduce its presence, but once established it is very difficult to eliminate.

Additional impacts related to invasive species are discussed below in the section on excessive plant growth.

Table 11
Target and Prevention Invasive Species

Species	Scientific Name	PRISM
Target/General Species		
Asian Clam	*Corbicula fluminea*	APIPP
Asian Jumping Worm	*Amynthas spp.*	SLELO
Chinese Mystery Snail	*Cipangopaludina chinensis*	APIPP
Curly-leaf Pondweed	*Potamogeton crispus*	APIPP
Eurasian Milfoil	*Myriophyllum spicatum*	APIPP
European Frog-bit	*Hydrocharis morsus-ranae*	APIPP
Fanwort	*Cabomba caroliniana*	APIPP
Fishhook Waterflea	*Cercopais pengoi*	APIPP
Phragmites	*Phragmites australis*	SLELO
Round Goby	*Neogobius melanostomus*	SLELO
Spiny waterflea	*Bythotrephes longimanus*	APIPP/SLELO
Spring Viraemia of Carp (SVC)	*Spring viraemia*	SLELO
Variable-leaf Watermilfoil	*Myriophyllum heterophyllum*	APIPP
Viral Hemorrhagic Septicemia		SLELO
Water Chestnut	*Trapa natans*	APIPP/SLELO
Yellow Iris	*Iris pseudacorus*	APIPP/SLELO
Zebra Mussels	*Dreissena polymorpha*	APIPP
Prevention Species		
Asian Clam	*Corbicula fluminea*	SLELO
Didymo	*Didymosphenia geminate*	SLELO
Fanwort	*Cabomba caroliniana*	SLELO
Hemimysis	*Hemimysis anomala*	SLELO
Hemlock Woolly Adelgid	*Adelges tsugae*	SLELO
Hydrilla	*Hydrilla verticillata*	APIPP/SLELO
New Zealand Mud Snail	*Potamopyrgus antipodarum*	SLELO
Quagga Mussel	*Dreissena rostriformis bugensis*	APIPP
Rusty Crayfish	*Orconectes rusticus*	APIPP/SLELO
Silber, Big Head and Grass Carp	*Ctenopharyngodon spp,*	SLELO

Species	Scientific Name	PRISM
Tench	*Tinca tinca*	SLELO
Water Hyacinth	*Eichornia crassipes*	SLELO
Water Lettuce	*Pistia stratiotes*	SLELO
Water Soldier	*Stratiotes aloides*	SLELO

SOURCE: SLELO and APIPP PRISMS

6.2.5 Nutrients

Impaired Uses: Aquatic Life, Recreation

Although nutrients are required to support healthy ecosystems, excessive nutrients can harm water supplies, recreational uses, and aquatic life. Nutrient contamination of surface waters, primarily attributed to nitrogen and phosphorus, has been a longstanding issue that is not unique to the St. Lawrence River watershed. The WI/PWL cited nutrients as the primary pollutant of streams in the St. Lawrence River watershed, affecting 1,520 miles (24% of the assessed 6,212 miles). Nutrients affect the fourth greatest amount of assessed lake area (11,074 lake acres, 19%) in the watershed.

In freshwater systems, phosphorus is typically the limiting element on growth and productivity. Excessive levels of nutrients stimulate the growth of algae and aquatic plants, which upon dieback are decomposed by bacteria that consume oxygen on the water floor. This can result in hypoxia (low oxygen conditions), which is detrimental to aquatic life and habitat. Other impacts related to excessive plant and algal growth are discussed below.

6.2.6 Excessive Plant and Algal Growth

Impaired Uses: Aquatic Life, Recreation, Water Supply

Twenty-one percent of lakes (12,630 acres) and an additional 156 miles of streams in the watershed are impacted by excessive plant and algal growth. Excessive plant growth diminishes the recreational value of the waterbody by inhibiting swimming and boating, which in turn impacts local economies that are largely dependent on tourism and recreation. Excessive plant growth can also decrease habitat for fish and spawning beds. Often, the excessive growth is due to the introduction of invasive species that form dense beds on the lakebed and outcompete native species for habitat. In particular, invasives such as Eurasian milfoil and curly leaf pondweed can inhabit various sediments, depths, and light conditions, altering conditions that were previously good conditions for spawning habitat.

Algae is a fundamental component of any aquatic food web, as it produces oxygen, provides food for many organisms, and removes nutrients from the water column. However, when a significant influx of nutrients occurs, algae can grow excessively, creating an unpleasant and unaesthetic atmosphere for swimmers and recreationists. Algal growth can contribute to taste and odor issues and clog intake pipes impacting drinking water sources. Large mats of algal growth block sunlight

necessary for aquatic plants below the surface, altering habitat and reducing oxygen levels. In the dieback season, algae falls to the water floor where it is microbially decomposed in a process that reduces dissolved oxygen levels. Reduced oxygen levels significantly affect organisms in the benthic zone and cause changes in community dynamics and potential migration of organisms to areas with more suitable conditions.

Some algal species can produce toxins. Harmful algal blooms (HABs) are kept in check partly by native nontoxic algae that readily take up excess nutrients from the water column. However, HABs can proliferate in suitable environmental conditions, which include excess nutrients, increased precipitation, sufficient sunlight, low-flow conditions, warm temperature, and calm waters (low wind). Lake dynamics such as native algal species and presence of invasive species contribute to their presence. Lake associations and organizations such as the Adirondack Watershed Institute are actively involved in training the public and lake residents on how to identify and report HABs in the watershed.

6.2.7 Sedimentation

Impaired Use: Aquatic Life, Recreation

Sedimentation affects 13% (812 miles) of assessed stream miles in the St. Lawrence River watershed (WI/PWL, 2016). Sedimentation occurs when loose sand, clay, silt, and other soil particles enter and fill catch and flood basins, structures that are important for mitigating flooding and increasing volumetric capacity during times of increased precipitation and snowmelt. When these structures are instead filled with excess sediment, their functionality is inhibited.

Sediment deposits in rivers can alter the natural flow of water and reduce water depth, affecting recreational use and navigation. In addition, sediment deposits are often soft deposits that make swimming undesirable and murky. Aquatic life is also affected by the transport of sediment and associated nutrients, as water can become cloudy, preventing fish from finding prey, and sediment can clog fish gills, lowering growth rates and reducing resistance to disease.

6.2.8 Pathogens

Impaired Use: Water Supply

Pathogens affect 11% of assessed stream miles (661 miles) and 1% of lake acres (727 lake acres) (WI/PWL, 2016). Swimming in and drinking contaminated waters can make people ill, resulting in beach closures and an unsafe drinking water source. EPA has developed criteria to protect people from bacteria and their associated toxins in water bodies.

6.2.9 Road Salt

Impaired Use: Water Supply

The Adirondack Watershed Institute at Paul Smith's College collected data showing that wells in the Adirondacks were contaminated by road salt at unhealthy levels. Two-thirds (2/3) of the wells tested downslope from state roads contained concentrations of sodium beyond the federally recommended health limit of 20 parts per million (ppm). The natural salinity of water in the Adirondacks is 0.5 ppm. Sodium has been strongly linked with hypertension, a condition that affects 12–30% of Americans. Chloride levels exceeded 250 ppm, the recommended NYSDOH guideline for chloride, in nearly one-third of the 157 wells downslope of state roads. Some wells contained around 1,000 ppm of chloride, a level deemed not potable or drinkable (Virtanen, 2019).

Lakes in watersheds with paved roads have a median sodium concentration four times greater than those in watersheds without paved roads (Kelting, Laxson, and Yerger 2012). Dissolved salts can leach into aquifers and ground water when exposed to rain, snow, and wind. Road salt that enters roadside soils can also displace other cations within the soil, leaching them from the soil for offsite transport and depleting soil fertility. This cation loss from soils demonstrates a flux that may have a significant impact on soil and waterbody biogeochemistry and ecosystem health. Deicing compounds are known to be nontoxic at lower concentrations, but at higher concentrations they can place stress on plants and animals. Ultimately, salt intolerant species are outcompeted by salt-tolerant species, which often include invasive species.

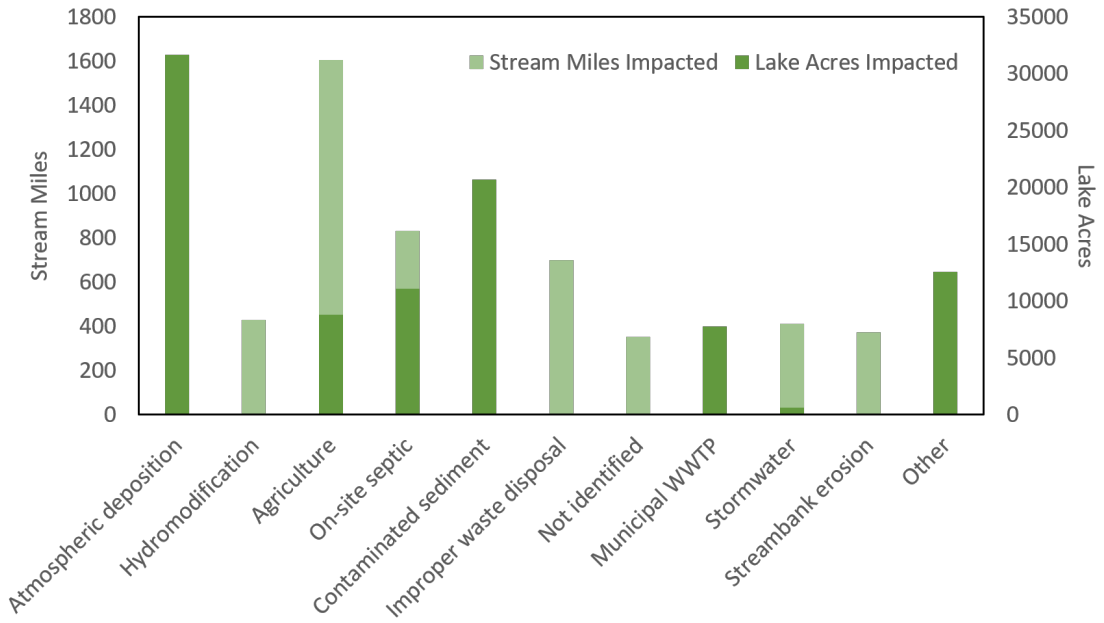
6.3 Potential Sources of Stressors

Lakes and streams in the St. Lawrence River watershed are affected by a combination of local and regional sources of pollution, which presents a challenge for those developing strategies to combat stresses and impairments to waterbodies. These sources include atmospheric deposition of pollutants originating outside the basin (regional), as well as local point and nonpoint sources related to industry, agriculture, hydromodification, municipal infrastructure, development, and commercial and recreational navigation. Point sources refer to discharges that originate from a single, identifiable source such as a pipe or drain from a sewage treatment plant, whereas nonpoint sources represent diffuse combinations of pollutants from a large area, such as stormwater runoff that accumulates contaminants from several sources and then flows into streams.

Figure 5 shows the potential pollutant sources affecting the St. Lawrence River watershed and the magnitude of their impact. **Maps 31** and **32** display pollution sources within the St. Lawrence River watershed, such as sites permitted under the National Pollution Discharge Elimination System (NPDES), Superfund, Brownfield, and Environmental Restoration sites, landfills, sites undergoing voluntary cleanup programs, and mines. Regional sources contributing to pollution, nonpoint local

sources, and local point sources affecting the St. Lawrence River watershed are discussed in the subsections that follow.

Figure 5
Potential Sources of Pollutants and Stressors



SOURCE: NYS WI/PWL & 303(d) List, (2016)

6.3.1 Regional Nonpoint Sources

Atmospheric deposition of acid rain and mercury is the primary source of lake pollutants in the watershed, affecting 53% (31,680 lake acres) and 400 miles of streams. Atmospheric deposition is the process by which pollutants in the form of particulates, aerosols, and gases are transported by wind currents and released through precipitation to the earth's surface. For the St. Lawrence River watershed, the pollutants released through this process are inorganic acids (known as acid rain) and mercury. These pollutants represent historical sources that still affect the system due to the recycling of contaminants in the environment and the atmosphere; they are addressed by federal and state regulations, including the Clean Air Act and Clean Water Act.

6.3.1.1 Acid Rain

Acid rain is formed when sulfur dioxide (SO_2) and nitrogen oxides (NO_x) combine with moisture in the atmosphere to produce sulfuric and nitric acids. Sulfur dioxide and nitrogen oxides are largely produced through the combustion of fossil fuels and emitted by motor vehicles, power plants, and industries. Higher elevation areas of the St. Lawrence River watershed, including the Adirondacks, are highly susceptible to the impacts of acid rain due to their thin soils, which are largely devoid of

limestone (calcium carbonate). This severely limits the soil's buffering capacity to counteract the impacts of acid rain, making lakes more vulnerable to its effects. Acid rain has affected 19% of lake acres (11,167 acres) in the watershed.

Federal and state programs including the Clean Air Act (1990), Clean Air Interstate Rule (CAIR), and NYS Acid Deposition Control Act have reduced emissions of nitrogen oxide and sulfur dioxide. Environmental improvements in the region have been documented recently in response to these air pollutant control strategies (Waller 2012).

6.3.1.2 Atmospheric Deposition of Mercury

Mercury is emitted into the air through human activities such as mining and fossil fuel combustion and through natural processes such as volcanic eruptions. It is then deposited via atmospheric deposition onto land and water, where microbial processes can metabolize it into an organic form, methylmercury. Approximately 47% of the St. Lawrence River watershed lake acres are threatened, stressed, or impaired due to mercury found in sediments, waters, and fish. New York State has issued blanket and regional advisories for all waters in the Adirondack region concerning consumption of specific species. The advisories include additional limits on fish consumption for women of child-bearing age and all children.

6.3.1.3 Recreation and Commercial Transport

Aquatic invasive species typically enter waterbodies via transport by boats. The St. Lawrence River watershed is particularly susceptible to aquatic invaders due to international commerce from Eurasia across the Atlantic. Invasive plants and animals in the ballast water enter the watershed through the St. Lawrence Seaway and rivers flowing from the Great Lakes. In addition, recreational boating, particularly in the Adirondack's region, can hasten the spread of invasive species. The NYSDEC coordinates efforts to combat invasive species through its Partnerships for Regional Invasive Species Management (PRISM).

6.3.2 Nonpoint Local Sources

6.3.2.1 Runoff from Agricultural Areas

Agricultural activities and associated runoff contribute nutrients, sediments, and pesticides to receiving waters, which can have adverse effects on aquatic life and water quality. Twenty six percent (26%) of assessed stream miles (1,604 miles) and 15% of assessed lake acres (8,800 acres) in the watershed are threatened, stressed, or impaired due to agricultural activities (WI/PWL, 2016). There are 2,344 farms in the watershed occupying 620,000 acres of land, and agricultural districts (**Map 22**) are concentrated primarily in the northern skirt of the basin, which is host to flat plains and rich soils (**Maps 14** and **18**). **Table 4** lists the farmed crops and livestock of the St. Lawrence River watershed and the associated amount of land used for the activity.

The Oswegatchie and Indian subbasins dedicate 14% and 22% of their total area, respectively, to agriculture and have the highest count of surface water segments listed as impaired due to nutrients. The counts include state-assigned pollutants/causes identified as nutrients, organic enrichment/oxygen depletion, algal growth, or noxious aquatic plants. These IDs are associated with excess nutrients and sediment transport via agricultural runoff.

Fifteen percent (15%) of croplands and pasture in the watershed are contiguous to water, and 3% are on hydric soils. The Upper St. Lawrence has the highest percentage of agriculture contiguous to water at 31%. 70% of newly converted agricultural lands (1,100 acres) from 2001-2012 are within hydrologically connected zones, land that is comprised of wet areas with high runoff potential.

Impacts to local waterways can result from poor agricultural management, such as improper manure application on fields, intense cultivation of lands with little riparian buffer, and unrestricted access of livestock to streams. The St. Lawrence River watershed fertilizes 104,254 acres of farmland via manure application (USDA-NASS, 2018). An average of approximately 380 and 390 kg N/ha/year of manure and synthetic nitrogen, respectively, are applied to lands for fertilization purposes (WSIO Indicator Data, 2018).

6.3.2.2 On-Site Water Treatment Systems (Septics)

On-site septic systems threaten, stress, or impair 19% (11,100 acres) of lake acres and 13% (830 miles) of stream miles in the St. Lawrence River waterbasin. Pathogens associated with sewage effluent can impair the use of a waterbody for swimming and recreational purposes. Excess nutrients released in the process can exacerbate algae growth, threatening aquatic life, recreation, and swimming access. Septic systems can be effective in protecting water quality, but regulations regarding inspection or upgrade of these systems is lacking in New York State.

Historically, the St. Lawrence River watershed and the broader Adirondack region have been host to many seasonal visitors from late spring to fall. Recently, there has been a rise in the conversion of lakefront properties from seasonal cottages into year-round residences. If homes fail to upgrade their septic systems to accommodate this transition, they risk sewage effluents reaching nearby waterbodies. Pathogens associated with sewage effluent can impair the use of the waterbody for swimming and recreational purposes. Depending on the age of the septic system, its distance from waterways, and the biogeochemical properties of the leach field, a well-maintained system might also contribute nutrients to nearby waters and thereby exacerbate algae growth threatening aquatic life, recreation, and swimming access.

6.3.2.3 Road Deicing

Deicing compounds are effective and necessary in maintaining safe travel conditions for motorists and travelers throughout the winter months. However, only about 50% of road salt is removed annually via overland flow; the remainder accumulates and moves through soils and groundwater

(Kelting & Laxson 2017). Studies found a high correlation between road density and sodium and chloride concentrations, pointing to road salt as the primary source of salt loadings to lakes (Kelting, Laxson, & Yerger 2012). This same study found that roads maintained following NYSDOT deicing protocols (state roads) are the greatest contributors to salinization of lakes in the Adirondack Park. In addition, coarse texture glacial till and soils of granitic origin have high infiltration rates and low retention within the soil matrix, contributing to the rapid and increased migration of salts to aquifers and groundwater. The storage of deicing compounds is currently unregulated, and many municipalities have inadequate storage facilities, leaving deicing compounds exposed to the elements and increasing the potential for offsite transport.

6.3.2.4 Hydromodification

Hydromodification is the alteration of the natural flow of water through a landscape that results from changes in land cover or channel modification. Road and streambank erosion, shoreline erosion, development, and the building of dams are examples of hydromodification. Seven percent (7%) of assessed stream miles in the St. Lawrence River watershed are impacted by hydromodification (WI/PWL, 2016).

Streambank and shoreline erosion. Sediment carried by rivers and streams draining large watersheds is primarily attributed to bank and channel erosion. When a stream is straightened or widened, whether via human manipulation or fast-flowing waters, its banks and shoreline can erode as the stream reestablishes a stable size and pattern. Vegetation removal and land use changes can contribute to more erosion. As sediments are released downstream, they can potentially settle in low-flow areas, altering stream flow and filling in areas that previously mitigated flooding. Banks and shorelines that are unvegetated, high sloped, and experience large flow rates during times of increased precipitation are more susceptible to erosion.

Dams. Dams can alter hydrology, surface water quality, and aquatic habitat in the stream or river where they are located. There are 190 dams in the St. Lawrence River Watershed, shown on **Map 29**. In some cases, a dam wall can block fish migrations or separate spawning habitats from rearing habitats. Dams trap sediment and inhibit its transport downstream, altering both upstream and downstream habitat. Disrupting water flow and sediment transport by changing the quantity and timing of water flow impacts the ecological web of a river system. For example, increased flow conditions are an important environmental queue to initiate the salmon run of Chinook salmon in the Salmon River. In recreational reservoirs impounded by dams, sedimentation is cited as a nuisance for swimmers and lakeshore residents, who experience difficulty navigating due to buildup of sediment and increased plant growth.

Development. Development, or “back-country sprawl,” is an emerging threat to aquatic ecosystems and water quality in the St. Lawrence River watershed. New development brings new roads,

driveways, power and water lines, leach fields, invasive species, and other disruptions to the natural hydrography of the landscape. Development also increases impervious surfaces in the watershed that can disrupt the natural flow of water. Studies have shown that water quality can be harmed when as little as 2% of a watershed is converted from natural vegetation to artificial hard surfaces (Adirondack Council, 2008).

6.3.3 Point Sources

The Clean Water Act regulates point sources that discharge pollutants into a waterbody by requiring the discharger to have a National Pollutant Discharge Elimination Systems (NPDES) permit. The permit identifies the pollutant(s) of concern, the discharge allowance, and monitoring and reporting requirements. This system protects water quality by ensuring that the state's water standards are met and specifying acceptable levels of a pollutant, or pollutant indicator, in a discharge. Major NPDES sites in the St. Lawrence River watershed (**Map 31)** include publicly owned treatment works (39), combined sewer overflows (33), municipal separate storm sewer systems (2), stormwater constructs (8), industrial wastewater discharges (56), and concentrated animal feeding operations (72).

6.3.3.1 Publicly Owned Treatment Works

Publicly owned treatment works (POTWs) are tasked with collecting municipal wastewater and treating it to meet discharge requirements before the effluent can be released into adjacent waters. Wastewater can contain pathogens, metals, suspended solids, residual chlorine, and trace contaminants that can threaten drinking water and recreational activity. Wastewater treatment plants (WWTPs) are cited as the suspected source of pollutants of 13% (3,130 lake acres) of assessed lake acres and 6% (410 miles) of assessed streams (WI/PWL, 2016). **Table 12** lists POTWs within the St. Lawrence River watershed.

The Clean Water Act, passed in 1972, provided funding to support the construction and upgrade of wastewater treatment facilities, which led to a significant improvement in water quality. However, funding for maintaining and upgrading these systems has been greatly reduced, which coincides with the end of these systems' 30- to 40-year design lives. Many sewage treatment systems in small towns and villages are aging, inadequate, or operating beyond their capacity.

Table 12
Publicly Owned Treatment Works Permitted under NPDES

HUC8	HUC12	Facility Name	NPDES ID	Receiving Waterbody
Upper St. Lawrence	041503010102	Clayton (V) STP	NY0027545 NYL027545	
	041503010104	Alexandria Bay WWTP	NY0022501	St. Lawrence River
		Orleans/Alexandria Joint WWTP	NY0258059	St. Lawrence River
		Thousand Island Park STP	NY0030686	

HUC8	HUC12	Facility Name	NPDES ID	Receiving Waterbody
		Us Coast Property At Wellesley Island	NY0022284	St. Lawrence River
	041503010107	Morristown (V) WWTF	NY0206997	
	041503010202	Ogdensburg Secondary WWTP	NY0029831	St. Lawrence River
		Waddington (V) WWTF	NY0030180	
	041503010203	Lisbon STF	NY0257559	St. Lawrence River
Oswegatchie	041503020102	Fine - T Wanakena Sewer District	NY0034533	
	041503020604	Edwards (V) WWTP	NY0023809	Oswegatchie River
	041503020802	Gouverneur (V) WWTF	NY0020117 NYR00E780	Oswegatchie River
	041503020902	Dekalb Junction STP	NY0034762	Gulf Creek
	041503020904	Rensselaer Falls WWTP	NY0257613	Oswegatchie River
	041503021002	Heuvelton (V) WPCP	NY0027146	Oswegatchie River
Indian	041503030205	Antwerp (V) WWTP	NY0235890	Indian River
	041503030301	Evans Mills (V) WWTP	NY0024660	
	041503030303	Philadelphia (V) WWTP	NY0033022	Indian River
	041503030401	Theresa (V) WWTP	NY0207004	Indian River
	041503030501	Redwood SD	NY0215911	
	041503030505	Hammond (V) STP	NY0033561	
Grasse	041503040402	Hermon (V) WWTP	NY0257532	Elm Creek
	041503040404	Canton (V) WWTP	NY0236586 NYR00E591	Grasse River
	041503040501	Madrid WPCP	NY0024635	Grasse River
	041503040502	Massena (V) WWTP	NY0031194 NYR00E618	Grasse River
Raquette	041503050409	Tupper Lake (V) WPCP	NY0029939	Raquette River
	041503050604	Colton STP	NY0022012	Raquette River
	041503050703	Norfolk (T) SD#1	NY0023604	Raquette River
	041503050703	Norwood (V) WWTP	NY0021369	Raquette River
		Potsdam (V) WPCP	NY0020818	Raquette River
	041503050703	Potsdam Sewer District #1 STP	NY0023337	Raquette River
St. Regis	041503060303	N. Lawrence & Nicholville STP	NY0110116	Saint Regis River
	041503060405	St Regis Falls WWTP	NY0255858	Saint Regis River
	041503060408	Brasher Falls SD#1 STP	NY0030732	
Salmon	041503070302	Malone (V) WWTP	NY0030376	Salmon River
	041503070306	High Street WWTP	NY0027863	Salmon River

HUC8	HUC12	Facility Name	NPDES ID	Receiving Waterbody
Chateaugay-English	041503080102	Lyon Mountain SD WWTP	NY0239577	Separator Brook
	041503080104	Brainardsville SD#1 WWTP	NY0255726	
	041503080201	Chateaugay (V) STP	NY0024830	

SOURCE: Enforcement and Compliance History Online (ECHO), USEPA
NOTE: Colored rows are "major" permit types

6.3.3.2 Stormwater Collection Systems

Stormwater runoff is generated when water from rain and snowmelt events flows over land or impervious surfaces and does not seep into the ground. If runoff is not captured or treated, it can accumulate and transport nutrients, chemicals, sediment, and other pollutants that adversely affect water quality in receiving waters. Urban and developed areas with a higher concentration of impervious surfaces are more vulnerable to the impacts of stormwater runoff. Stormwater impacts seven percent of assessed streams (410 miles) and one percent of assessed lakes (634 acres) in the St. Lawrence River watershed (WI/PWL, 2016). The CWA regulates combined sewer overflows (CSOs), municipal separate storm sewer systems (MS4s), industrial facilities, and construction sites to prevent and monitor discharges of pollutants in stormwater runoff.

Combined Sewer Overflows. Combined sewer systems collect water from domestic sewers and wastewater, industrial wastewater, and stormwater runoff. These systems are designed with relief points to mitigate periods of high flow. A CSO occurs when stormwater runoff from precipitation or snowmelt exceeds the sewer's capacity and excess waters are discharged directly to its receiving waterbody through the built-in relief points. CSO discharges may contain mixtures of domestic sewage, high levels of suspended solids, toxic chemicals, floatable material, and other pollutants. In the event of an overflow, receiving waterbodies may be hazardous for human and animal health and have significant water quality impacts such as bacterial contamination, algae growth, and reduced oxygen levels in the water. As permittees, municipalities are required to comply with long-term control plans that present mechanisms to reduce the frequency and volume of CSO discharges. Popular methods include separating stormwater and sewer lines, expanding wastewater treatment capacity, creating retention basins to hold overflow during storm evens, and using green infrastructure to reduce stormwater flows.

There are 33 permitted CSOs in the St. Lawrence River watershed (**Table 13)**. CSOs are concentrated in the City of Ogdensburg, and Villages of Massena, Clayton, Tupper Lake, Gouverneur, and Potsdam. The highest number of CSOs exist within the City of Ogdensburg, with 17 overflows monitored and owned by the City of Ogdensburg WWTP. The Village of Massena monitors ten CSOs operated by the Massena WWTP. The NYSDEC website presents a mapping tool showing the locations of CSOs within the state.

Table 13
Permitted CSOs

HUC8	HUC12	Receiving Waterbody	Permit ID	Facility Owner	Operating CSOs
Grasse	041503040502	Grasse River	NY0031194	Village of Massena, WWTP	5
Raquette	041503050706	Raquette River	NY0031194	Village of Massena, WWTP	5
	041503050409	Raquette Pond	NY0029939	Village of Tupper Lake, WPCP	2
	041503050703	Raquette River	NY0020818	Village of Potsdam, WPCP	1
Oswegatchie	041503020802	Oswegatchie River	NY0020117	Village of Gouverneur, WWTF	1
	041503021003	Oswegatchie River	NY0029831	City of Ogdensburg, WWTP	10
Upper St. Lawrence	041503010202	St. Lawrence River	NY0029831	City of Ogdensburg, WWTP	7
	041503010102	St. Lawrence River	NY0027545	Village of Clayton, STP	2

SOURCE: CSO Outfalls Google Earth Map, NYSDEC; Enforcement and Compliance History Online (ECHO), USEPA.

Municipal Separate Storm Sewer Systems. The St. Lawrence River watershed hosts two MS4s, serving areas within the Indian subwatershed at Fort Drum and an adjacent town, Leray (**Table 14**). These systems utilize a collection of structures, including retention basins, ditches, roadside inlets, and underground pipes, to gather stormwater from flooded areas and discharge it into local streams and rivers without treatment. Many rural developments use similar stormwater management structures, but only communities that the US Census Bureau classifies as "urbanized areas" (based on population density) are required to become part of the MS4 program and retain a permit. Urbanized areas contain more impervious surfaces and development that leads to increased stormwater runoff. In conjunction with retaining an NPDES permit for these systems, communities are required to develop a stormwater management plan.

Table 14
Permitted MS4s

HUC8	HUC12	Receiving Waterbody	Permit ID	Facility Name	Operating MS4s
Indian	041503030301	West Creek	NYR20A556	Fort Drum	Base-wide, Fort Drum
			NYR20A557	Leray	Town-wide, Evan Mills

SOURCE: Enforcement and Compliance History Online (ECHO), USEPA.

Industrial Wastewater and Stormwater. Industrial wastewater may contain pollutants at levels that have adverse impacts on water quality. Effluents may contain components that interfere with POTWs that receive their wastewater. Industry and construction are often exposed to the weather, where runoff from rainfall or snowmelt can potentially transport pollutants to stormwater catchments or adjacent waterbodies. The NPDES permitting program establishes discharge limits and conditions for industrial sources with specific standards relevant to the type of industrial activity. Relevant subjects to regulation in the St. Lawrence watershed subject include sand and gravel storage sites, mines, manufacturing and solid waste management facilities. **Table 15** lists industrial facilities subject to the NPDES permitting system.

Table 15
Industrial Wastewater and Stormwater Sites Permitted under NPDES

HUC8	HUC12	Facility Name	NPDES ID	Receiving Waterbody
Upper St. Lawrence	041503010101	Clayton WWTP	NYR00E598	
		French Creek Marina	NYR00A10F	
	041503010102	Northern Marine Inc	NYR00A494	St. Lawrence River
	041503010106	Stout's Ready Mix Ltd.	NYR00F161	Chippewa Creek
	041503010107	Acco Brands USA LLC	NYR00E721	St. Lawrence River
	041503010201	Acco Brands	NYR00G008	
		Maxam Us, LLC	NYR00F749	
		Ogdensburg Distribution And Manufacturing Facility	NYR00F496	
		Ogdensburg Power Plant	NYR00D126	
	041503010202	Port of Ogdensburg	NYR00A860	St. Lawrence River
Oswegatchie	041503020503	Viking Cives Inc USA	NYR00B403	West Branch Oswegatchie River
	041503020702	Bestway of New York	NYR00F489	
	041503020801	Gouverneur Division, #1 Mill And #2 Mine	NYR00A595	
		Gouverneur Division, #3 Mill	NYR00A894	
	041503020802	Cargill Feed and Nutrition Gouverneur	NYR00C212	Oswegatchie River
		Cives Steel Company	NYR00B413	
		Dunn Paper - Natural Dam Inc	NYR00F629	Oswegatchie River
		Gouverneur (V) WWTF	NYR00E780	Oswegatchie River
	041503020804	Seavey Road Quarry	NYR00B614	Oswegatchie River
	041503020902	Stiles Used Auto Parts	NYR00G028	
		Losurdo Foods Inc	NYR00D375	Oswegatchie River
		Sunopta Aseptic Inc	NYR00E518	Oswegatchie River

HUC8	HUC12	Facility Name	NPDES ID	Receiving Waterbody
	041503021003	Ogdensburg International Airport	NYR00A859	
Indian	041503030102	Gouverneur Division, #4 Mine	NYR00B205	Clark Creek
	041503030301	Building 2084 - Jp-8 Storage Tanks	NYR00F375	Black River
		Building 21510 Central Vehicle Wash Facility	NYR00F376	Black River
		Fort Drum Military Installation	NYR00E835	
Grasse	041503040303	Poulin Grain Inc	NYR00F610	Tracy Brook
	041503040404	Canton Wastewater Plant	NYR00E591	Grasse River
	041503040406	Canton Usarc	NYR00C438	Grasse River
		St Lawrence County Manufacturing & Properties LLC	NYR00A798	Grasse River
		Witherbee And Whalen Inc	NYR00B829	Grasse River
	041503040502 041503040502	Massena (V) WWTP	NYR00E618	Grasse River
		Massena Energy Facility	NYR00E893	Robinson Creek
Raquette	041503050603	UPS-Potsdam	NYR00C046	Plum Brook
	041503050604	Potsdam Quarry And Concrete	NYR00F954	Stafford Brook
		Waste-Stream Inc	NYR00D032	Stafford Brook
	041503050703	Knapps Station Facility	NYR00B231	
		Norwood Facility	NYR00B658	Raquette River
		Village Of Potsdam WWP	NYR00E695	Raquette River
	041503050704	Potters Industries, LLC	NYR00D568	Raquette River
	041503050706	Massena Ready Mix Plant	NYR00G151	
		Massena Terminal Railroad Company	NYR00D761	Raquette River
Salmon	041503070204	Malone Quarry	NYR00F957	Farrington Brook
	041503070302	Malone Ready Mix Plant	NYR00G126	
		Westville Facility	NYR00B660	Salmon River
	041503070303	Malone Distribution Warehouse	NYR00G146	
Chateaugay-English	041503080102	Wi Ore Sand	NYR00F865	
	041503080103	Lyon Mountain Convenience Sta	NYR00E340	Separator Brook
	041503080201	McAdam Plant Chateaugay	NYR00D497	Marble River
	041503080202	Clinton Quarry	NYR00F955	
	041503080203	Grasslands	NYR00D031	
	041503080301	Waste Stream Management Transfer Station	NYR00D595	
	041503080303	County Of Franklin Solid Waste Management Authority	NYR00D523	
	041503080406	Mooers Transfer Station	NYR00D597	English River
	041503080501	Churubusco Convenience Station	NYR00E548	Hinchinbrook Brook

SOURCE: Enforcement and Compliance History Online (ECHO), USEPA.

6.3.3.3 Concentrated Animal Feeding Operations

Animal feeding operations and their associated manure and wastewater contribute nutrients, pathogens, organic matter, hormones, and antibiotics to the environment. Agricultural animal feeding operations are defined by the following conditions:

- Animals have been, are, or will be stabled or confined and fed or maintained for a total of 45 days or more in any 12-month period, and
- Crops, vegetation, forage growth, or post-harvest residues are not sustained in the normal growing season over any portion of the lot or facility

Animal feeding operations that meet the regulatory definition of a *concentrated* animal feeding operation (CAFO) are considered point sources, as defined by the CWA [Section 502(14)] and regulated under the NPDES permitting program. CAFOs are classified by the type and number of animals they contain, and the way they discharge waste into a waterbody. A CAFO is defined as a "large" when 1,000 or more head cattle are present (including heifers, steers, bulls, and cow/calf pairs). A "medium" CAFO" has 300-999 head and meets one of the criteria below:

- Pollutants are discharged into waters through a manmade ditch, flushing system, or other similar manmade device, or
- Pollutants are discharged directly into waters that originate outside of and pass over, across, or through the facility or otherwise come into direct contact with the animals confined in the operation (122.23(b)(2)).

"Small" CAFOs—those with less than 300 head—are designated CAFOs on a case by case basis, depending on factors such as size and amount of manure reaching waters, location relative to waters, slope, vegetation, rainfall, and other factors that affect the likelihood and frequency of discharge to waters.

There are 69 CAFOs permitted under the NPDES program in the St. Lawrence River watershed (**Table 16**). CAFOs with effective coverage under the general permit also submit CAFO-specific nutrient management plans, which provide information on production and land application areas, best management practices, an implementation schedule, and an emergency action plan. These plans and permits are essential to reducing nutrient and pathogen transport to surface and groundwaters from agricultural runoff and activities.

Table 16
CAFOs Permitted under NPDES

HUC8	HUC12	Facility Name	NPDES ID	Receiving Waterbody
HUC-8	**HUC-12**	**Facility Name**	**NPDES ID**	**Receiving Waterbody**

HUC8	HUC12	Facility Name	NPDES ID	Receiving Waterbody
Upper St. Lawrence	041503010102	Bourcy Farm Property	NYA001542	
		Wood Farms LLC	NYA000351	
	041503010106	Pitcher Farms	NYA000579	
	041503010107	Beamish Farm	NYA000547	
	041503010202	Woodcrest Dairy LLC	NYA000561	
	041503010203	Five Mile Farms	NYA000071	
		Flack Farms	NYA000628	
		Harvest Dairy Farm	NYA000267	
		Keystone Dairy	NYA001385	Squaw Creek
		Lisbon Centre Farms, LLC	NYA000565	
	041503010204	Brandy Brook Haven Farms, LLC	NYA001374	Brandy Brook
		Brandy View Farms	NYA000615	Brandy Brook
		Ceda-Meadow Farm	NYA000448	
	041503010205	Fobare Lake Farm	NYA001380	Coles Creek
		River-Breeze Farm	NYA000083	Grass River
		Corscadden Family Farm	NYA000207	
Oswegatchie	041503020902	Mclean Farms	NYA001432	Line Creek
	041503020903	Martin Farm	NYA000076	Merrill Creek
	041503020904	Kelly Farm	NYA000573	Beaver Creek
		Rainbow Acres	NYA001386	
	041503021002	Chambers Farms LLC	NYA000013	Oswegatchie River
	041503021003	Bruce Nichols	NYA000569	
		Fishel Farms LLC	NYA000498	
		Royal-J-Acres LLC	NYA000090	
		Virgil Valley Farms	NYA000480	
		Pominvilles Farm	NYA001556	Indian River
Indian	041503030303	Leuze Farms	NYA000354	Indian River

HUC8	HUC12	Facility Name	NPDES ID	Receiving Waterbody
		Thompson Farm Property	NYA001538	
	041503030504	Dori B S Farm	NYA000461	
		Shady Brook Farm	NYA001578	Mud Lake Outlet
	041503030505	White Acre Farms	NYA000560	
Grasse	041503040401	Gebarten Acres	NYA001325	
	041503040402	Gotham Family Farm, LLC	NYA000162	
	041503040404	Greenwood Dairy Farm, LLC	NYA000067	Nettle Creek
		Lloyd T. Smith & Sons	NYA001394	Grass River
	041503040406	Jordan Farms	NYA000206	Grass River
		Kingston Brothers Farm	NYA000515	Grass River
		Teriele Family Dairy, LLC	NYA000428	
	041503040501	Mapleview Dairy LLC	NYA000059	
		Paradise Valley Farm	NYA000020	Grass River
Raquette	041503050603	Snell Farm	NYA001369	
	041503050604	Adon Farms	NYA000092	
		Chambers Dairy	NYA001424	
St. Regis	041503060302	Durant Farms	NYA000581	Allen Brook
		Dutch Pride Farm	NYA001357	
		New Beginnings	NYA000073	
		Roberts Dairy Farm LLC	NYA001329	
	041503060303	Stauffer Farms	NYA000489	Deer River
	041503060305	Tri Oak Lea Farm	NYA001519	
	041503060406	Norco Farms	NYA000068	Hopkinton Brook
	041503060407	Adirondack Heifer Management, Inc.	NYA000082	
Salmon	041503070203	Jimali Holsteins	NYA001320	
	041503070302	A. Miller	NYA001431	
		Dan'S Dairy LLC	NYA001458	Salmon River
	041503070303	Carsada Farms	NYA001292	East Branch Deer Creek
		Clearview Dairy	NYA001355	
		Ellsworth Farms	NYA001339	

HUC8	HUC12	Facility Name	NPDES ID	Receiving Waterbody
		Monica Farms	NYA001321	East Branch Deer Creek
		Papas Dairy, LLC	NYA001315	
		White'S Dairy Farm LLC	NYA001316	West Branch Deer Creek
	041503070305	Brockway Hilltop Farm	NYA001289	Pike Creek
Chateaugay-English	041503080201	Brior Farm	NYA001537	Marble River
	041503080203	Trainer Farm, LLC	NYA001310	
	041503080204	Sunset Lake Farm #2 LLC	NYA00C010	Allen Brook
		Swanston Farms, Inc.	NYA001313	Allen Brook
	041503080205	Shipman Farm LLC	NYA001452	Flynn Brook
	041503080303	Metcalf Farms	NYA001317	
	041503080402	Lamberton Farms	NYA000542	English River

SOURCE: Enforcement and Compliance History Online (ECHO), USEPA

6.3.3.4 Legacy Industrial Waste Disposal Practices

The St. Lawrence River watershed has been affected by industrial production and improper waste disposal practices that resulted in the contamination of sediments and waterways. The Massena area in northeastern St. Lawrence County, once an industrial powerhouse, is now dealing with the pollution left behind from several decades of industrial manufacturing. Priority organics (PAHs, PCBs) and pesticides have contaminated 875 stream miles (14% of assessed miles), and 700 miles are suspected to be contaminated due to improper industrial waste disposal.

Alcoa Inc., an aluminum manufacturing facility, has operated in Massena since 1903. The facility released hazardous wastes from its production and fabrication activities onto facility property and into the Grasse River via industrial outfalls from the 1950s to the 1970s. PCBs were among the primary organic contaminants in the waste, but wastes also included aluminum, furans, and PAHs. In 1989, the USEPA declared it a Superfund Site and issued an Administrative Order to investigate the extent of contamination. Sediments in the river system immediately surrounding the facility and those up to 7 miles downstream were found to have been contaminated, with fish also containing high levels of PCB contamination. In 1990, the NYSDOH advised the public to not eat any fish from the mouth of the Grasse River to the Massena Power Canal. From 1995 to 2001, Alcoa completed some dredging and capping of the contaminated site, but a severe ice jam event in the Grasse River damaged a portion of the capping, so subsequent monitoring and remediation is needed. In 2013, a cleanup plan was released to the public, and remediation is ongoing.

Reynolds Metals operates Alcoa East, a 1,600-acre facility on the St. Lawrence River that is now owned by Alcoa. Industrial wastes contaminated with PCBs and PAHs were discharged into river through four permitted outfalls. The USEPA issued a Unilateral Administrative Order ordering investigation and cleanup of the site, and Alcoa worked cooperatively with the USEPA to remediate the site by dredging the river adjacent to the facility. This remediation has been completed.

In 1984, another 270-acre site in Massena was added to the Superfund National Priorities List. General Motors produced aluminum cylinder heads at this plant from 1959 to 2009, and onsite disposal of industrial wastes led to PCB contamination of the groundwater, on- and off-site soils, and sediment in the St. Lawrence and Raquette Rivers, Turtle Cove, and Turtle Creek. This site is still undergoing cleanup under the federal Superfund program to address onsite and waterway contamination.

6.4 Sensitive Areas

The St. Lawrence River watershed encompasses many sensitive areas, including lakes and streams, steep slopes, wetlands and hydric soils, floodplains, and primary aquifers (**Map 33)**. These areas provide several ecosystem services. For example, wetlands provide a buffer against flooding, woodlands and natural land cover of riparian areas buffer waterbodies from runoff, and vegetation stabilizes steep slopes prone to erosion. The St. Lawrence River watershed has a large area within the Adirondack region consisting of slopes greater than or equal to 15%, which classifies these areas as having a high risk of soil erosion. The plains of the northern region traversing the St. Lawrence River shoreline are dominated by emergent and forested wetlands, which are threatened by agricultural practices and land use change.

New York State and the New York Natural Heritage Program are working to protect select areas that are more vulnerable to ecological degradation and poor management. As a result, some areas are designated “critical environmental areas” or are managed by the NYNHP to enhance community resiliency and ecological integrity through restoration and protection.

7 Emerging Issues

In addition to the previously mentioned stressors, emerging issues affecting the St. Lawrence River watershed are climate change and water-level management. Solutions to these problems require knowledge and a collaborative effort beyond the watershed boundaries. In addressing these issues, it is essential to take an ecosystem-based approach, to recognize the importance of intermunicipal collaboration for implementing successful strategies, and to realize that watershed management planning is a continual process that involves stakeholder participation and long-term, complex solutions.

7.1 Floodplain and Water-Level Management

Many communities in the St. Lawrence River watershed are suffering and recovering from extreme flooding. Water levels of the St. Lawrence River change in response to the supply it receives from Lake Ontario, and the outflow adjusts in response to the flow through the Moses-Saunders and Long Sault Dams. A change in outflow of 323 cubic meters per second (m^3/s) for one week will cause a change of 1 cm in the Lake Ontario level, whereas the St. Lawrence River will experience a 16 cm variation (IJC, 2014). Small releases can increase Lake Ontario levels and potentially be hazardous for river navigation, threatening ship groundings. Large releases may reduce Lake Ontario flooding but increase river flooding, demonstrating the complexity and difficulty of managing this water system.

Widespread and record-setting precipitation in 2017 and 2019 brought significant water volumes and flooding to both Lake Ontario and the St. Lawrence River, affecting residents, business owners, and municipalities. Impacts from the flooding affect local economies due to expensive remediation and infrastructure repairs, decreased tourism, and damage to residential and business properties. Rapid runoff resulting from increased precipitation is expected to affect sediment and contaminant transport, impairing waterways and eroding shorelines. Alterations in flow patterns and consequential sedimentation of low-flow areas can decrease fish spawning and egg viability, biodiversity, and habitat. Adaptation strategies to flooding should focus on projects that contribute to the resiliency of shorelines and infrastructure to high volumes of water. These should involve infrastructure that enhances natural hydrologic processes (soil infiltration, groundwater recharge, evaporation) and slows the movement of water instead of rapidly conveying it to waterbodies.

7.2 Climate Change

Climate change is influencing the severity of numerous water quality issues. Water resources are influenced by climate factors, such as temperature, amount and duration of snowfall and snow cover, rainfall, and evaporation. Climate change has the potential to shrink water supplies and degrade the quality of remaining supplies. Warmer weather and more variable precipitation complicate efforts to manage lakes and watersheds.

Changes in seasonal precipitation and frequency have been noted in recent years, with increased precipitation in the form of heavy rain events in the spring and fall, and periods of low precipitation and drought during the summer months. The northeastern United States has experienced an increase heavy rains that create hazardous runoff flows and increase vulnerability to flooding. With higher temperatures, as well as alterations in precipitation and wind patterns and associated nutrient-dense runoff, algal blooms are expected to occur more frequently. A warming climate threatens fish populations by decreasing the levels of dissolved oxygen, increasing water temperature and turbidity, and altering water flow. As these impacts are not due to local or point sources, adaptation strategies should incorporate resiliency and “smart growth” projects to moderate stressed waterbodies and prepare for the future.

8 Data Gaps

This watershed characterization process uses available data to offer a snapshot of watershed health at a moment in time, laying a foundation that will allow us to evaluate progress and changes in response to implementation strategies. However, several data gaps exist that limit the extent of the characterization:

- Only 48% of stream miles and 43% of lake acres have been assessed for water quality, meaning that nearly 50% of the waters within the watershed were not characterized or monitored for impairment. Of the assessed waters, 38% of stream miles and 80% of lake acres were found to be threatened, stressed, or impaired. Given that high percentage, it is likely that many of the unassessed waters are also impacted.
- The North Country of New York State is largely unmapped by FEMA for identification of high-risk flood areas. Consequently, parameters such as slope, soil type, storage capacity, and incoming flow were used to evaluate which areas are more vulnerable to flooding.
- Citizen science is a major source of data in the identification of invasive species, which can introduce biases related to the frequency of site visitation to sites and can result in imbalances in the availability of data from one area to another.
- The land use characterization did not include an analysis of zoning codes, due to the expense of obtaining this data across so many municipalities. However, since much of the land is agricultural and generally lacks intense development, this information may not be as essential. We also know that water quality impairments are largely due to regional contamination of mercury and acid deposition, as well as nonpoint sources throughout the watershed.

Although some of the information in this watershed characterization is imperfect or incomplete, the implementation of the watershed revitalization plan can proceed in a dynamic and adaptable way as more and improved information becomes available.

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Figures

Appendix A
Local Laws and Programs Affecting Water Quality