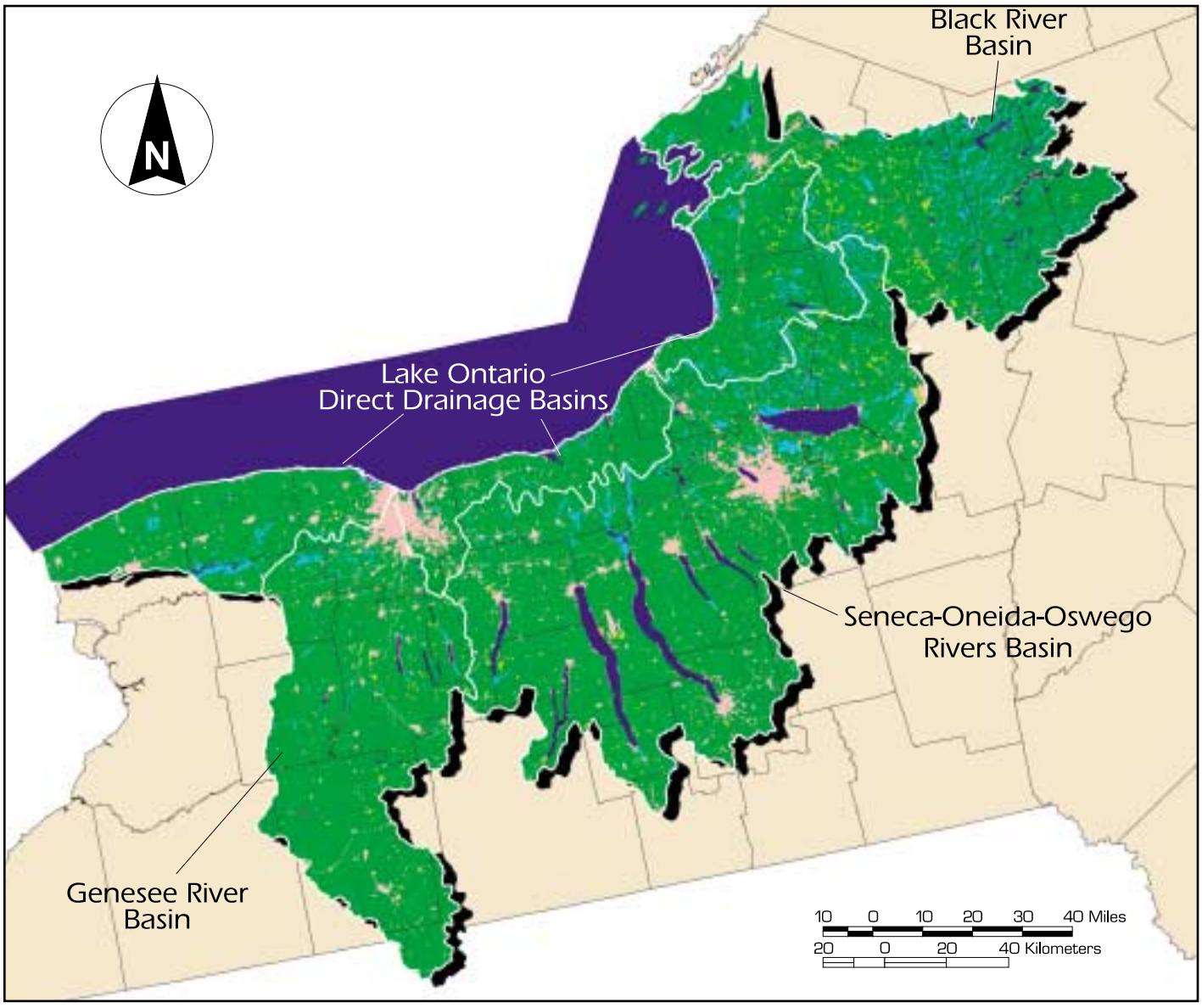
The State of the New York Lake Ontario Basin:

A Report on Water Resources and Local Watershed Management Programs



Finger Lakes-Lake Ontario Watershed Protection Alliance
309 Lake Street, Penn Yan, New York
315-536-7488

Correspondence on this report may be forwarded to:

Water Resources Board
309 Lake Street
Penn Yan, New York 14527
315-536-7488
e-mail: wrb@eznet.net

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An endeavor to characterize water quality status and programming at the local level across a region as vast as the New York Lake Ontario Basin depends upon information from many sources. Dozens of water resources professionals at the federal, state, regional, county and local levels and water quality coordinating committees in the Basin provided valuable information that made this project possible. The New York State Department of Environmental Conservation Division of Water is acknowledged for contribution of state-level water quality data and information, as is Mike Stoogenke for mapping assistance.

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CHAPTER ONE

THE STATE OF THE LAKE ONTARIO BASIN: PROJECT OVERVIEW

PURPOSE OF REPORT

The objectives of this report were to examine the New York Lake Ontario Basin to determine:

- the status of surface water resources
- the scope and methods of watershed management at the local level
- ways to advance resource-based watershed management programs and practices at the local level with regional benefits

This report was commissioned by the Finger Lakes – Lake Ontario Watershed Protection Alliance (FL-LOWPA) as a means to track progress, identify needs, and ultimately refine program direction for effective water resources management in the new century. The primary audience for this report is FL-LOWPA and those who interact with FL-LOWPA at the local level to protect water quality. Other important audiences for this report include local and state lawmakers, water resources program managers and planners at the regional, state, federal/international levels, environmental and citizen's organizations, and all others with an interest in Lake Ontario and its watershed.

FL-LOWPA'S ROLE IN WATER RESOURCES MANAGEMENT

The Alliance

FL-LOWPA is an alliance of 25 counties wholly or partially in the New York Lake Ontario Basin (Figure 1-1; Table 1-1). The Water Resources Board, composed of one voting representative from each member county, governs the Alliance. Representatives are drawn from county Soil and Water Conservation Districts, Health Departments, Planning Departments, and Water Quality Management Agencies.

Table 1-1. The 25 member counties of FL-LOWPA.

Allegany	Hamilton	Madison	Ontario	Steuben
Cayuga	Herkimer	Monroe	Orleans	Tompkins
Chemung	Jefferson	Niagara	Oswego	Wayne
Cortland	Lewis	Oneida	Schuyler	Wyoming
Genesee	Livingston	Onondaga	Seneca	Yates

FL-LOWPA Mission

FL-LOWPA's mission is to protect and enhance water resources by:

1) *Promoting the sharing of information, data, ideas, and resources pertaining to the management of watersheds in New York's Lake Ontario Basin;*
2) *Fostering dynamic and collaborative watershed management programs and partnerships; and*
3) *Emphasizing a holistic, ecosystem-based approach to water quality improvement and protection.* (Water Resources Board 1999)

A unique facet of FL-LOWPA is a commitment to developing local solutions to meet local water quality needs while promoting the integration and transfer of tools and information to enhance the regional effectiveness of water resources management.

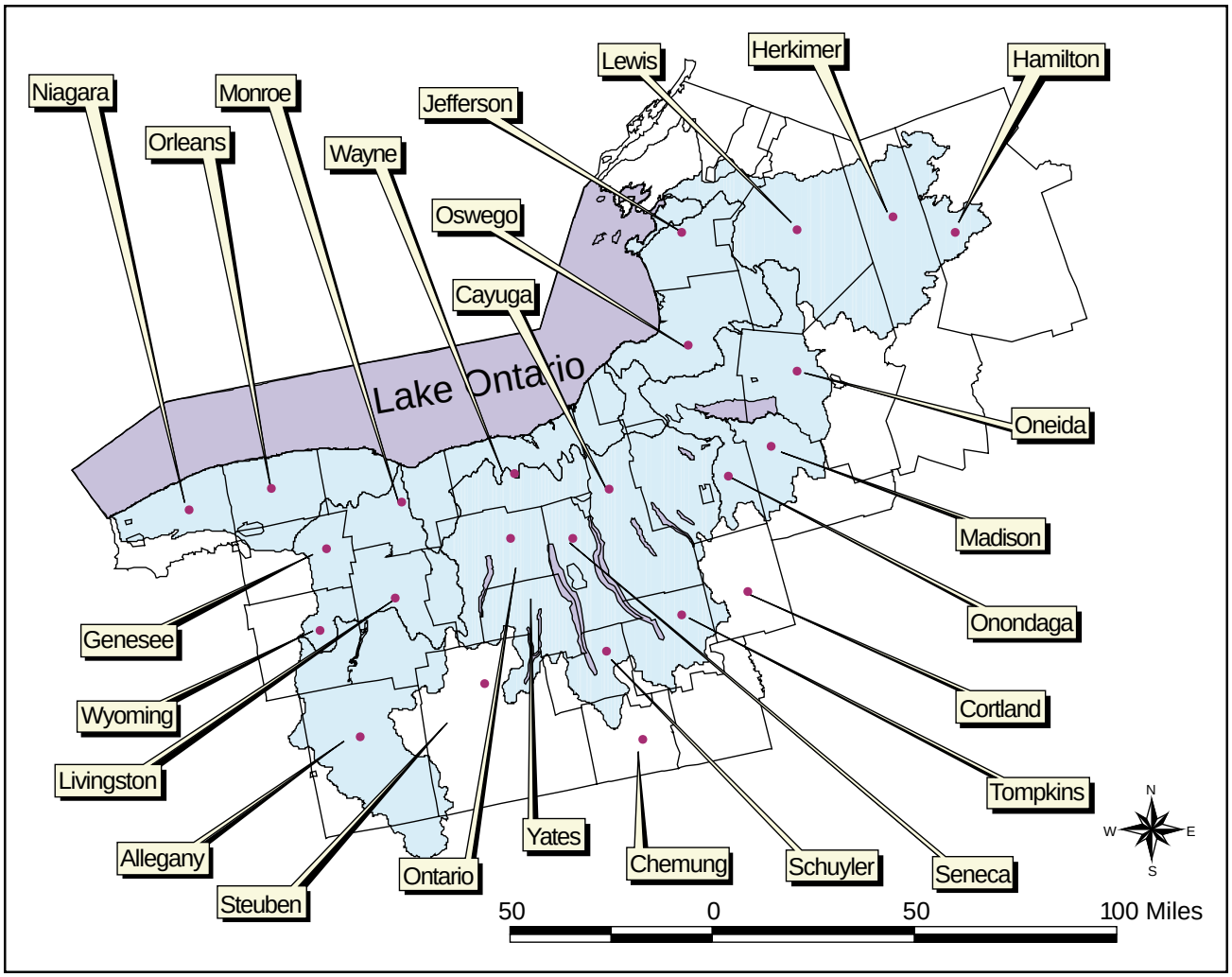

Figure 1-1. Twenty-Five counties of the New York State Lake Ontario Basin.

FL-LOWPA History

FL-LOWPA has its roots in the successful Aquatic Vegetation Control Program (AVCP) that began in Cayuga County in the heart of New York State's Finger Lakes region in the mid-1980s. This program was initiated to address problems affecting the recreational use of local water bodies primarily due to cultural eutrophication. Between 1984 and 1988 the membership expanded from one to 18 counties, and the program focus extended to nonpoint source pollution control and watershed management. In 1994, the Water Resources Board reexamined its goals and structure in light of its evolving attention to watersheds. This process culminated in 1996 with the expansion of the now former AVCP into the Finger Lakes – Lake Ontario Watershed Protection Alliance (FL-LOWPA). The expansion brought into focus a unifying watershed, the New York Lake Ontario Basin, and growth in membership that by 1998 included all 25 counties within the New York Lake Ontario Basin.

FL-LOWPA FUNDING AND RESOURCE ALLOCATION

FL-LOWPA is funded through annual appropriations in the New York State budget. Beginning with the 1997-98 State Fiscal Year, the program has been included in the New York State Environmental Protection Fund at the annual level of $1.3 million. Annual FL-LOWPA appropriations have been divided into 27 equal shares, with one share going to each of the 25 participating counties ($48,148 for a $1.3 million appropriation). Another share is used for program coordination and public outreach through the Water Resources Board. The final share sustains the FL-LOWPA Special Projects Fund, a competitive grant program providing seed moneys for collaborative and innovative watershed projects based on demonstrated need.

Local Programs

Each member county of FL-LOWPA develops a work plan and budget that addresses local priorities to protect and restore water resources. Work plans and budgets are reviewed by New York State Department of Environmental Conservation (DEC) Division of Water. County FL-LOWPA programs include projects in the following areas based on local needs:

- Water quality monitoring and research
- Nonpoint source pollution control and remediation projects
- Watershed planning
- Invasive species control
- Public education and outreach

Collaboration between counties on projects that transcend political boundaries is promoted through the Water Resources Board (WRB) and Special Projects Fund. The WRB develops its own annual work plan that emphasizes communication and information sharing among the member counties, their constituents, and partner organizations. The Board sponsors a public watershed conference each fall, a technical workshop for practitioners each spring, publishes a newsletter and maintains a web site (www.fllowpa.org).

STUDY AREA

Water from over 13,600 square miles of New York State ultimately flows to Lake Ontario through a complex network of streams and rivers, lakes, ponds and wetlands. The diversity of the natural and human environment in the Basin has created a number of water resources management challenges. The Basin includes several urban areas with the two largest being the cities of Rochester and Syracuse, where stormwater management from impervious surfaces is a major concern. Other nonpoint sources of pollution, like failing septic systems, agricultural runoff, stream and road bank erosion, and construction sites are concerns in more rural areas of the Basin. In high elevation lakes such as those in the Black River watershed, acid deposition is the primary cause of water resource impairments. Clearly an adaptive approach is required to successfully manage diverse nonpoint sources of pollution in the Basin.

Also complex is the institutional network of federal, state, regional, county, and local public and private entities that interplay in water resources issues in the Basin. Water resources planning and management initiatives occur at international/federal, state, regional and local levels in the Lake Ontario Basin.

This project examines management of the New York Lake Ontario Basin resource. The emphasis is on water resources impairments at the river basin level with reliance upon DEC data, and nonpoint source pollution control programs and watershed management activities at the local level.

Water resource impairments are analyzed within four major watersheds to Lake Ontario:

- Seneca-Oneida-Oswego Rivers basin
- Genesee River basin
- Black River basin
- Lake Ontario Direct Drainage Areas:
  Oak Orchard-Twelvemile; Irondequoit-Ninemile; and Salmon-Sandy

INFORMATION SOURCES

Several data gathering techniques were used for this assessment. Key representatives of state and regional agencies were personally interviewed in an effort to define major program areas and responsibilities. Structured group interviews and written surveys were used to elicit information from water resources representatives in each of the FL-LOWPA counties. The interviews were convened through the County Water Quality Coordinating Committee (WQCC), or equivalent and were intended to identify local water resources priorities and programs, with an emphasis on integrated, community-based efforts with stakeholder involvement.

The status of water resources, including data on pollutant sources and severity of use impairment, was derived from various sources. Primary data sources were the DEC Priority Waterbodies List (PWL), Rotating Intensive Basin Studies (RIBS), Unified Watershed Assessment (UWA), Citizens Statewide Lake Assessment Program (CSLAP), and County Water Quality Strategies. These sources were supplemented with information gathered

from the interviews and surveys. Additional relevant publications and data sources were identified during the meetings with the individual county groups. Three regional workshops with FL-LOWPA representatives were conducted to brainstorm topics in water resources management including communication, education, planning, funding mechanisms, and coordination. Also explored were the current and possible future roles for FL-LOWPA.

DEFINING WATERSHED TERMS IN THE REPORT

Depending on the scale of a discussion, different hydrologic units are commonly referred to as basins, sub-basins, watersheds, and sub-watersheds. To avoid confusion, the use of these terms is clarified for the purposes of this report. The term **Basin** (with a capital B) refers to the Lake Ontario watershed in New York State, the study area. To be consistent with language commonly used by New York State agencies, the four sub-basins or major drainages within the New York Lake Ontario Basin, are referred to as **river basins** (with a lower case b) or **drainage areas** (as in the case of the Lake Ontario Direct Drainage watershed). Much of the water quality and program analysis in this report is at this basin/drainage areas scale. The term **subwatershed** is used to describe smaller watershed units, such as those for individual lakes or streams within a basin. The term **watershed** is used more generally for convenience throughout the report, referring to the drainage area of a recognizable water resource, regardless of scale.

REPORT ORGANIZATION

Five chapters follow the Project Overview in Chapter One. Chapter Two provides a general description of the New York Lake Ontario Basin in terms of natural resources and water quality. Summary statistics for lakes and streams meeting DEC's designated resource uses are presented. Chapter Two also summarizes the roles of key federal, state, regional, and local agencies and partners in water resources management in the study area.

In Chapter Three, four basin perspectives are presented which include the extent and severity of water resource impairments and local program priorities. A gap analysis, which correlates local agency priorities with resource impairment, is included for each basin.

Chapters Four and Five go hand-in-hand. Chapter Four is a discussion of key elements of the process of watershed planning and management. Barriers to effective programs commonly experienced in the Basin are identified. Chapter Five builds upon Chapter Four by depicting the breadth and depth of local water resources programming in four areas: comprehensive watershed planning, watershed restoration, assessment and monitoring, and site-specific nonpoint source pollution control projects. Several case studies are included. Recommendations for FL-LOWPA and all organizations involved in water resources management in the Basin are outlined in Chapter 6. Appendices include detailed information on ecoregions, contact information, and definition of acronyms.

CHAPTER TWO

THE LAKE ONTARIO BASIN: THE RESOURCE AND ITS MANAGEMENT

OVERVIEW OF NATURAL RESOURCES

Almost one-third of the land area in New York State drains into Lake Ontario, the most downstream of the Great Lakes. The total watershed area of Lake Ontario is approximately 24,720 square miles (64,030 sq. km). The New York portion of the Lake Ontario Basin comprises 13,600 square miles (35,230 sq. km), with the remaining 45% of the watershed in Canada. Physical features of Lake Ontario and its drainage basin are summarized in Table 2-1.

Table 2-1. Physical features of Lake Ontario and its watershed.

FEATURE	ENGLISH UNITS	METRIC UNITS
Water Surface Elevation	243 ft.	74 m.
Length	193 mi.	311 km.
Width	53 mi.	85 km.
Average Depth	283 ft.	86 m.
Maximum Depth	802 ft.	244 m.
Volume	393 cu. mi.	1,640 cu. km.
Water surface area	7340 sq. mi.	18,960 sq. km.
Land drainage area	24,720 sq. mi.	64,030 sq. km.
Shoreline length	712 mi.	1,146 km.
Hydrologic retention time	6 years	
U.S. Basin Population (1995)	2,250,000	
Canadian Basin Population(1991)	5,447,000	
Total Basin Population	7,797,000	

Sources: USEPA and Government of Canada 1995

The New York portion of the Lake Ontario Basin encompasses part or all of 25 counties. Surface water is a significant landscape feature with more than 16,200 miles of streams and 260 lakes (Figure 2-1). Lakes in the Basin range in size from small Adirondack ponds in the upper elevations of the Black River basin to the large Finger Lakes and Oneida Lake in central and western New York.

The Lake Ontario Basin encompasses three distinct *ecoregions*, defined as areas of broad ecological unity based on characteristics such as topography, geology, plant and animal communities, climate, and hydrology. Most of the New York portion of the Lake Ontario Basin is in the **Lake Plain ecoregion**, with an elevation of 100 – 200 meters above sea level. The southern portion of the drainage basin is in the **Northern Appalachian Upland ecoregion**, at a higher elevation of 300 – 500 meters. The Genesee River originates in the Appalachian Upland ecoregion and travels north through the Lake Plain on its way to Lake Ontario. Several Finger Lakes watersheds also encompass these two ecoregions, with headwaters originating in the higher elevation Northern Appalachian Upland and flowing north towards the lower Lake Plain. The third ecoregion, the **Northeastern Highlands**, distinguishes the upper reaches of the Black River basin, with elevations between 300 and 500 meters.

These ecoregions have been divided into smaller, more distinct ecological units called subsections (USFS 1995). Knowledge of this more detailed information about landscapes in the Lake Ontario Basin is useful to natural resource and watershed planners and managers, educators, and government officials responsible for guiding

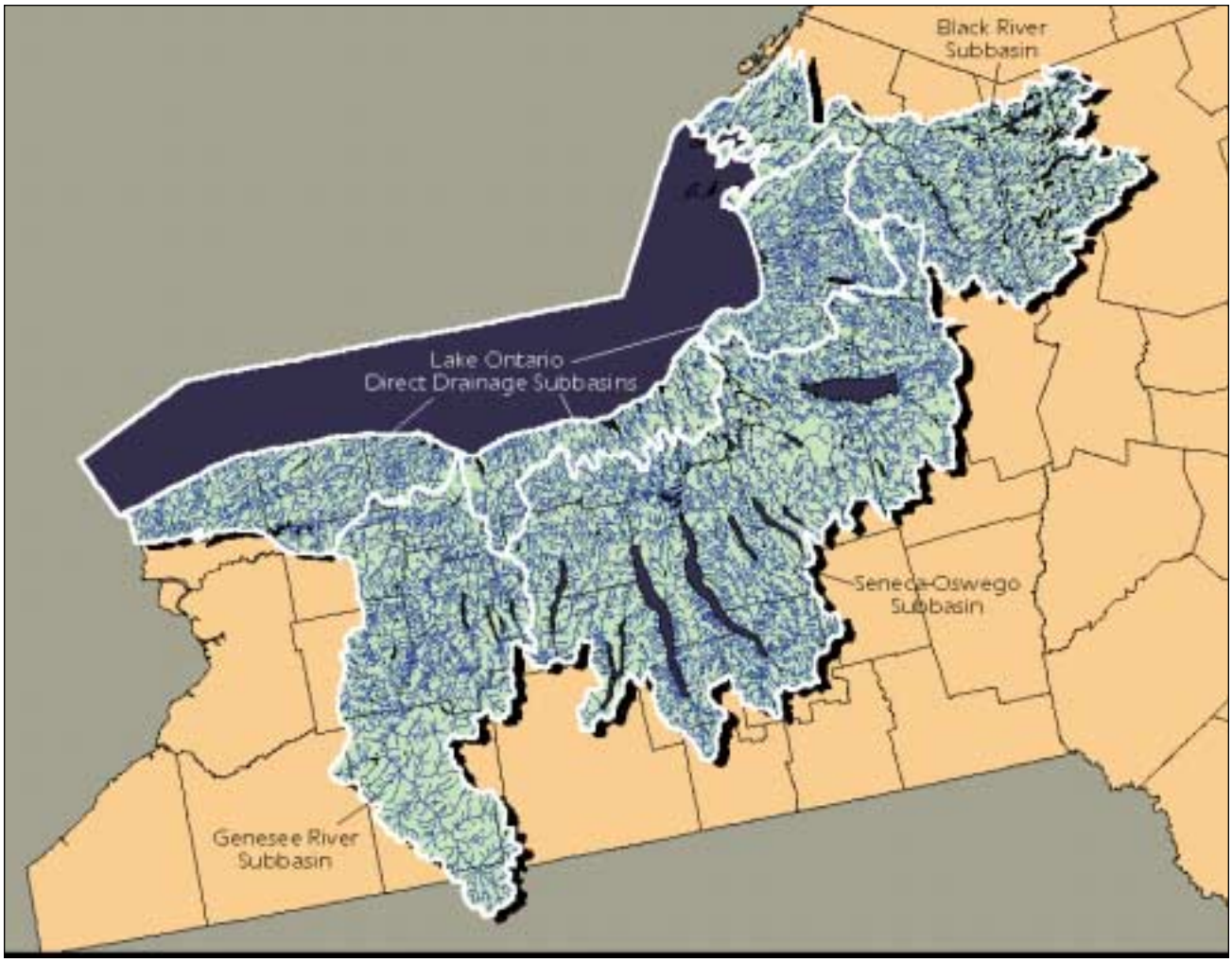

Figure 2.1 Surface Hydrology in the New York Lake Ontario Basin.

compatible and appropriate land use in the future. More detailed information on ecoregions and subsections is provided in Appendix A, and is highlighted for the river basins and drainage areas analyzed in Chapter Three.

Outstanding Natural Resources

The Lake Ontario Basin hosts a multitude of unique natural areas. Much of the topography is rolling hills and wide valleys providing open vistas and stunning views. The land use is a patchwork of forest (53%), agricultural land (33%), and low-density residential development interspersed with village centers and a few urban areas (residential land covers an estimated 8%). Extensive forest cover supports a forest-products industry, wildlife habitat, and recreation. The easternmost portion of the Basin lies within the Adirondack Park, and the Basin also encompasses the Finger Lakes National Forest in the Finger Lakes region. Agricultural land is a diverse mixture of pasture, grain crops, row crops, orchards and vineyards which contribute to the striking variation in landscape color and texture.

The regional geologic setting provides outstanding natural resources areas. Reminders of the Basin's glacial history are evident in the hanging valleys with their deep glens and waterfalls. Glacial landform features such as moraines, drumlins and eskers are found throughout the Basin. The Genesee River has carved a steep valley in its upper reach with the river cascading over three waterfalls in Letchworth State Park, and three additional waterfalls within the City of Rochester in the Genesee River's lower reach. State and County parks are plentiful in the Basin, and provide access to many of these unique resources (Figure 2-2).

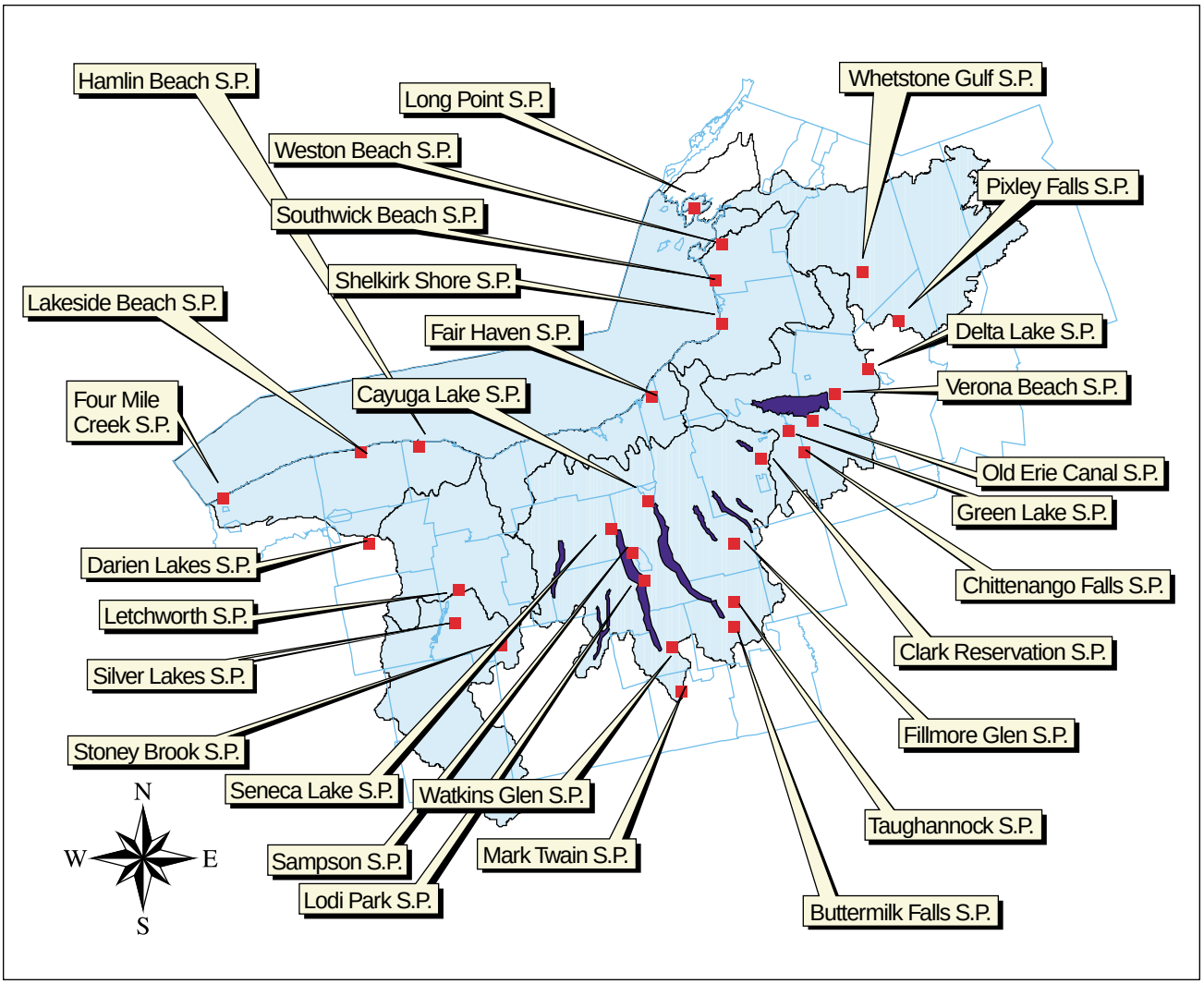

Figure 2.2 State parks in the New York Lake Ontario Basin.

Human Resources: Population and Land Use

Based on the 1990 census and 1995 national water-use data compiled by the U.S. Geological Survey, approximately 2,250,000 people reside in the New York portion of the Lake Ontario Basin. Population concentrations are found in the region's urban centers, particularly Greater Rochester (Monroe County) and Syracuse (Onondaga County) as evident in Table 2-2.

Table 2-2. County population and estimated land area in the Lake Ontario Basin.

County	County population (1990)	Percent of county land area in Lake Ontario Basin				
		Total	Seneca Oneida-Oswego Rivers basin	Black River Basin	Direct Drainage Areas	Genesee River basin
Allegany	50,470	75				75
Cayuga	82,313	100	85		15	
Chemung	95,195	10	10			
Cortland	48,963	12	12			
Genesee	60,060	60			25	35
Hamilton	5,279	25		25		
Herkimer	65,797	45		45		
Jefferson	110,943	100			20	80
Lewis	26,796	100	20		70	10
Livingston	62,372	98				98
Madison	69,120	45	45			
Monroe	713,968	100			30	70
Niagara	220,756	60			60	
Oneida	250,836	65	45	20		
Onondaga	468,973	95	90		5	
Ontario	95,101	100	80			20
Orleans	41,846	100			98	2
Oswego	121,771	100	30		70	
Schuyler	18,662	80	80			
Seneca	33,683	100	100			
Steuben	99,088	15	10			5
Tompkins	94,097	85	85			
Wayne	89,123	100	50		50	
Wyoming	42,507	70				70
Yates	22,810	95	95			

Of the 2.25 million people in the New York portion of the Basin, a total of 1.1 million are employed in the economy (Figure 2-3). Professional and manufacturing jobs are most common. Agriculture accounts for a small fraction of employment with only 2% of the 1990 census respondents employed in this segment Basin-wide. The small number of people employed in agriculture is striking when compared with the land use distribution for the Basin (Figure 2-4). Approximately one-third of the land area of the New York portion of the watershed is in agricultural use.

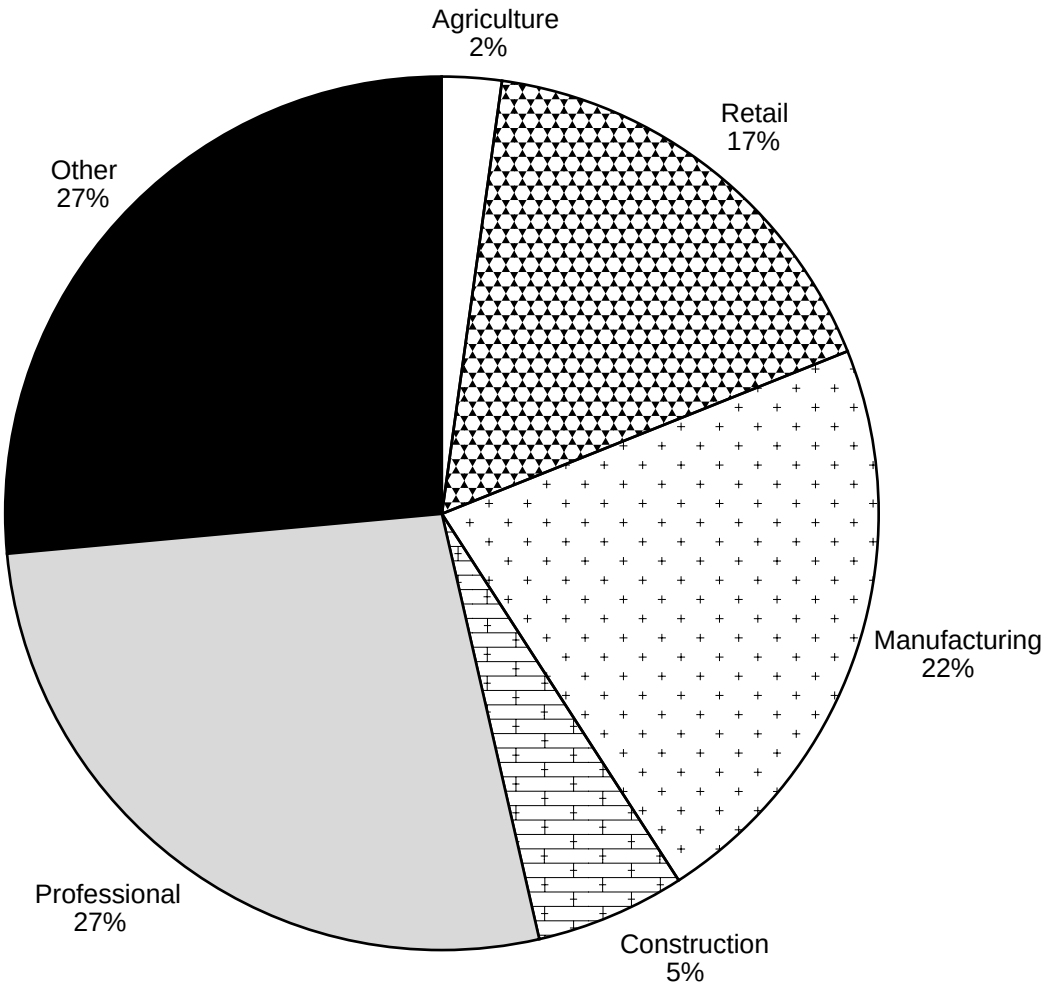

Figure 2-3. Employment distribution in the New York Lake Ontario Basin

Source: U.S. Census, 1990

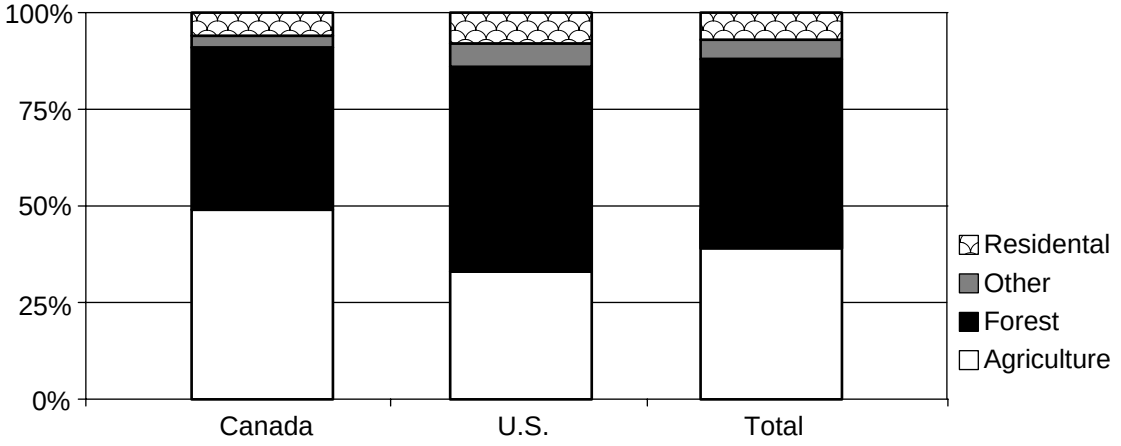

Figure 2-4. Land use in the Lake Ontario Basin.

Use of Water Resources

The surface water bodies in the Basin support multiple uses. Lakes and streams are used for water supply, wastewater disposal, cooling water for thermoelectric power plants, electricity generation, irrigation, and recreation. Water withdrawals are routed for domestic, commercial and industrial uses (Table 2-3). Most of the water withdrawn in the Basin is returned; the largest consumptive use is domestic supply (Figure 2-5). A total of 297 million gallons of treated wastewater are returned to the waters of the Basin daily through 146 permitted wastewater treatment plants.

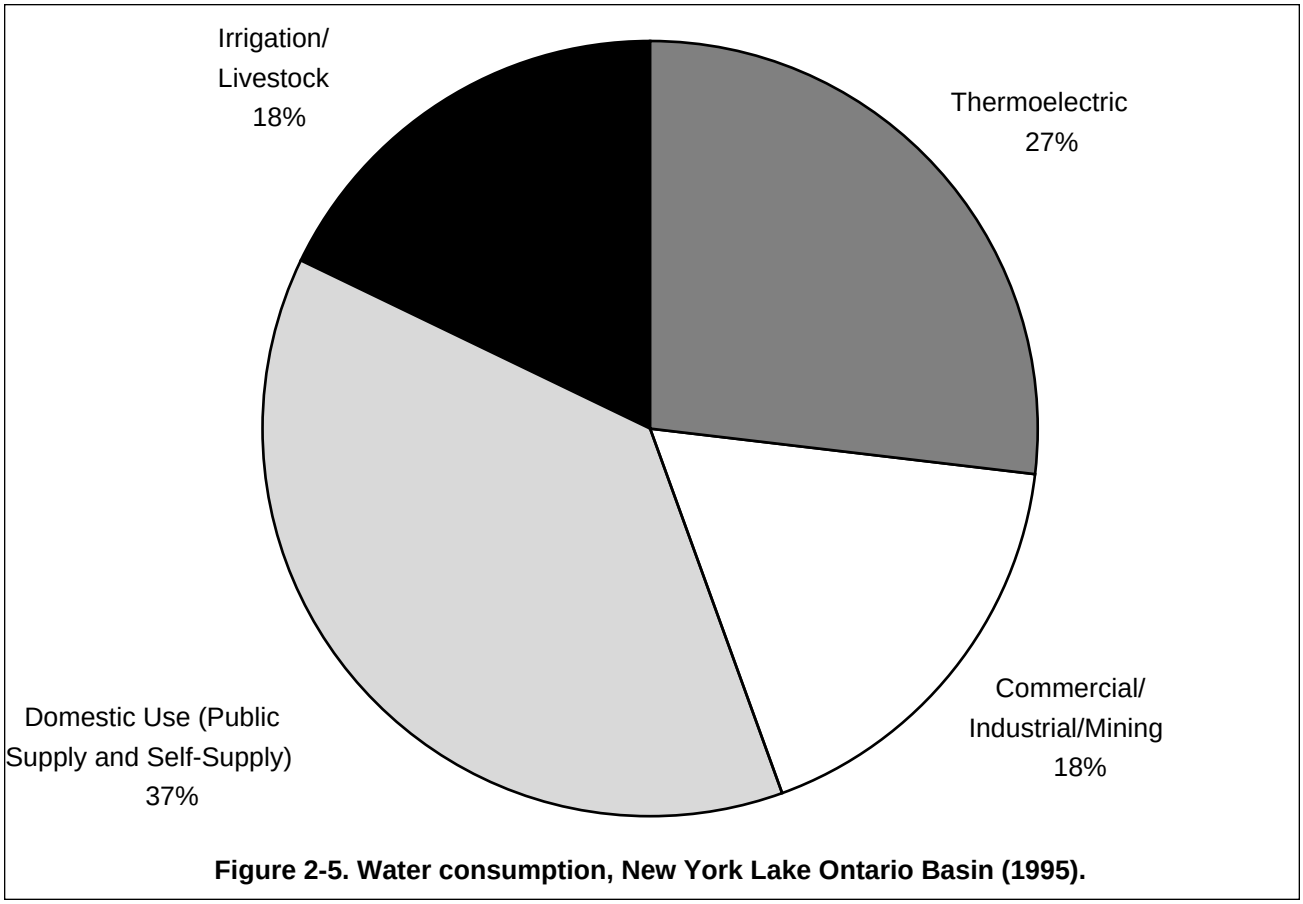

Figure 2-5. Water consumption, New York Lake Ontario Basin (1995).

Table 2-3. Use of water resources in the Lake Ontario Basin.

BASIN POPULATION	2,252,490
PUBLIC WATER SUPPLY	
Population served by groundwater	239,360
Population served by surface water	1,533,250
Total withdrawals, groundwater, million gallons per day (mgd)	32.71
Total withdrawals, surface water (mgd)	357.79
Per capita withdrawal (gallons per day)	2140.81
COMMERCIAL WATER USE	
Groundwater withdrawals (mgd)	3.14
Surface water withdrawals (mgd)	21.1
Total withdrawals plus delivery from public supplies (mgd)	81.42
Consumptive use (mgd)	8.13

Table 2-3. Use of water resources in the Lake Ontario Basin. (cont.)

DOMESTIC WATER USE	
Self-supplied population	479,880
Groundwater withdrawal (mgd)	37.65
Surface Water withdrawal (mgd)	0
Per-capita use (gallons per day)	80.4
Public-supplied population	1,772,610
Deliveries from public supplies (mgd)	185.75
Per-capita use (gallons per day)	101
INDUSTRIAL WATER USE	
Groundwater withdrawals (mgd)	12.06
Surface water withdrawals (mgd)	49.56
Total consumptive use (mgd)	17.59
THERMOELECTRIC POWER WATER USE	
Groundwater withdrawals (mgd)	0
Surface water withdrawals (mgd)	2485.32
Total consumptive use (mgd)	88.74
MINING WATER USE	
Groundwater withdrawals (mgd)	3.24
Surface water withdrawals (mgd)	14.76
Total consumptive use (mgd)	5.79
LIVESTOCK WATER USE	
Groundwater withdrawals (mgd)	6.79
Surface water withdrawals (mgd)	4.4
Total consumptive use (mgd)	11.19
IRRIGATION WATER USE	
Groundwater withdrawals (mgd)	1.27
Surface water withdrawals (mgd)	3.8
Total consumptive use (mgd	4.57
WASTEWATER TREATMENT	
Number of wastewater treatment plants	146
Total volume of permitted discharges (mgd)	297

Source: USGS Water Use Statistics, 1995

With the exception of water for livestock, surface water is used more extensively than groundwater throughout the Basin to supply various needs. This is particularly true for public water supply. Nearly 80% of the New York State Basin population is served by public water supplies. Of this group, surface waters serve 87% while 13% are served by groundwater sources. Groundwater (via private wells) supplies the approximately 20% of the Basin's population not on public water (Figure 2-6).

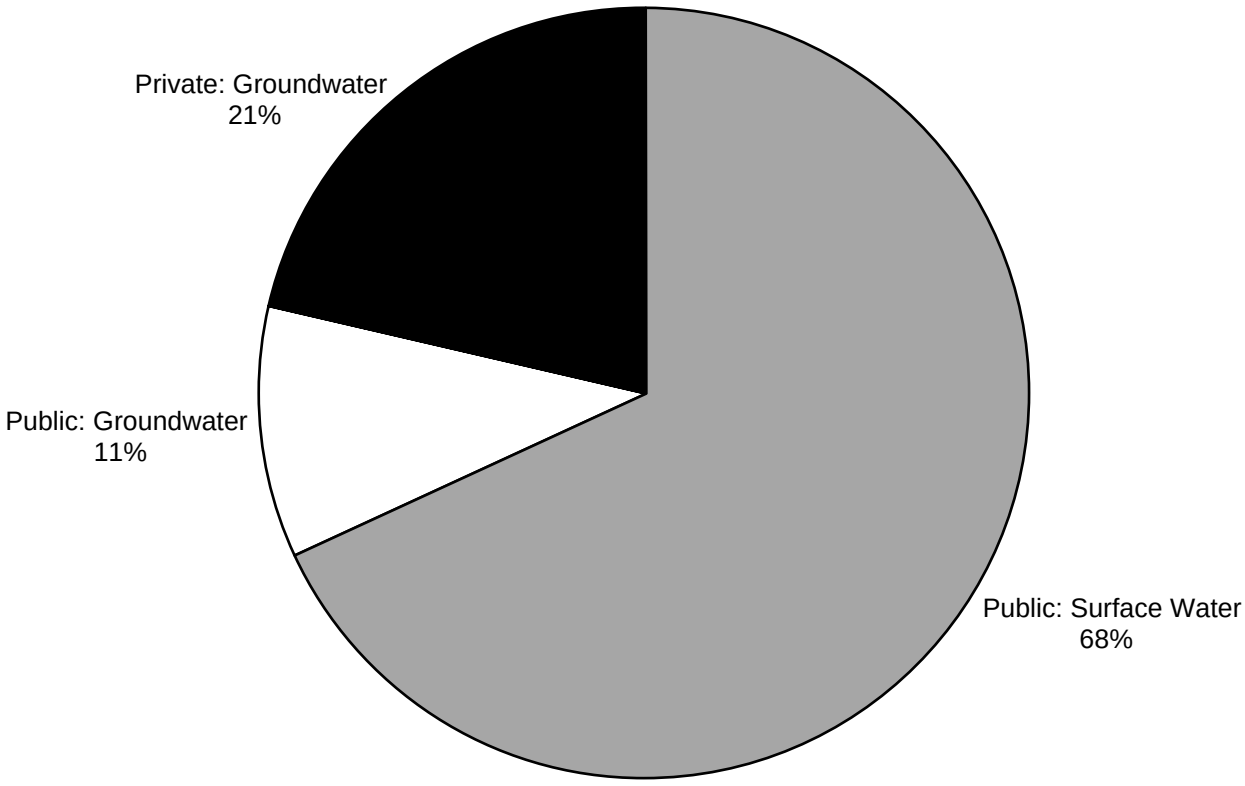

Figure 2-6. Water supply sources, New York Lake Ontario Basin (1995).

Fisheries and Wildlife Habitat

Lakes

Surface waters also support diverse fish communities. Sport fishing is a popular pastime and economic activity throughout the Basin. The deep Finger Lakes, including Hemlock, Canadice, Canandaigua, Keuka, Seneca, Cayuga, Owasco and Skaneateles have extensive cold water habitat that supports recreational salmonid fisheries. The littoral areas of these and shallower lakes support warm water fish communities including smallmouth and largemouth bass, walleye and pike. Oneida Lake supports a renowned walleye and yellow perch fishery. Lake Ontario is a favorite destination for anglers in search of Pacific salmon, lake trout, brown trout, rainbow trout and steelhead, walleye, black bass, northern pike, and panfish. Many lakes in the Basin support ice fishing for the warmwater species.

Streams

Stream fishing is also popular in the Basin. Oatka Creek, Cayuga Inlet, East Koy Creek, Wiscoy Creek, Salmon Creek, Owasco Inlet, Skaneateles Creek, Sandy Creek and other streams support trout fisheries. Scriba Creek and Oak Orchard Creek are examples of popular destinations for walleye anglers. In early spring, runs of rainbow smelt attract anglers to the mouths of many tributaries of the larger Finger Lakes.

Basin rivers are also notable fishing waters. Recreational anglers in pursuit of chinook salmon, coho salmon, steelhead and rainbow trout heavily utilize a twelve-mile stretch of the Salmon River. The lower Genesee River supports fisheries for Pacific salmon, brown trout, steelhead, and walleye. The upper reaches of the Genesee River are fished for brown trout. The Black River supports recreational fisheries for Pacific salmon, walleye, and black bass.

Wetlands

Extensive wetlands are present in the Basin. Notable areas include the privately owned Bergen Swamp and Iroquois National Wildlife Refuge in Genesee County, Montezuma National Wildlife Refuge at the northern end of Cayuga Lake, Catharine Creek at the southern end of Seneca Lake and the High Tor Marsh at the southern end of Canandaigua Lake. There are extensive wetland areas along the Seneca-Oneida-Oswego Rivers, and the Black River. Many of the small lakes and ponds in the Black River basin are fringed with extensive wetland areas. These areas provide important habitat for resident and migratory birds as well as other wildlife species.

Water Quality Issues

Approximately 90% of the stream miles within the Basin are considered by DEC to support designated uses such as drinking water supply, swimming, and fish consumption (Figure 2-7). DEC classifies stream miles where there is a resource use concern along a continuum of impairment, from *threatened* (least degraded) to *precluded* (most degraded), with *stressed* and *impaired* as intermediate categories (Figure 2-8).

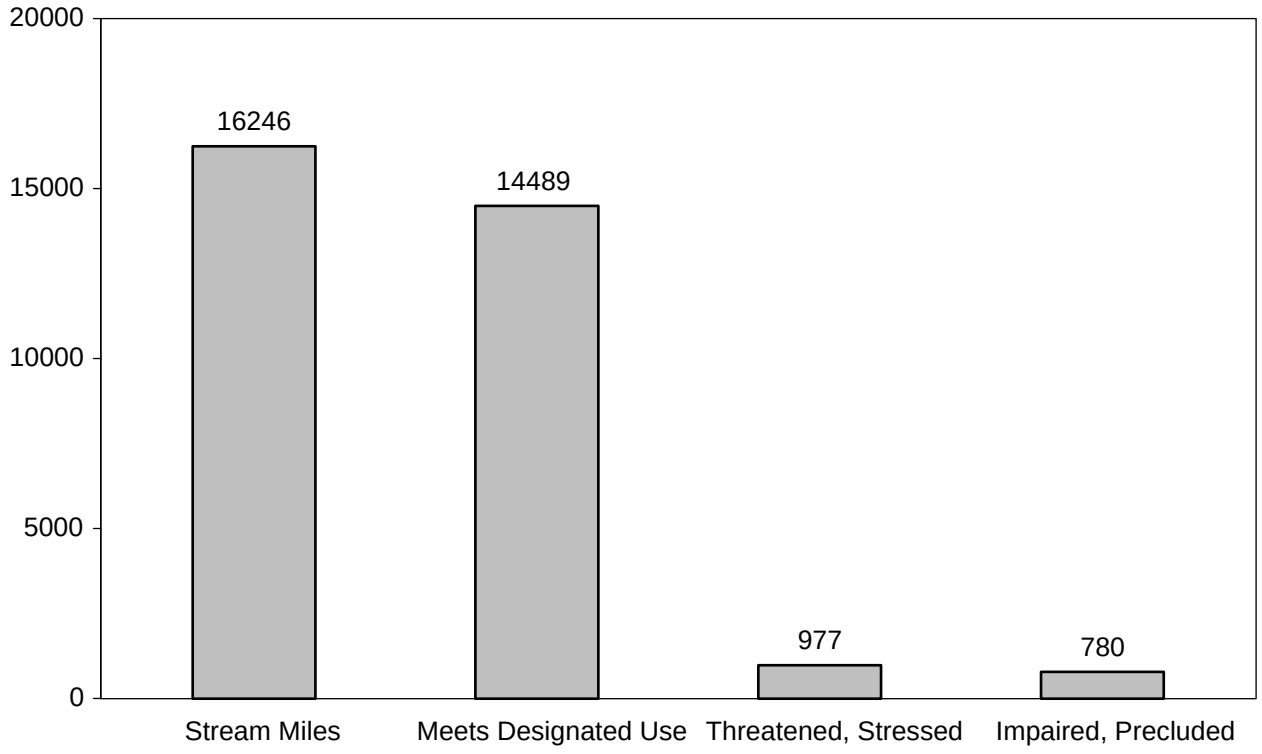

Figure 2-7. Stream miles meeting DEC designated uses, New York Lake Ontario Basin.
Source: DEC 1996

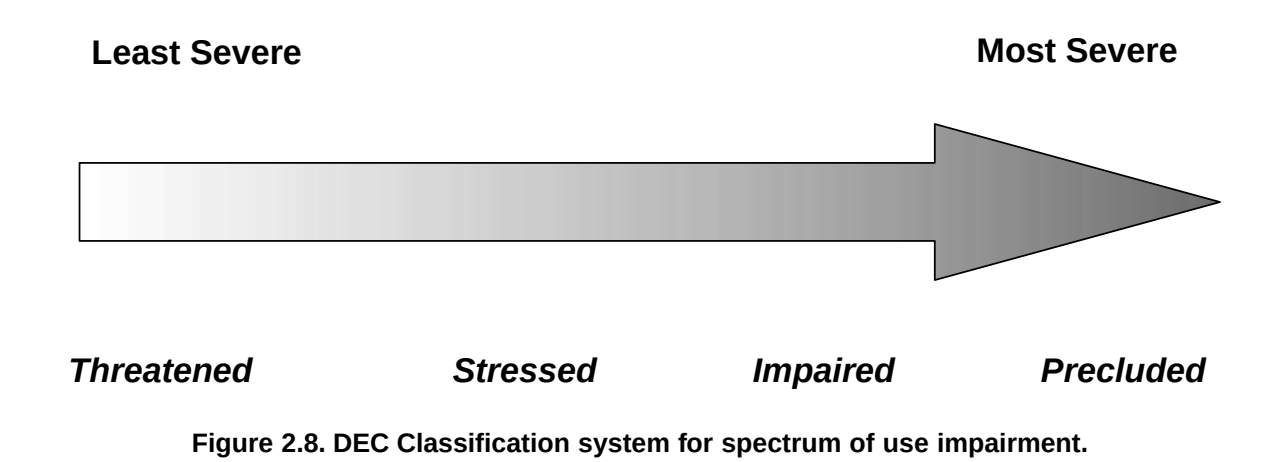

Figure 2.8. DEC Classification system for spectrum of use impairment.

Lakes or lake segments (portions of lakes) are also classified by DEC with respect to whether water quality supports designated best uses. There are approximately 220 lakes and ponds within the New York portion of the Lake Ontario Basin. Of these, 171 have at least some area that is considered impaired for its best use. The majority (142 of 171) of the affected lakes and ponds are located in the higher elevations of the Black River basin and are affected by acid deposition.

The classifications of impaired stream segments and lakes are summarized in the DEC Division of Water 1996 Priority Waterbodies List (PWL) for River Basins. The PWL identifies the primary use affected (e.g., fishing, bathing, water supply, fish consumption, or aesthetics), the primary pollutant causing impairment (e.g., silt, nutrients, pathogens, or organic compounds), and the primary source of the pollutant (e.g., stream bank erosion, municipal or industrial discharges, urban runoff, or agriculture). Listings are updated with quantitative and qualitative information from within DEC and outside sources.

The PWL indicates that nonpoint sources of pollution are the chief factor affecting the quality of streams and lakes throughout the Lake Ontario Basin. Point sources are discharges from municipalities and industries, including combined sewer overflows or CSOs. Major nonpoint sources included in the PWL are acid deposition, agriculture, streambank erosion, septic tanks, contaminated sediments, land disposal, construction, and hydrologic modification. Point sources account for less than 10% of the total affected stream miles and only about one-third of the affected lake segments (Figures 2-9 and 2-10).

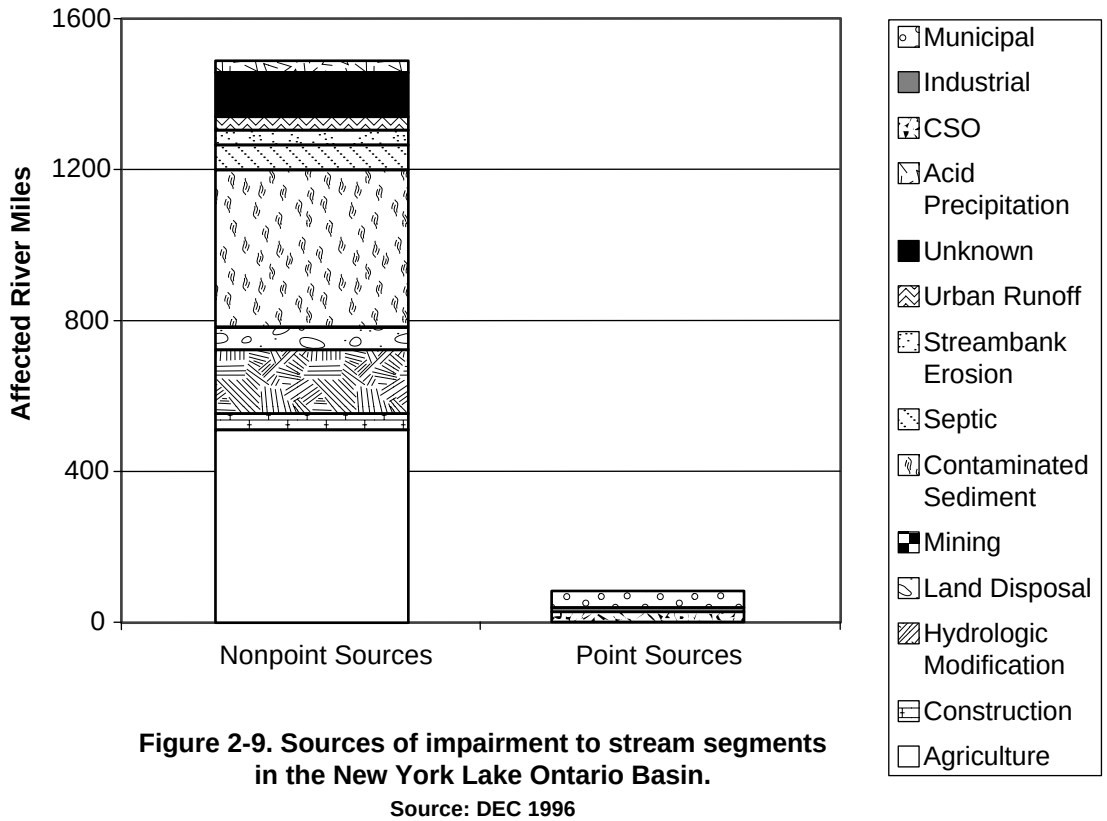

Figure 2-9. Sources of impairment to stream segments in the New York Lake Ontario Basin.

Source: DEC 1996

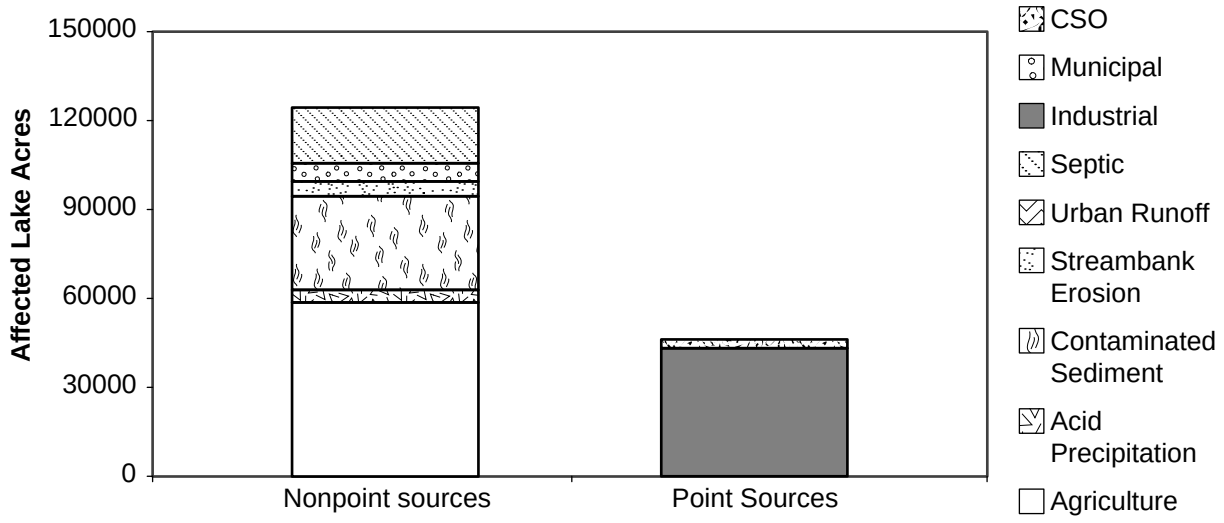

Figure 2-10. Sources of impairment to lake segments in the New York Lake Ontario Basin.
Source: DEC 1996

Chemical contamination has resulted in concentrations of contaminants in fish flesh that exceed health-based standards for human consumption in some lake and stream segments within the Lake Ontario Basin. The New York State Department of Health issues fish consumption advisories with recommended limits for particular fish species taken from affected waters. The current fish consumption advisories for the Lake Ontario Basin, including Lake Ontario, are summarized in Table 2-4.

Table 2-4. Summary of fish consumption advisories, Lake Ontario Basin.

Lake/Stream Segment	Species Affected*	Contaminant(s)	Specific Advisory
Skaneateles Creek	*Brown trout > 10″*	PCB	Eat no more than one meal/month
Keuka Lake	*Lake trout > 25″*	DDT	Eat no more than one meal/month
Onondaga Lake	*Lake Walleye** *All other species***	Mercury Mercury	* Eat none ** Eat no more than one meal/month
Canandaigua Lake	*Lake trout > 24″*	PCB	Eat no more than one meal/ month
Oswego River	*Channel catfish*	PCB	Eat no more than one meal/month
Canadice Lake	*Lake trout* *Brown trout > 21″*	PCB	Eat no more than one meal/ month
Stillwater Reservoir	*Yellow perch* *Smallmouth bass* *Splake*	Mercury	Eat no more than one meal/ month
Moshier Reservoir	*Yellow perch*	Mercury	Eat no more than one meal/month
Big Moose Lake	*Yellow perch*	Mercury	Eat no more than one meal/month
Fourth Lake	*Lake trout*	DDT	Eat none
Eighteen Mile Creek	*All species*	PCB	Eat none

Table cont. on page 16

Table 2-4. Summary of fish consumption advisories, Lake Ontario Basin. (cont.)

Lake/Stream Segment	Species Affected*	Contaminant(s)	Specific Advisory
Salmon River	*Smallmouth bass*	PCB, Mirex	Eat no more than one meal/month
Irondequoit Bay	*Carp*	PCB, Mirex	Eat none
LAKE ONTARIO	*American eel** *Channel catfish** *Carp** *Lake trout > 25"** *Brown trout > 20"** *White perch** *Chinook salmon** *White sucker ** *Smaller trout ** *Coho salmon >25"**	PCB, DDT, Mirex	*Eat none ** Eat no more than one meal/month

Source: NYSDOH 1998

Non-Indigenous Species

Invasion of ecosystems by non-indigenous species has become a problem worldwide. Travel and trade have facilitated the introduction of plant and animal species into new environments. Most exotics die quickly, but an estimated one species in ten survive in the new environment. An even smaller percentage of the invaders (less than 1%) actually thrive and can outcompete native species. In many cases, invasive species alter the processing of energy and nutrients throughout the food web. Biological invasions are the second largest cause of the loss of biodiversity, second only to habitat destruction.

Since the 1800s, at least 136 exotic aquatic organisms of all types—plants, fish, zooplankton, mollusks, and algae—have been introduced to the Great Lakes ecosystem. More than one-third of these organisms were introduced in the last 30 years, coinciding with opening of the St. Lawrence Seaway. Because of the hydrologic connection, many species introduced to the Great Lakes ultimately are found in Lake Ontario Basin lakes and streams

Some non-indigenous species have long been part of the Basin's ecosystem. Examples of nonindigenous fish species include rainbow and brown trout, chinook and coho salmon, alewife, rainbow smelt, white perch, and common carp. Introduced plant species include Eurasian watermilfoil, curly-leaf pondweed, water chestnut, and purple loosestrife. Eurasian watermilfoil has been a nuisance species in many lakes throughout the Basin, readily replacing native flora and impeding recreational uses of the waters. The water chestnut is also a nuisance species. It has been present in Sodus Bay of Lake Ontario for a number of years and is also found in the Seneca and Oswego Rivers and the western area of Oneida Lake. The Montezuma wetland at the northern end of Cayuga Lake is also vulnerable to invasion by this exotic species, and has been affected by opportunistic purple loosestrife.

Some of the most recent invaders to the ecosystem are among the most visible. The zebra mussel and the closely related quagga mussel, both dreisseneds, have spread throughout the Great Lakes and their connecting waterways, the Finger Lakes, and many major river systems of the Northeast. Native mollusks (clams and snails) are outcompeted in the presence of dreissened mussels. Water suppliers, utilities, and other water users with shallow intakes have found it necessary to employ control measures to minimize or prevent fouling. Recreational use of the waters is also adversely affected. The aquatic food web is altered by proliferation of these mussels, which remove nutrients from the water column by filtering particulate matter.

Two exotic crustaceans, the predatory zooplankton *Bythotrephes cederstroemi* (spiny waterflea) and *Cercopagis pengoi* (fishook waterflea) are recent invaders of water bodies within the Basin. Forming dense floating mats, they were first noticed when they began clogging fishing lines. Their impact on the ecosystem is not yet known. Predation by this zooplankter has the potential to affect the size distribution and composition of the plankton community. These organisms may also affect fish populations by competing with young fish for prey, or by becoming prey for older fish.

Two exotic fish have recently been confirmed in the Great Lakes and are finding their way into Basin streams and lakes. The round goby, *Neogobius melanostomus*, is an aggressive bottom-dwelling fish considered a voracious feeder. A native of the Caspian Sea, the goby was probably introduced in ballast water and is now found throughout the Great Lakes and in major river basins of the Midwest. The goby can take over prime spawning sites and will compete with native fish for habitat. The river ruffe (*Gymnocephalus cernuus*) is a small spiny perch with a high reproductive rate. This fish has been found in Lake Superior and connecting waterways.

The introduction of exotic species to the Great Lakes is an international policy issue largely in the hands of North American federal and overseas governments. Management of invasive species at the local level, where resource uses are affected by their presence, is a major activity in the Basin.

WATERSHED MANAGEMENT AGENCIES AND RESPONSIBILITIES

Water quality and watershed management activities in the Lake Ontario Basin are conducted at multiple levels of government. These multiple levels create a complex institutional framework for addressing water quality in the Basin, as discussed in more detail in Chapter Four. A brief overview of this institutional framework follows.

Great Lakes Ecosystem Level

The 1972 Great Lakes Water Quality Agreement (GLWQA) between the U.S. and Canada adopted the goal to "restore and maintain the physical, chemical and biological integrity of the Great Lakes Basin ecosystem". The Agreement, revised in 1978 to address more fully toxic contaminants in the ecosystem, outlines general and specific water quality objectives the two governments agree to meet. The Agreement is implemented through a variety of federal, state, and provincial programs and is overseen by the International Joint Commission (IJC). The IJC is a Canadian/American body created by the Boundary Waters Treaty of 1909 to advise the North American federal governments on environmental problems along their 3,000 mile-long boundary. The IJC is chartered as an independent and objective advisor to pursue the common good of both countries and the two governments. Advisory boards, control boards, and task forces on air quality, water quality, water levels, biological issues, and research activities support the IJC mission. The Environmental Protection Agency's (EPA) Great Lakes National Program Office oversees U.S. activities toward meeting the GLWQA goals. An amendment to the GLWQA in 1987 added specific water quality planning and restoration programs, such as Remedial Action and Lakewide Management Plans for Great Lakes ecosystem improvement.

The IJC lists 43 *Areas of Concern* (AOCs) within the Great Lakes ecosystem as localities failing to meet the objectives of the GLWQA and requiring remediation to restore beneficial resource uses. The 1987 GLWQA amendment called for a Remedial Action Plan (RAP) to be completed with public consultation for each AOC. Three AOCs are located in the New York Lake Ontario Basin: Rochester Embayment, Eighteen Mile Creek, and Oswego River. In all three cases, Stage 2 RAPs are completed which recommend actions to restore beneficial uses. The latter two RAPs were completed by DEC in cooperation with EPA and local stakeholders. Monroe County was the lead agency in completing the Rochester Embayment RAP in cooperation with DEC, EPA, and other local stakeholders. Following completion of the RAPs, resources are being sought for and dedicated to implementation.

Under the 1987 amendment to the GLWQA, the United States and Canadian federal governments agreed to develop a Lakewide Management Plan (LaMP) for each of the five Great Lakes. LaMPS are intended to provide a comprehensive, ecosystem approach to restoring and protecting beneficial uses in open lake waters. The Lake Ontario LaMP is being completed by the "Four Parties:" EPA, DEC, Environment Canada, and Ontario Ministry of the Environment and Energy, in consultation with the public. The Problem Definition (Stage 1) report, completed in 1998, identified six critical pollutants needing action. Strategies to address these pollutants are expected in the Stage 2 report in 2000.

There are federal non-regulatory agencies that provide technical and financial support on water resources and nonpoint source pollution issues. The United States Geological Survey (USGS) monitors the quantity and quality of surface water and groundwater. The Natural Resources Conservation Service (NRCS) of the U.S. Department of Agriculture is the primary federal agency addressing nonpoint sources of pollution.

State Level

New York has a well-developed program of water resources management, including implementing EPA regulatory initiatives as well as initiatives unique to the State. Water resources protection and restoration are central to the mission of state agencies such as DEC, DOH, Department of State Division of Coastal Resources Management, and the Soil and Water Conservation Committee. Representatives of these and other agencies participate on a New York State Nonpoint Source Coordinating Committee to improve coordination of programs

and priorities. The New York State Canal Corporation (a subsidiary of the New York State Thruway Authority) regulates and monitors water levels in the Seneca-Oneida-Oswego River basin.

Regional Level

Other regional organizations are active in watershed management in the Basin. Notable examples include the Finger Lakes-Lake Ontario Watershed Protection Alliance (FL-LOWPA), Tug Hill Commission, Adirondack Park Agency, and New York State Association of Regional Councils (NYSARC). FL-LOWPA provides funding and technical assistance for locally defined water quality programs in every county in the Basin and regional watershed projects. Several multi-county regional planning councils under the umbrella of NYSARC are active in the Basin. Programs within these regional organizations provide planning, water quality, nonpoint source pollution, and watershed management services to their constituents. Regional agencies often play an important role in providing technical and financial support to local governments, where state policies are typically implemented.

County Level

At the county level are Water Quality Coordinating Committees (WQCCs) which are responsible for defining county water quality priorities and strategies. Representatives of county Soil and Water Conservation Districts chair the majority of the WQCCs in the Lake Ontario Basin. Membership typically includes representatives from county planning and health agencies, Environmental Management Councils (EMCs), regional planning councils, Farm Service Agencies (FSAs), Cornell Cooperative Extension, municipalities, environmental organizations, citizens groups, and lake associations. Representatives of regional DEC, NYS Department of Transportation (DOT), USGS, NYSARC, and NRCS offices often participate. The composition and activity level of WQCCs varies across the Basin. County agencies (e.g., SWCD or Planning Department) often take the lead in the work of the WQCC, and where WQCCs are not especially active, county agencies fill in the voids. FL-LOWPA is a county-based organization, with representatives from 25 counties comprising its governing Water Resources Board. FL-LOWPA is closely tied to WQCCs, with FL-LOWPA representatives commonly chairing or serving as active members of their respective committees. In several cases, WQCCs determine local FL-LOWPA programs.

Subwatershed Level

A number of organizations comprised of representatives from county agencies, municipalities, local colleges and universities, interested citizens and lake associations have formed in the last decade to address land and water issues at the subwatershed level (an individual lake or stream within the Basin). Chapter 5 identifies several of these groups in case studies for particular water bodies. Such groups can be called watershed umbrella organizations, as they provide a mechanism for coordinated planning, fund raising, education and implementation efforts. They go by names such as Task Forces, Networks, Foundations, Watershed Committees, and others. Like WQCCs, they are integrative groups that bring resources from federal, state, regional, county, and municipal levels together, but use a watershed boundary to define themselves. In addition, lake associations, traditionally concerned with in-lake and recreation issues are increasingly becoming active players in watershed protection programs (e.g., Keuka, Cazenovia, and Seneca Lakes).

A summary of agencies and programs is presented in Table 2-5 (for specific contact information, see Appendix B). Most organizations working on water quality in the Basin were not set up according to hydrology. For any given hydrologic unit in the New York Lake Ontario Basin, a variety of levels of agencies and organizations may be involved, presenting the need for communication and coordination to maximize efficiency. These issues are discussed in more detail in the first portion of Chapter Five.

Table 2-5. Agencies and organizations involved in water resources management in the New York Lake Ontario Basin.

AGENCY/WEB SITE	MISSION	RELEVANT PROGRAMS
International Joint Commission **www.ijc.org**	• Advisor to U.S. and Canada on trans-boundary issues. • Oversees Great Lakes Water Quality Agreement; reports on progress toward Agreement objectives.	• More than 20 control boards, advisory boards, and task forces on water levels, water quality, air quality, and research activities. • Initiated Remedial Action Planning for Great Lakes Areas of Concern (implemented primarily by state agencies).
U. S. Environmental Protection Agency (EPA) **www.epa.gov**	• Protect human health and safeguard the natural environment.	• Great Lakes National Program Office • Lake Ontario Lakewide Management Plan (in partnership DEC, Environment Canada and Ontario Ministry of Environment) • Acid deposition program • Environmental Monitoring and Assessment Program (EMAP) • Research and development • Office of Standards (supports Clean Water Act and Safe Drinking Water Act)
U.S. Geological Survey (USGS) **www.usgs.gov**	• Water resources monitoring and investigations.	• Streamflow monitoring • Groundwater quality research and monitoring • Surface water quality research and monitoring • Resource mapping and GIS
Natural Resources Conservation Service (NRCS) **www.nrcs.usda.gov**	Conservaton of soil, water, and related natural resources. • Technical assistance and cooperative conser-vation programs to land-owners and managers.	• Conservation Technical Assistance (CTA) • Conservation Reserve Program (CRP) • Environmental Quality Incentives Program (EQIP) • Wetlands Reserve Program (WRP) • Wildlife Habitat Incentives Program (WHIP)
NYS Dept. of Environmental Conservation (NYSDEC) Division of Water **www.dec.state.ny.us**	• Protect water quality. • Regulate wastewater and thermal discharges. • Monitor waterbodies. • Control surface runoff. • Manage water availability. • Prevent flood damage. • Prevent beach erosion. • Promote stewardship and education.	• Priority Waterbodies List (PWL) • Rotating Intensive Basin Studies (RIBS) • Citizens' Statewide Lake Assessment Program • List of impaired waters (303d List) • SPDES permits • Section 319 projects (nonpoint sources) • Management conferences for priority waterbodies • Great Lakes Initiative • Remedial Action Plans • Lake Ontario Lakewide Management Plan • Resource mapping and GIS • NYS Clean Water/Clean Air Bond Act • Environmental Protection Fund
NYS Dept. of Health (Bureau of Water Supply Protection) **www.health.state.ny.us**	• Protect public health through water resources resources protection and management.	• Source Water Assessment Program (SWAP) • Water supply testing and permitting • Contaminant monitoring and fish advisories

Table cont. on page 20

Table 2-5. (cont.)

AGENCY/WEB SITE	MISSION	RELEVANT PROGRAMS
NYS Dept. of State, Division of Coastal Resources Management **www.dos.state.ny.us**	• Provide technical and financial assistance to local government in coastal areas. NY coastal areas: Shorelines (NYC, LI) Major inland waterways: Finger Lakes, Great Lakes, Hudson, St. Lawrence, and Niagara Rivers.	• Watershed Planning • Coordinating government actions • Coastal resources information • Remote sensing, GIS • Coastal erosion, flooding, dredging, nonpoint sources • Clean Vessel Act • Waterfront Revitalization • Distribute Clean Water/Clean Air Bond Act and Environmental Protection Fund grants to local governments
NYS Canal Corporation **www.canals.state.ny.us**	• Monitor and regulate water levels in the Seneca-Oneida-Oswego River basin	• Water level management for Cayuga, Seneca, Keuka, Oneida, Otisco, Owasco, Skaneateles, and Canandaigua Lakes and NYS Barge Canal through 7 control points.
NYS Soil and Water Conservation Committee **www.agmkt.state.ny.us**	• Lead NY agency for agricultural nonpoint source management • Develop and oversee implementation of Soil and Water Conservation District programs	• Agricultural Environmental Management (AEM) • NYS agricultural nonpoint source abatement and control. Competitive grant fund for County Soil and Water Conservation Districts. Funding source is Environmental Protection Fund and Clean Air/Clean Water Bond Fund.
Cornell Cooperative Extension **www.cce.cornell.edu**	Education and outreach in resource management. Draws on research and experience.	• Agriculture, Forestry, Fish and Wildlife • Water resources, quantity and quality • Environmental education
Finger Lakes-Lake Ontario Watershed Protection Alliance (FL-LOWPA) **www.fllowpa.org**	Protect and improve water quality basin-wide through programs based on local needs; information exchange; cooperative watershed management; and an ecosystem perspective. Work is done primarily through county departments.	• Develop and implement water quality programs to meet local needs. • Promote communication among counties and other Basin stakeholders. • Technical and financial support for monitoring, nonpoint source pollution controls, watershed planning, community education. • Public education and outreach.
NYS Assoc. of Regional Councils (NYSARC) **www.albany.net/~cdrpc/nysarc.html** Regional Planning Boards: Central NY, Genesee/Finger Lakes, Southern Tier Central, East, and West and Herkimer-Oneida	Address multi-county issues, provide comprehensive planning services; facilitate intergovernmental coordination and cooperation and information sharing; water resources program.	Water resources program areas: • Local groundwater and wellhead protection • Public participation in state water quality policy development • Nonpoint source pollution abatement • Watershed planning • General water resources planning and management
County Water Quality Coordinating Committees (or equivalent)	• Define priorities • Coordinate among multiple stakeholders	• Provide input into Priority Waterbodies List • Monitoring and assessment programs • Develop/update county water quality strategies
Watershed Umbrella Organizations	• Pool technical and financial resources to advance watershed initiatives	• In-depth local watershed assessments • Comprehensive watershed plans • Community outreach • Local policy development

CHAPTER THREE

RIVER BASIN AND DIRECT DRAINAGE AREAS PERSPECTIVES

INTRODUCTION, FRAMEWORK, AND METHODS

As introduced in Chapter One, the major river basins and direct drainage areas of the New York Lake Ontario Basin were selected as units of analysis for this study. These holistic watershed units were selected primarily because, within them, creeks, ponds, lakes and rivers are connected as water flows and transports materials from upstream areas downstream toward Lake Ontario[1]. It is useful for FL-LOWPA and its watershed partners to know the status of water quality and water resources management priorities in the river basins and direct drainage areas to help define and target future local water resources management efforts that can have beneficial impacts at the larger scale. Lost in an assessment at the river basin scale is detailed information pertaining to individual counties, municipalities, subwatersheds or other units of local interest. Chapter Five offers detailed information on several case study programs of interest. Therefore, Chapter Three offers a big picture analysis of water quality and aggregate management priorities in the Seneca-Oneida-Oswego River, Genesee River, Black River basins and three Direct Drainage Areas while Chapter Five gives more specific information on local applications, programs and progress.

Ecoregions and an Ecosystem Approach

Three ecological provinces and 16 subsections or ecoregions characterize the Lake Ontario Basin in New York (Appendix A). Ecoregions are regional-scale ecological communities, large assemblages of plant and animal populations that share a common environment. These assemblages form a complex mosaic in the landscape. These ecological communities respond to gradients both spatially and temporally and form a continuum of changing communities as environmental characteristics such as climate, landforms, soils, vegetation, hydrology, and wildlife change. The boundaries of these communities have been drawn artificially for the purposes of classification along areas where change occurs very abruptly. The boundaries, therefore, delineate areas that exhibit broad ecological unity (Rescke 1990). The large number of ecoregions attests to the regional diversity and richness within the Basin.

The concept of an ecosystem approach to the management of the Great Lakes has been developed through the joint work of Canada and the United States. The countries' goal is to understand how environmental quality is affected by interactions between land, air, water, and human uses of natural resources in the Basin. An ecosystem perspective develops through the participation of multiple levels of government, industry, and non-government organizations. Those managing the New York side of the Lake Ontario Basin can take a more detailed, local view of resource issues while maintaining an ecosystem perspective. Understanding the ecoregions of the Basin and its subwatersheds is fundamental to watershed planning with an ecosystem perspective.

DEC Water Quality Status Assessments in River Basins and Direct Drainage Areas

DEC is responsible for monitoring the state's surface water resources. DEC classifies surface water bodies by segments (portions of a stream or lake) according to designated "best use", such as water supply, swimming, fish propagation, aesthetic enjoyment, and fish survival (Table 3-1). Best use designations are assigned based on current uses of the resource and potential desired uses with reasonable improvements to present conditions. Therefore, the best use designation represents resource goals tempered by existing impairments, and reflects DEC's best professional judgment for a water body segment. Designated best uses are assigned to each surface water segment.

Table 3-1. Surface water resource classifications are based on "best use" as defined by DEC[†].

Best Use	Classification
• Water supply	A, AA
• Bathing	B, SB, and higher stream classes
• Fish propogation	C, SC, CT, and higher stream classes
• Fish survival	D, SD
• Fishing	All Waters
• Boating	All Waters
• Aesthetics	All Waters

[†]Best uses are arranged hierarchically so that Classifications of AA or A indicate highest water quality status.

[1]Analyses for the Direct Drainage Areas are obscured in that these three watersheds are physically distinct, related only in that they each drain directly to Lake Ontario.

DEC monitors and reports on the extent to which the designated best uses are being met in surface water bodies. Water bodies that do not consistently meet their designated best use, or for which changes in land use threaten water quality, are placed on DEC's Priority Waterbodies List (PWL). Updated on a cyclical schedule, WQCCs and other entities provide input to the PWL as an increasing amount of quantitative information becomes available from more localities.

DEC ranks water body segments on the PWL according to the degree to which designated best uses are impaired by water quality conditions. The term "use impairment" means that the best use for the water body (e.g., swimming) has in some way been diminished in value. A scale representing the degree of impairment to best uses is defined from least to most severe:

- **Threatened:** Water quality supports the water body's designated use and the ecosystem exhibits no obvious signs of stress, however existing or changing land use patterns may result in future ecosystem disruption and use restrictions.
- **Stressed:** Water body use is not significantly limited or restricted, but occasional conditions discourage use.
- **Impaired:** Occasional water quality conditions periodically prevent use, or frequent and persistent conditions discourage use, or some aspect of use is limited or restricted, or use requires advanced measures or treatment.
- **Precluded:** Frequent, persistent water quality conditions prevent all aspects of the designated use.

The latest update of the PWL also rates the resolution potential (for water quality problems) as high, medium, or low. According to DEC (1996), "High resolution potential indicates that the water quality problem has been deemed to be worthy of the expenditure of available resources (time and dollars) because of the level of public interest and the expectation the commitment of these resources will result in a measurable improvement in the situation." Segments with low potential for resolution indicate water quality problems so persistent that improvement is expected to require an unrealistic commitment of resources, not likely to become available (e.g., lakes degraded by acid deposition).

There is a subset of the PWL called the 303(d) list or PWL-Total Maximum Daily Load (TMDL) list. The 303(d) list is named for the section of the federal Clean Water Act that requires states to report to EPA those water bodies failing to meet water quality standards and requiring a watershed approach to water quality protection and restoration. The PWL-TMDL is used in situations where DEC determines that standard technology for pollution control is not sufficient to attain water quality standards. The list includes priority waters in the state identified for TMDL development.

New York State Unified Watershed Assessment

In 1998, all the watersheds in New York State were categorized through a Unified Watershed Assessment (UWA) process under the federal Clean Water Action Plan. The purpose of the UWA was to assess the relative water quality conditions of watersheds statewide, and determine eligibility for Section 319 funding under the Clean Water Act. The primary source of information used to determine the UWA was the PWL, based primarily on the two most impaired PWL categories ("impaired" and "precluded").

Reporting Water Quality for the River Basin/Direct Drainage Unit of Analysis

To characterize water quality status in each of the major river basins and direct drainage areas, DEC assessment data discussed above was merged. The 1996 PWL list does contain some inherent limitations in that it is a general list based on a mix of quantitative and anecdotal information. It is not as detailed as data sets for many specific localities, however, at the time of this study, it was the only reasonably accessible and consistent data set that allowed comparisons across the 25-county study area and at the river basin unit of analysis. A more intensive study on a smaller scale (e.g., for each major river basin, direct drainage area, or for subwatersheds for individual lakes, streams and bays) should consider more fully all available data.

To check the validity of the use of the 1996 PWL in this study, listed water bodies were compared against WQCC priorities indicated in county water quality strategies. There were some differences in listings (with segments either added or subtracted at the county level) and some changes in degree of severity assigned or pollutant sources identified for a particular water body. Several counties in the study update their water quality strategies with more frequency than DEC updates the PWL, accounting for some differences. With generally few exceptions, there was a strong coincidence between the PWL and county strategies, supporting the use of PWL data for this study. DEC has identified means for improving the statewide PWL (Myers 2000), increasing its value to future studies.

Assessing Priorities of Local Water Quality and Watershed Management Agencies

A combination of focus group interviews and written questionnaires was used with representatives of each of the counties in the study area in 1998 to assess local roles in water resources management. The assemblage of local representatives was coordinated in each county by the respective FL-LOWPA member, usually in connection with a meeting of the WQCC. The group interviews varied from county to county as to the number and types of representatives. Throughout the Basin, counties were typically represented by Soil and Water Conservation Districts, Cornell Cooperative Extension, county health and planning departments, consultants, municipalities, solid waste and public works departments, local elected officials, Natural Resource Conservation Service, Farm Bureau and Farm Services Agency, Environmental Management Councils (EMCs), watershed organizations, lake associations, and special interest groups.

The written questionnaire was used to gather information about local agency services and programs, priorities, and commitments of staffing to priorities. Data from other survey questions pertaining to watershed planning, stakeholder involvement, and watershed assessment are reported in Chapter Five. Each respondent was asked to respond from the perspective of his or her home agency or organization.

Gap Analysis: Congruence between Impairments and Local Program Priorities

A ***gap analysis*** was constructed by examining the extent to which local agency priorities in each basin were aligned with resource-based priorities defined by water resource impairments. Ideally, the aggregate local agencies' priorities and targeting of staff resources would match up well with the water quality impairments and priorities indicated by the PWL for the river basins and direct drainage areas.

CHAPTER THREE, SECTION A:

SENECA-ONEIDA-OSWEGO RIVERS BASIN PERSPECTIVE

DESCRIPTION OF THE RIVER BASIN

The Seneca-Oneida-Oswego Rivers basin encompasses 5,100 square miles (Figure 3A-1). Among the significant water resource features in this basin are seven Finger Lakes, Oneida and Onondaga Lakes, and a major segment of the New York State Barge Canal that incorporates the Clyde, Seneca, Oneida and Oswego Rivers. Surface water generally drains northward to the Seneca River from the Finger Lakes and Onondaga Lake. The eastern portion of the watershed drains to Oneida Lake and eventually to the Oneida River, where it merges with the Seneca River (at the Three Rivers Junction) to form the Oswego River flowing north to Lake Ontario. The Oswego River/Harbor at Oswego, New York, is designated by the IJC as one of the 42 Great Lakes Areas of Concern. The major metropolitan area of Syracuse lies within the watershed, as do the smaller cities of Auburn, Ithaca, and Oswego.

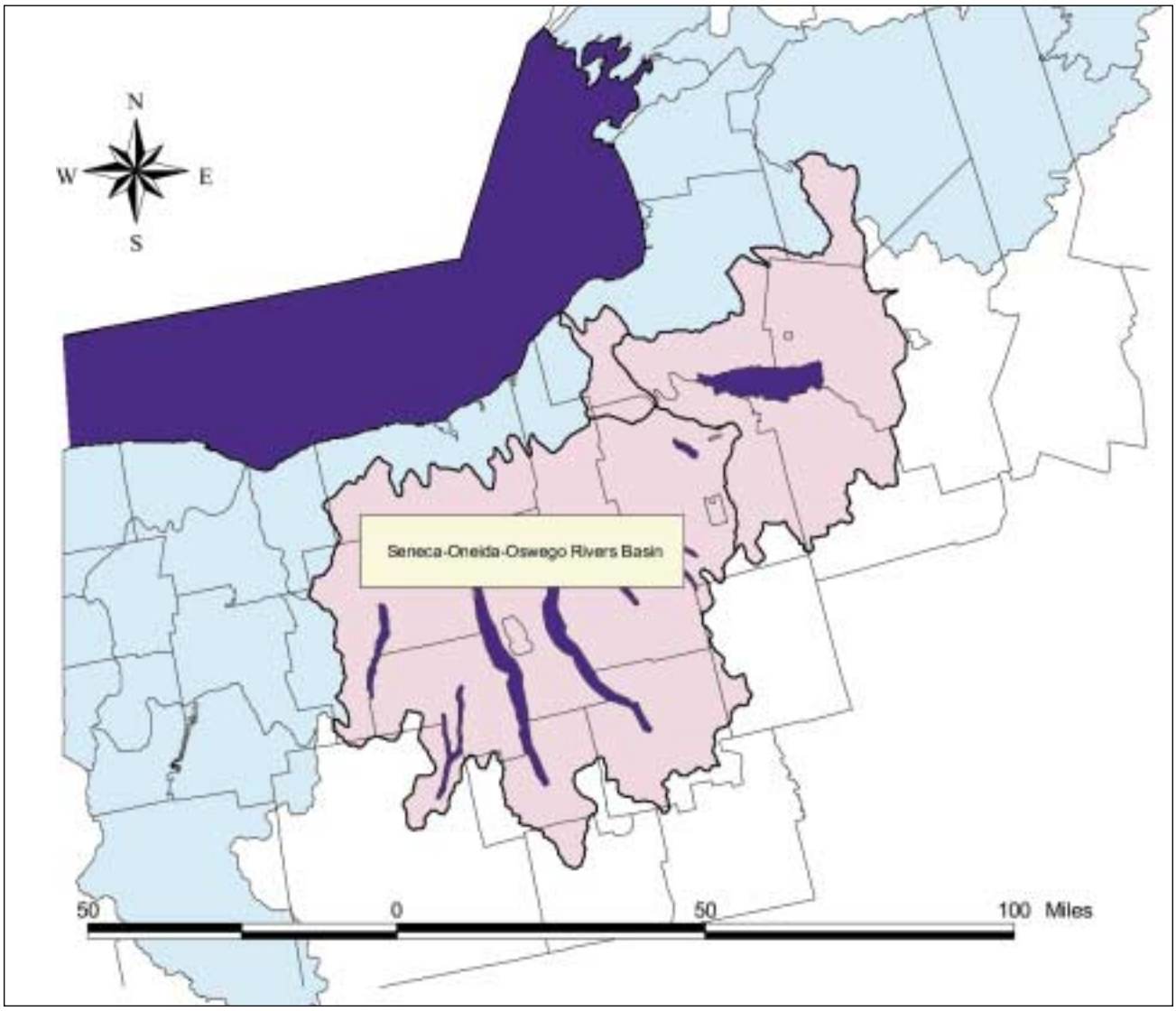

Figure 3A-1 The Seneca-Oneida-Oswego Rivers Basin.

History and Human Population

The Seneca, Cayuga, Onondaga and Oneida nations of the Iroquois Confederacy populated the Seneca-Oneida-Oswego Rivers region up to the late 16th and mid-17th centuries (Grymont 1988). Dutch and English settlers began to move north of Manhattan into upstate New York in the late 1700s. By the early 1800s, there was keen competition for favorable locations for agricultural and industrial production and trade. Some of the very early industries were set up throughout the Finger Lakes region, and many new villages were formed. The population of the area increased significantly after 1823 when the section of the Erie Canal linking Rochester to Albany was opened. The full length of the canal was opened in 1825, connecting Lake Erie (and the rest of the Great Lakes) to the Hudson River. The population of cities like Syracuse grew, with neighboring Onondaga Lake serving as a popular summer resort area for swimming, boating and fishing from the 1880s until around 1920. Agriculture, primarily the production of fruits and vegetable crops, expanded during the last half of the 19th century, particularly in the Finger Lakes and Oneida Lake Plain areas. This period represented the height of agricultural production throughout the Seneca-Oneida-Oswego Rivers basin.

The region's human population continued to increase in the beginning of the twentieth century, as railroads became fully operational. Tourism and recreational uses of area lakes increased, leading to extensive shoreline development marked by cottages and second homes.

To keep up with competition from railroads, the Erie Canal was widened and deepened in 1905 and many of the rivers along the route were incorporated into the canal system, including the Clyde, Oneida, Oswego, Mohawk, and Seneca. The new system comprised the expanded Erie Canal, the Cayuga-Seneca Canal between Cayuga and Seneca Lakes, the Oswego Canal from Syracuse to Oswego, and the Champlain Canal from Albany to Lake Champlain. This expanded system, called the New York State Barge Canal System, opened in 1918.

Other transportation links that encouraged growth in the basin were the completion of the St. Lawrence Seaway and New York State Thruway and improvements to secondary roads in the late 1950s. The St. Lawrence Seaway linked the Great Lakes with the Atlantic Ocean, spurring growth of the port city of Oswego. The Thruway increased access to the Thousand Islands and the Adirondacks, which reduced recreational interest in Onondaga Lake, already degraded by industrial discharges. With the Finger Lakes more accessible by automobile, population growth continued from the 1950s to the 1970s.

After the 1970s the trend in population growth slowed (and in some counties, such as Seneca, actually declined), yet development close to lakes intensified. During this period, many of the earlier summer homes were converted to year-round use. New development included lake-view areas, increasing pressures on wetlands, agricultural lands, and areas with steep slopes.

The 1990 census shows the population for the entire basin is about 974,000, averaging 192 persons per square mile—the second highest population density of the major basins in the New York Lake Ontario watershed.

Land Use

Major land cover/uses in the Seneca-Oneida-Oswego Rivers basin include agriculture (48%), forest (36%), waters and wetlands (9%), and urban (7%) (Figure 3A-2). The nearly 2,400 square miles of agriculture are divided between horticultural crops (e.g., vineyards, fruit trees, berries), row crops (e.g., corn, sorghum, soybeans), close-grown crops (e.g., wheat, oats), hayland (e.g., grass, legumes), pastureland (e.g., grass, legumes), and other cropland (e.g., summer fallow and other unplanted cropland). In the 7% of the region categorized as urban land use, the largest proportion of that area is residential (3% of the basin). Since the 1980s there has been a gradual trend toward urbanization, with a resulting decline in forests and acres in agriculture.

Employment

The three largest employment sectors in the Seneca-Oneida-Oswego Rivers basin are professional (28%), retail (17%), and manufacturing (17%). Three percent of the labor force is employed in agriculture, while six percent work in construction (Figure 3A-3).

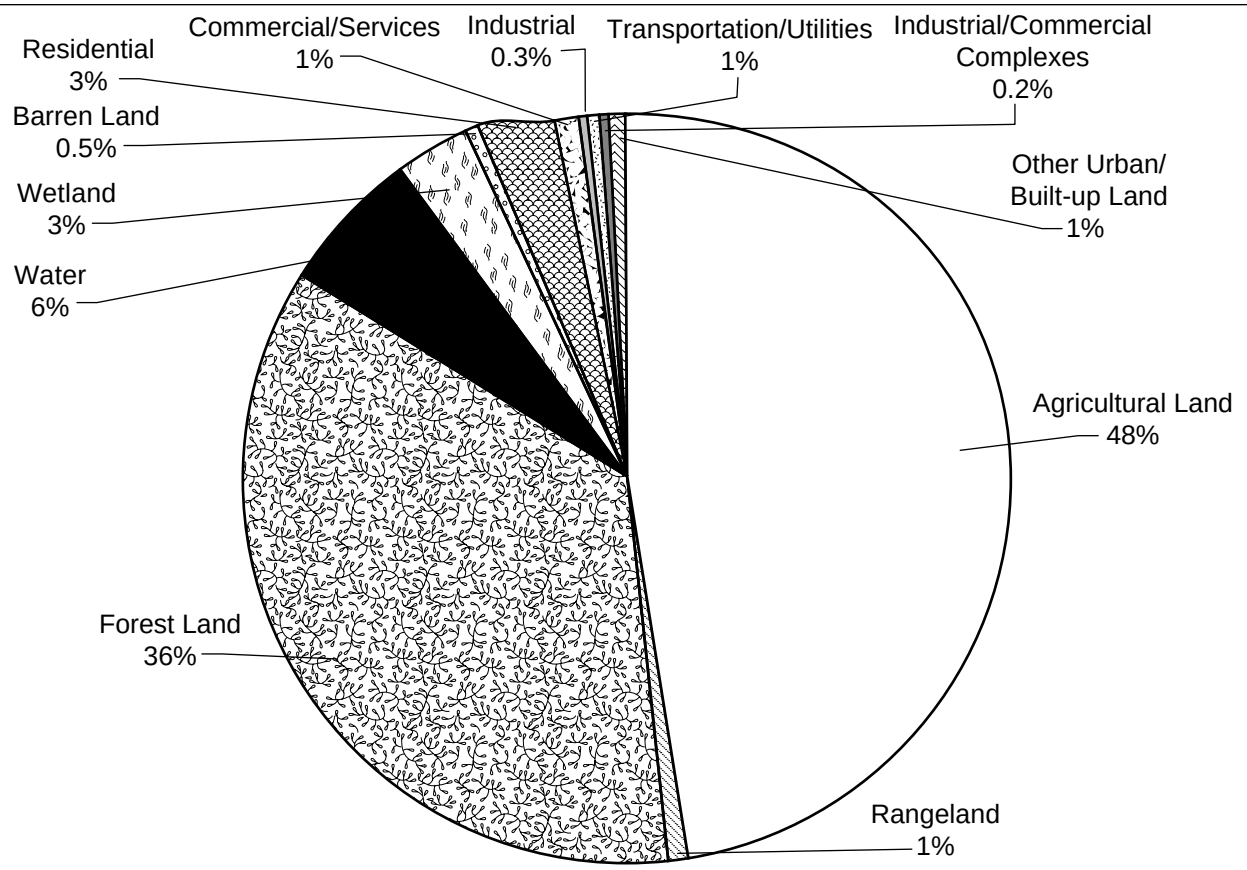

Figure 3A-2. Land use/land cover, Seneca-Oneida-Oswego Rivers basin.

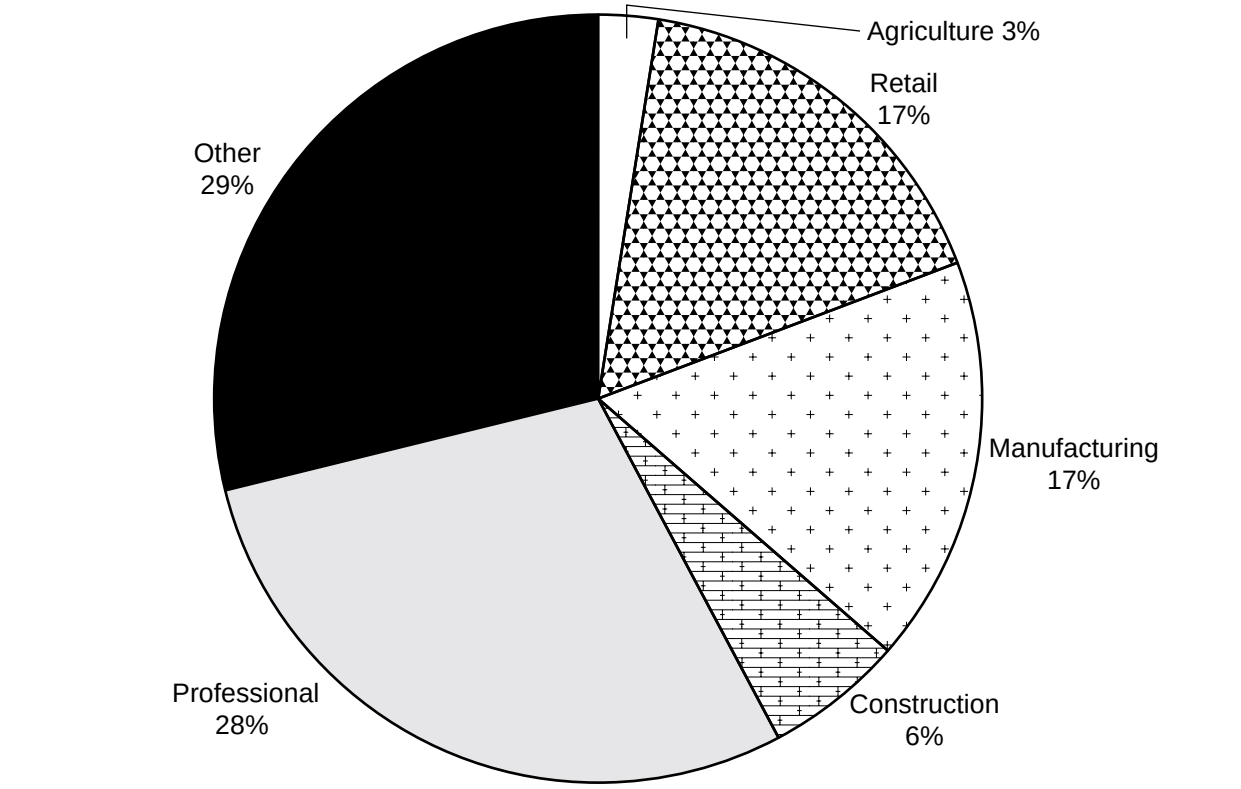

Figure 3A-3. Employment distribution in the Seneca-Oneida-Oswego Rivers basin.

Significant Features

The Seneca-Oneida-Oswego Rivers basin is rich with diverse cultural, geological, and hydrological resources. Syracuse is the major cultural and urban center of the watershed. It is located in the geographic center of New York State and is a transportation hub. The City is home to many fine examples of architecture representing various genres (e.g., the Niagara Mohawk and Gridley buildings). The City is also recognized for historic preservation and revitalization through re-use (e.g., Armory Square), and cultural attractions (such as Everson Museum of Art, a symphony, and an Urban Cultural Park program). The City and Onondaga County have plans to restore Onondaga Lake, and promote further economic development along its waterfront area, linking it to downtown.

Oswego is the second largest urban area in the watershed and a major shipping port. It is the oldest freshwater port in North America, and was a major shipbuilding center in the early 1900s. Oswego is the first port of call on the Great Lakes for ships coming through the St. Lawrence Seaway. The Oswego River flows through the City to Lake Ontario and was once a principal mode of transportation in the watershed.

While the Erie Canal's impact on the early social and economic development of cities like Syracuse and Oswego was significant, today's New York State Barge Canal System is considered more of a promising regional recreational and cultural resource. This transformation was spurred by a number of planning initiatives, such as the New York State Canal Recreational Commission under the 1994 New York State Thruway Authority, and input from counties bordering the canal for incorporation into the statewide New York Canal Recreational Plan. These initiatives seek to encourage economic development in communities bordering the canal, provide a regional framework to guide tourism and recreational use of the canal resources, and ensure historic preservation of the old canal system.

Water Level Management, Geology and Ecoregions

The NYS Barge Canal System also plays a key role in water resources management in the Seneca-Oneida-Oswego Rivers watershed. In particular, water level management, an issue hotly debated for decades is closely tied to the Canal System. The New York State Canal Corporation regulates water flow in the canal for navigation through a series of seven locks within the system. The Canal Corporation also aims to minimize flooding while providing sufficient levels for other resource uses in the watershed, including recreation, hydropower, wastewater assimilation and public drinking water supplies. The Canal Corporation coordinates with municipal authorities responsible for regulating water outflows from upstream lakes within the watershed (i.e., Canandaigua, Keuka, Seneca, Cayuga, Otisco, Owasco, and Skaneateles). Oneida Lake levels are regulated directly by the Canal Corporation. Water levels in these lakes are regulated in accordance with rule curves showing minimum and maximum levels for navigation and target levels (Figure 3A-4). The challenge of managing water levels in this basin is compounded by the fact that the canal system runs along a particularly flat and low-lying corridor. This low gradient corridor is the result of regional geology and glaciation. During the last Ice Age (ending about 14,000 years ago), glaciers carved out erodible shale between the Lockport Dolomite bedrock ridge to the north and the Onondaga Limestone bedrock ridge to the south. The resulting "trough" is conducive to a transportation route, but the hydrological system does not adequately accommodate large amounts of runoff or inputs from higher elevation lakes after storms. Relatively frequent flooding is the result (Kappel and Landre 2000).

The challenge for the Canal Corporation is to maintain optimal water levels for diverse water uses under changing watershed conditions. The Canal Corporation's management goals include lowering water levels in the fall, after the navigation season, to provide storage capacity for anticipated spring runoff. During the winter the Corporation attempts to keep water levels as low as possible while maintaining sufficient levels for water supplies and other needs. During the spring, low levels (for storage) are maintained for as long as possible to accept heavy runoff, but then levels are gradually increased to ensure summer conditions are above the minimum low water curves. During the summer, the Canal Corporation tries to balance the available water supply with other recreational demands.

Three ecoregions characterize this basin. They are the Erie/Ontario Lake Plain; Tug Hill Plateau (the northeast portion of the basin), and Northern Glaciated Allegheny Plateau. The majority of the basin, including the central Finger Lakes, falls into Eastern Ontario Till Plain subsection. The headwaters area (i.e., Cayuga Inlet, Six Mile Creek, Buttermilk Creek, Catharine Creek) and associated falls and escarpments are located in the Cattaraugus/Finger Lakes and Moraine and Hills subsection (Appendix A).

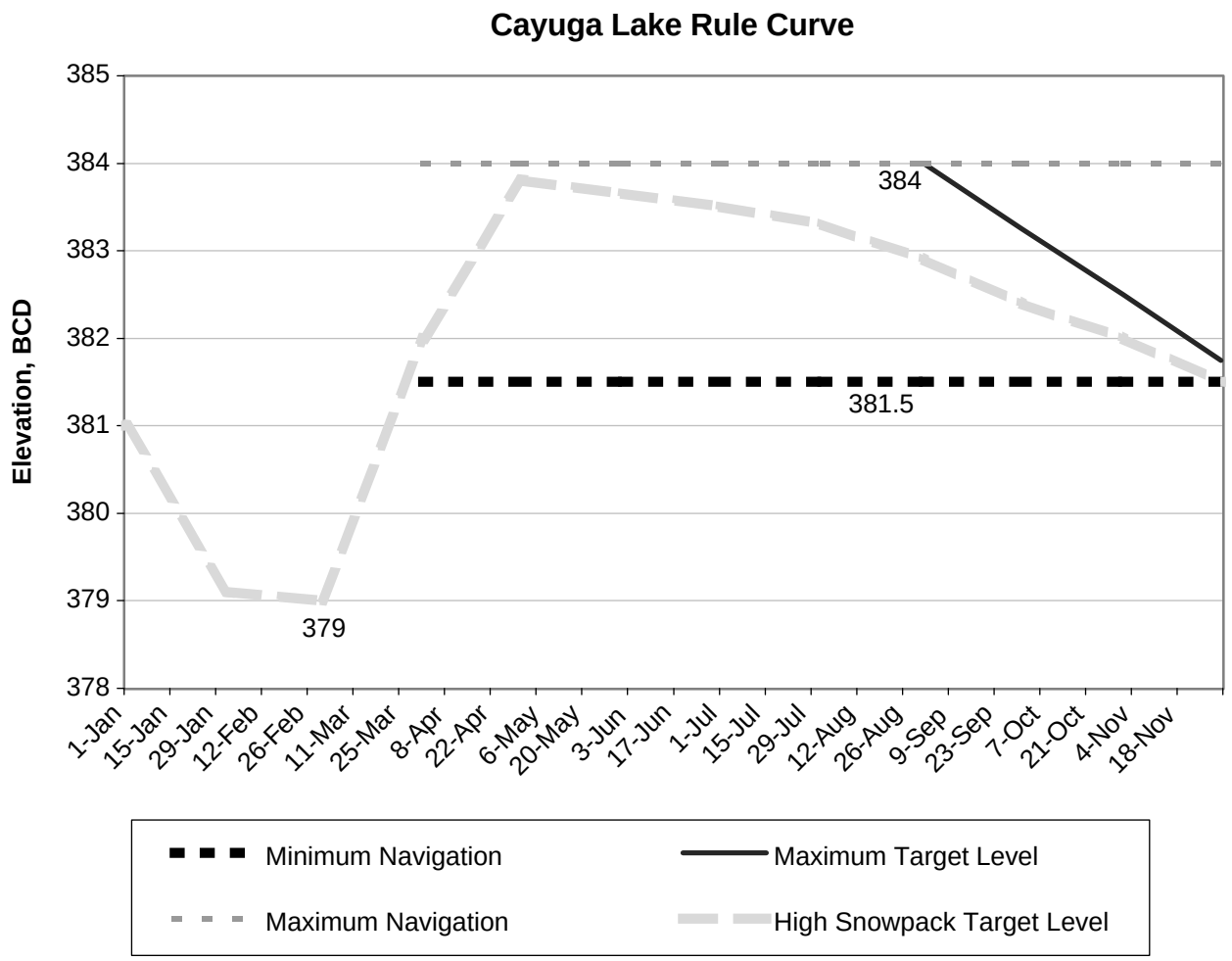

Figure 3A-4. Rule curves guide water level management in the larger Finger Lakes to balance multiple use.

WATER QUALITY STATUS

Extent of Impairment

According to DEC, about 173 stream miles and 21 water bodies are included on the PWL in the Seneca-Oneida-Oswego Rivers basin (Figure 3A-5). The more degraded PWL-TMDL stream areas represent about 2.7 percent of the total (6,446) stream miles in the basin. The majority of the listed segments are in the Seneca River subwatershed (133 miles) while 12 miles are in the Oswego River subwatershed and 29 are in the Oneida River subwatershed.

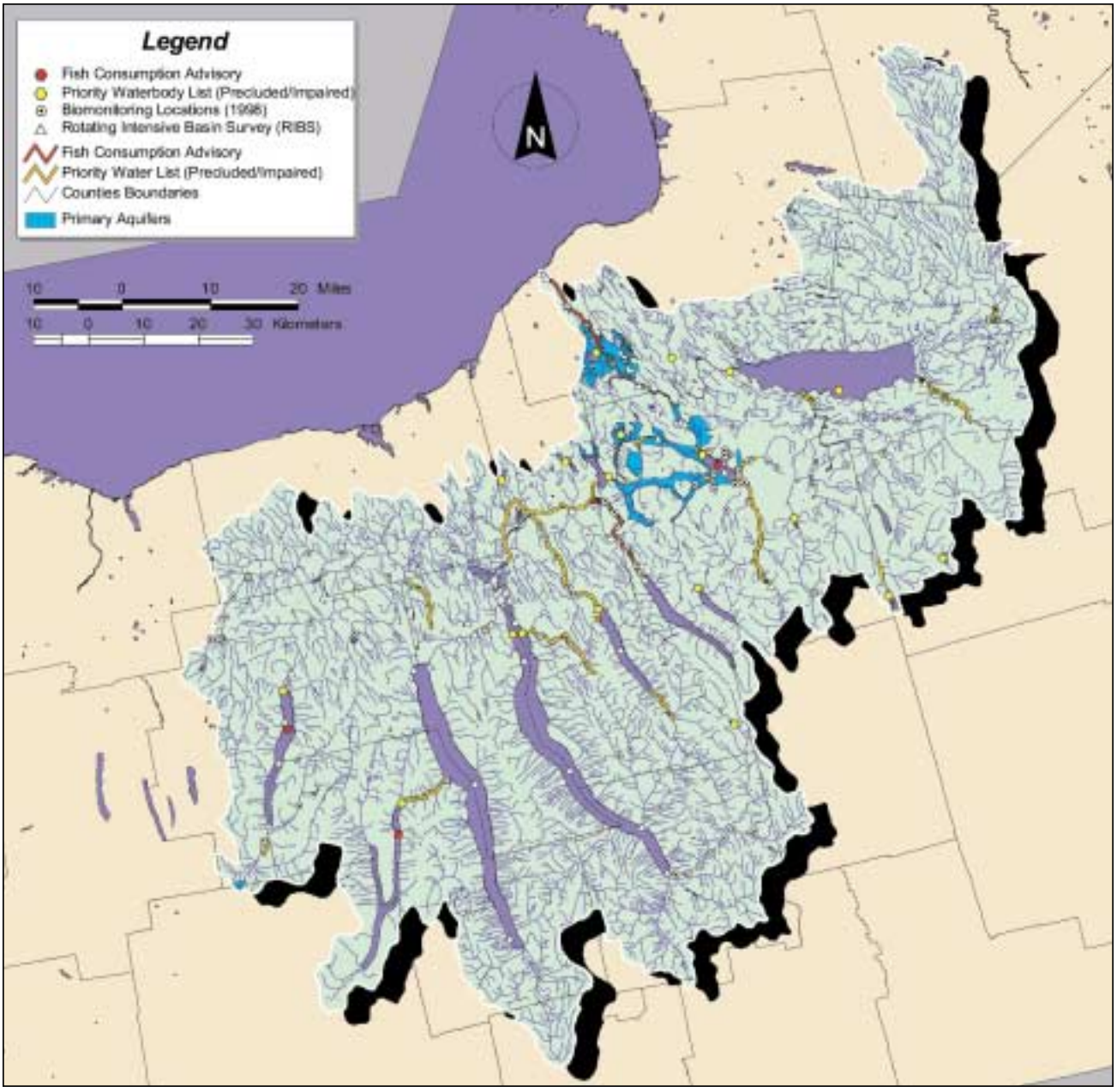

Figure 3A-5 Water body segments classified as Impaired or Precluded in the Seneca-Oneida-Oswego Rivers basin, DEC Unified Watershed Assessment (1998).

Sources of Impairment

Primary causes of impairment to lakes in the Seneca-Oneida-Oswego Rivers basin are agriculture (affecting over 40 percent of PWL lake acres); industry (affecting 22 percent of PWL lake acres), contaminated sediments and on-site septic systems (affecting 16 and 12 percent, respectively) (Figure 3A-6). Streams and rivers listed on the PWL in this basin are affected by a variety of sources. Agriculture affects 44 percent of stream and river miles on the PWL, while on-site septic systems affect 11 percent and hydrologic modification and streambank erosion each affect nine percent of PWL stream miles (Figure 3A-7).

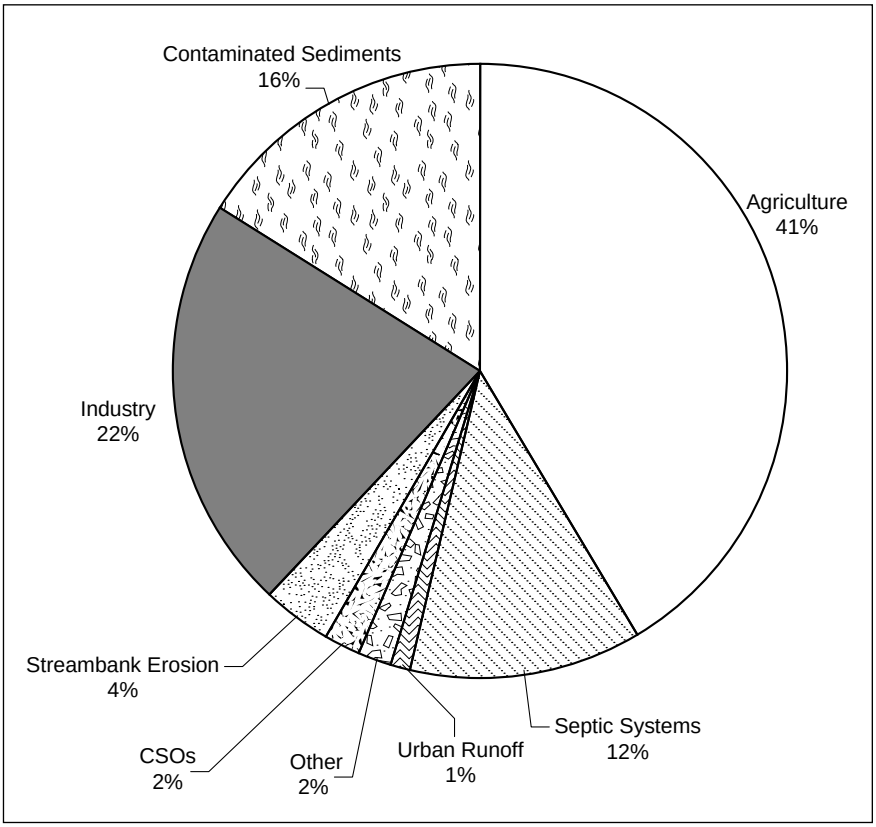

Figure 3A-6. Primary causes of use impairment for lakes of the Seneca-Oneida-Oswego Rivers basin.
Source: DEC 1996

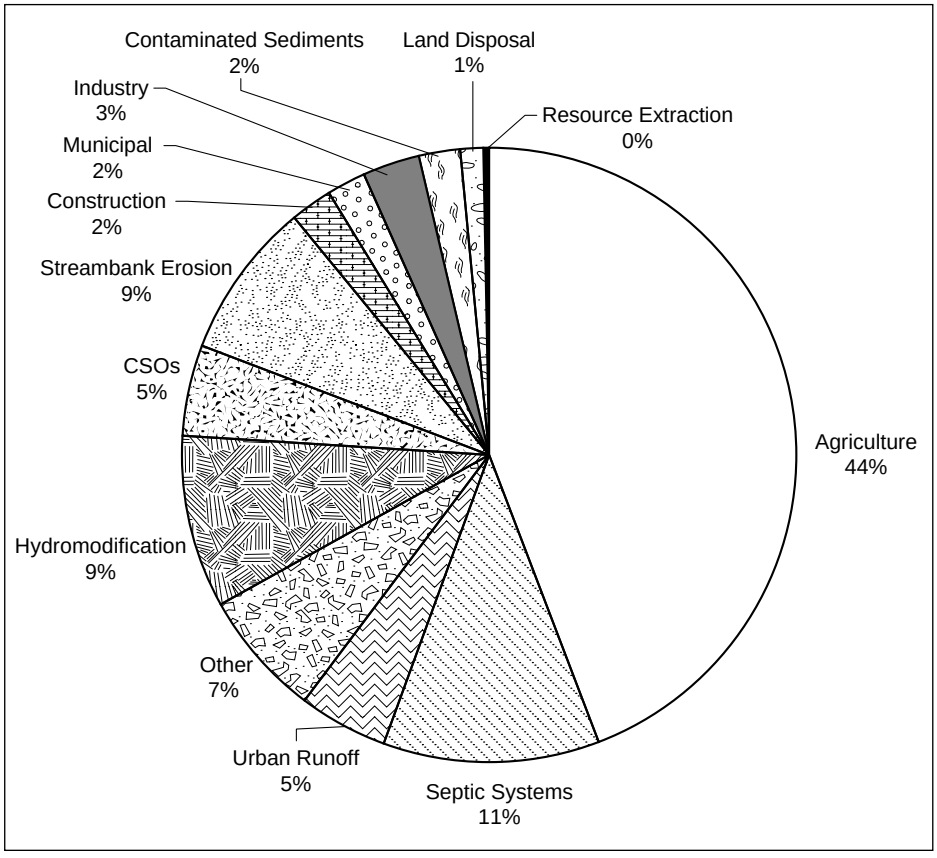

Figure 3A-7. Primary causes of use impairment for rivers and streams in the Seneca-Oneida-Oswego Rivers basin.
Source: DEC 1996

Lakes in the precluded category in the Seneca-Oneida-Oswego Rivers basin are affected largely by combined sewer overflows (CSOs) and industrial sources. The most serious impairments result from discharges to Onondaga Lake. The primary sources of impairment for lake acres classified as impaired are agriculture, contaminated sediment, and failing septic systems (Figure 3A-8). Primary sources of impairment for river and stream miles in this basin include agriculture, hydrologic modification, CSOs, streambank erosion, failing septic systems, and contaminated sediment. There are also a number of sources (e.g., industrial, municipal, construction, land disposal. and urban runoff) affecting fewer stream and river miles, and a relatively large number of miles affected by unknown sources (Figure 3A-9). Overall, agriculture is responsible for the greatest number of segments listed in the PWL in this basin, followed by industrial inputs, contaminated sediments, septic system inputs, stream bank erosion, and CSOs.

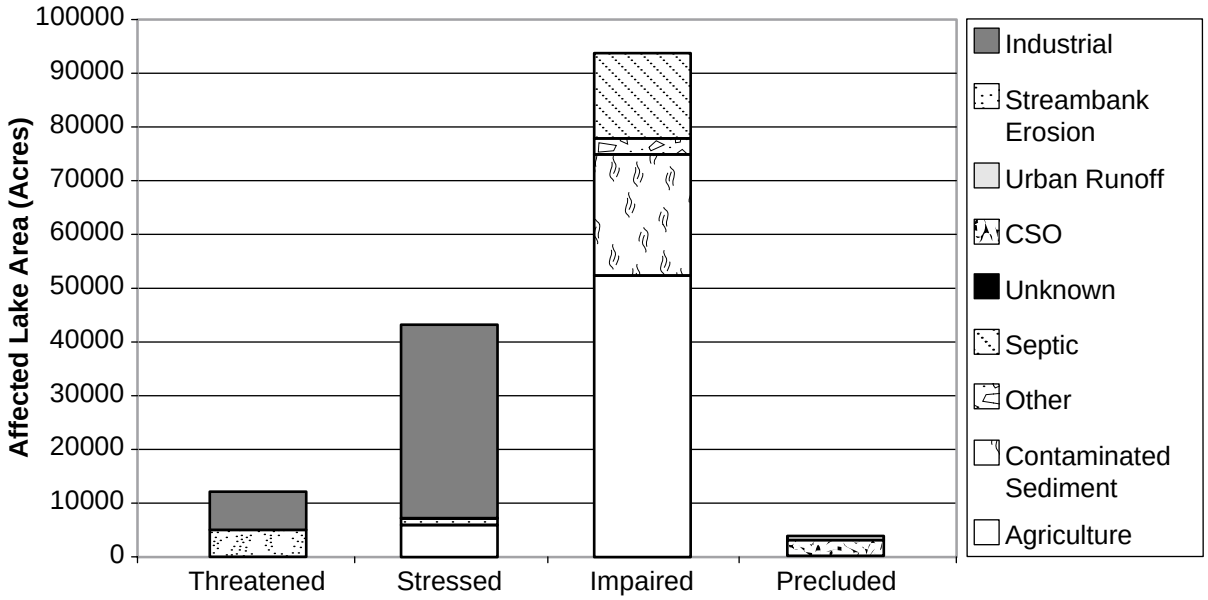

Figure 3A-8. Sources of impairments by PWL severity class to lake segments in the Seneca-Oneida-Oswego Rivers basin.

Source: DEC 1996

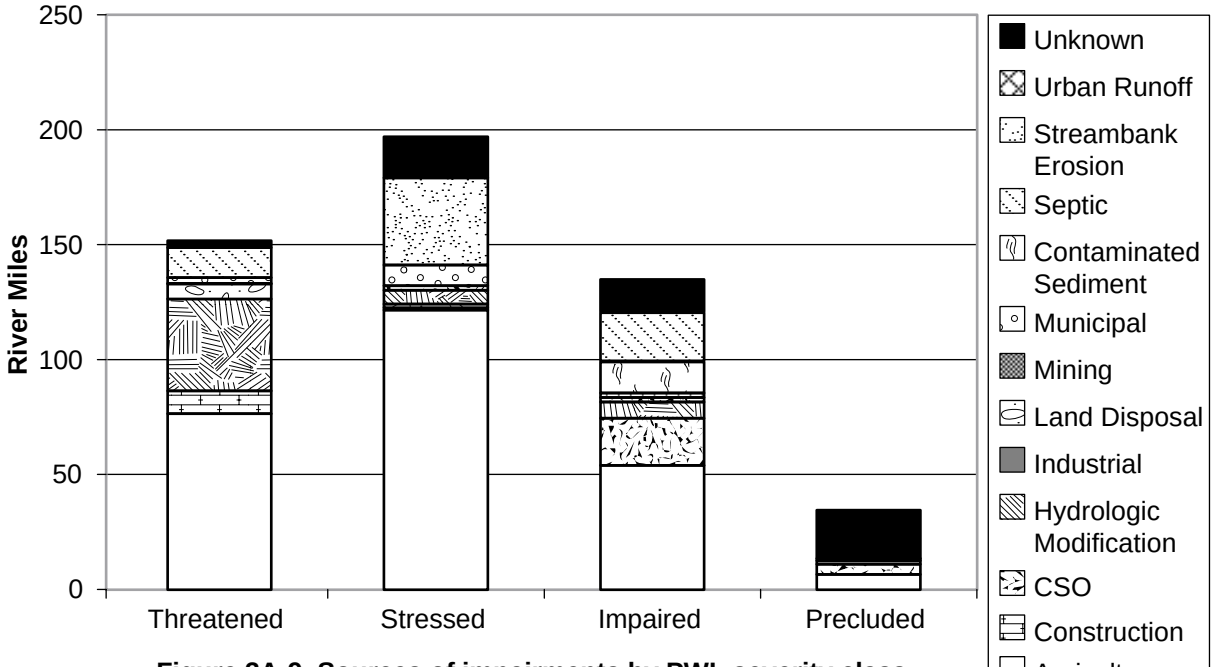

Figure 3A-9. Sources of impairments by PWL severity class to river segments in the Seneca-Oneida-Oswego Rivers basin.

Source: DEC 1996

LOCAL PRIORITIES

Based on the written questionnaire completed by participants in focus groups at the county level, groundwater and drinking water, agricultural practices, lake eutrophication, and flood control are top priorities of local water quality agencies in the Seneca-Oneida-Oswego Rivers basin (Figure 3A-10). There are important groundwater resources present in this basin and, in some locations (e.g., Cortland County) residents rely solely on groundwater for drinking water. In addition, this top priority ranking reflects the participation of several local agencies in watershed protection programs tied to the protection of surface waters serving as public drinking water supplies (e.g., Skaneateles and Otisco Lakes).

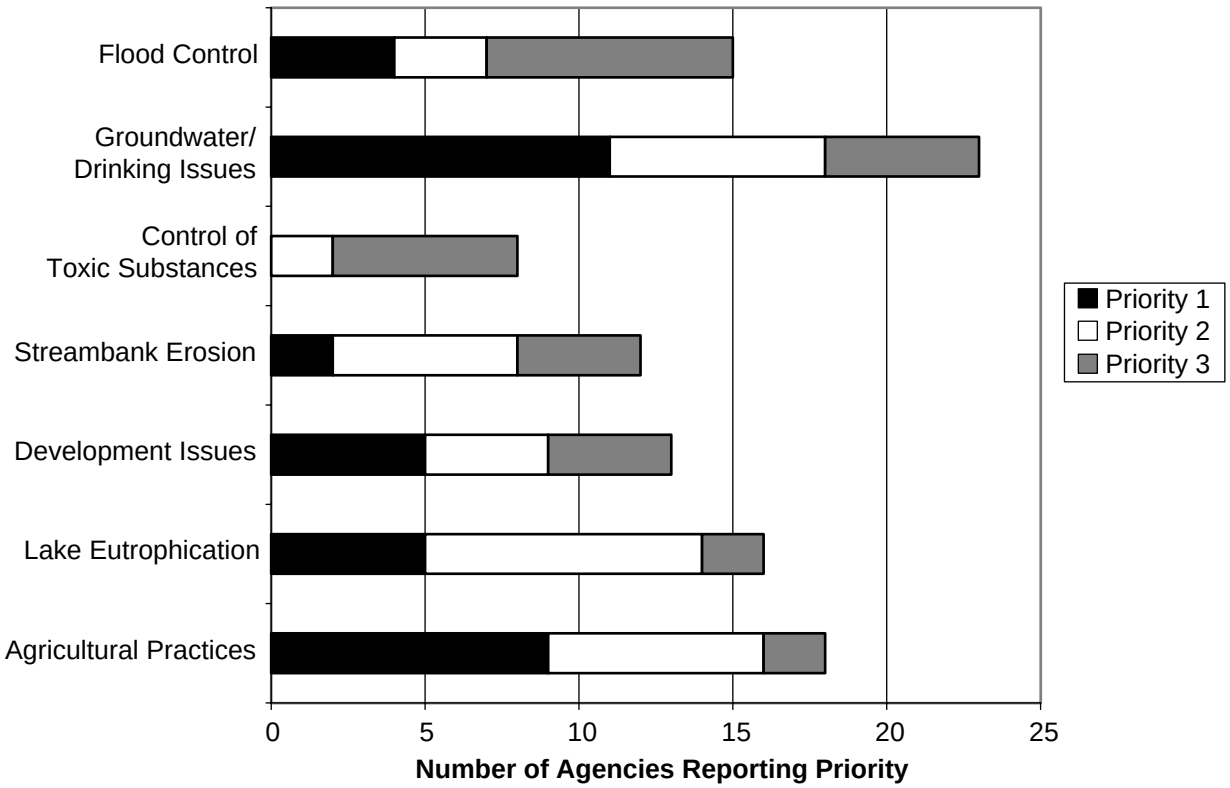

Figure 3A-10. Priorities among water resources agencies in the Seneca-Oneida-Oswego Rivers basin.

GAP ANALYSIS:
CONGRUENCE BETWEEN IMPAIRMENTS AND LOCAL PRIORITIES

The priorities identified in this basin during the county interview process match up fairly well with the extent of resource impairment from various sources as identified in the PWL (Figure 3A-11). Figure 3A-12 shows staffing levels for various agencies in multiple counties in this basin. Of those agencies participating in the interviews, the county SWCDs and health departments had the most staff resources, averaging six full-time and two part-time persons. The other agencies averaged two full-time and two part-time personnel. Figure 3A-13 shows the percent of staff committed to the top three priority areas at the time of this study. Most agencies committed about 50 percent of their staff resources to their first priorities, and about 90 percent of their staff resources within their top three priority areas.

In summary, the overall agency priorities for the Seneca-Oneida-Oswego Rivers watershed match the resource impairments. In addition, the ability to target agency resources to the priority areas indicates effective use of resources and close connection to the resource impairments.

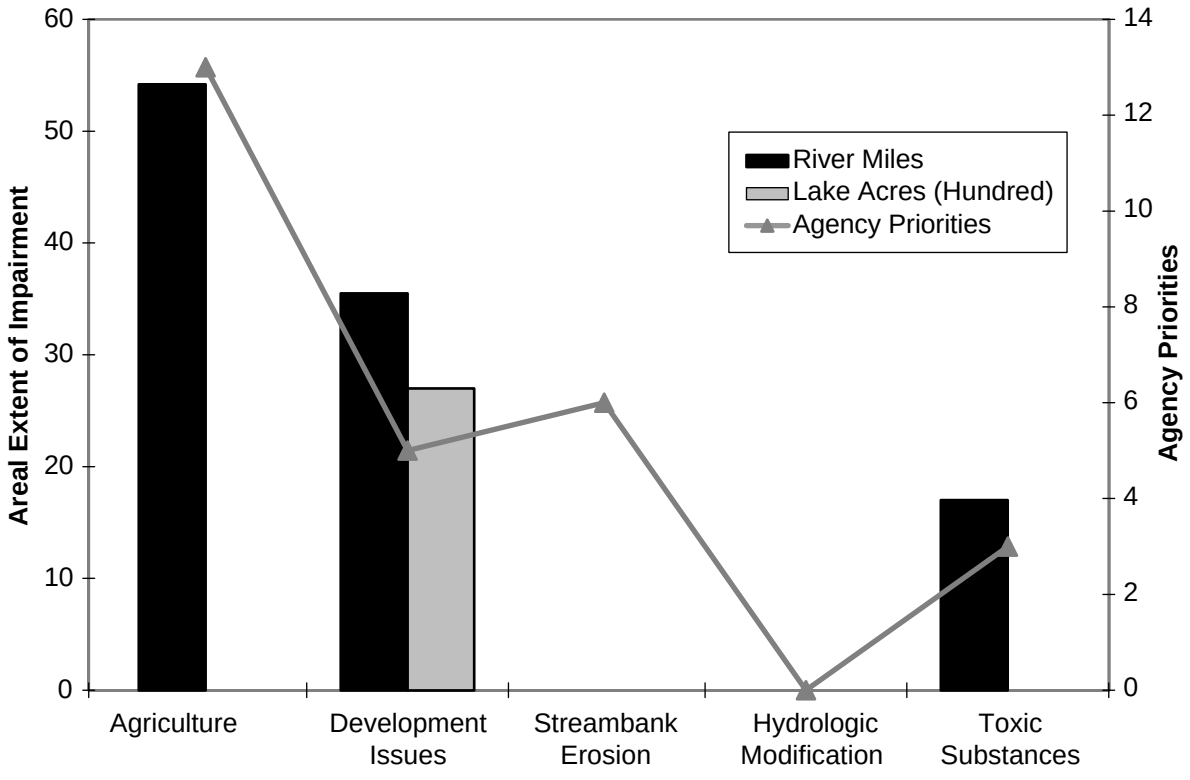

Figure 3A-11. Gap analysis: Relationship between agency priorities and resource impairments for the Seneca-Oneida-Oswego Rivers basin.

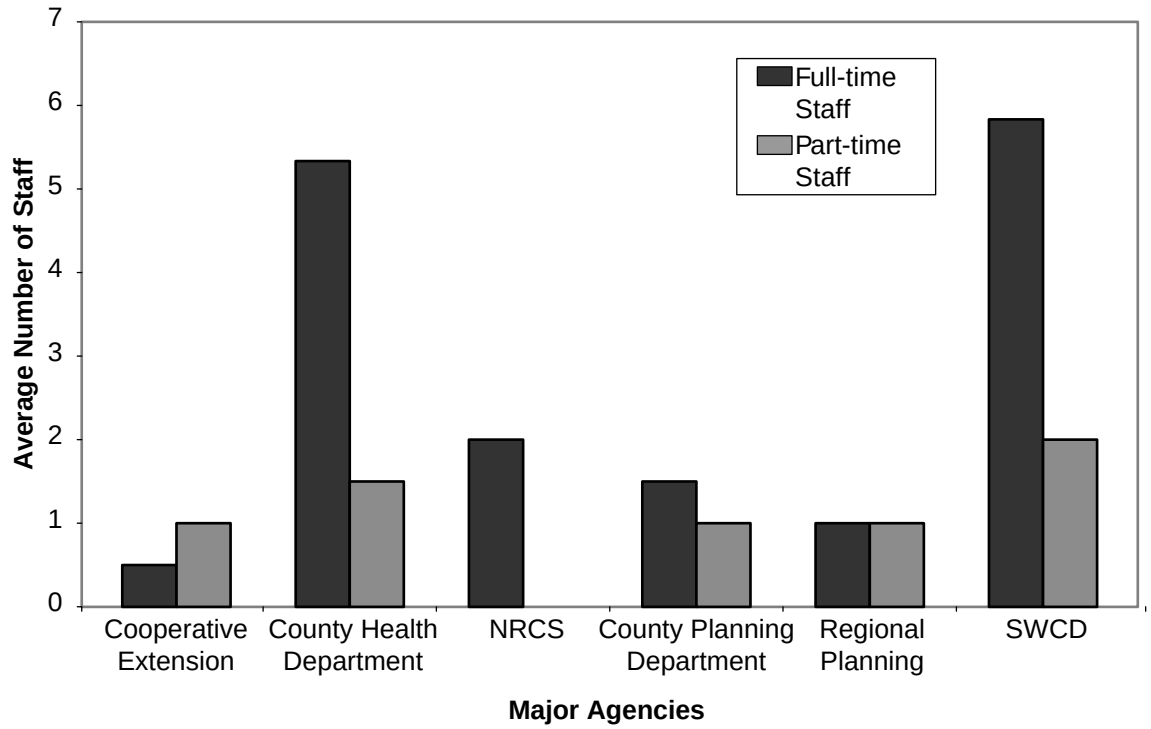

Figure 3A-12. Average staffing levels for water resources agencies in the Seneca-Oneida-Oswego Rivers basin.

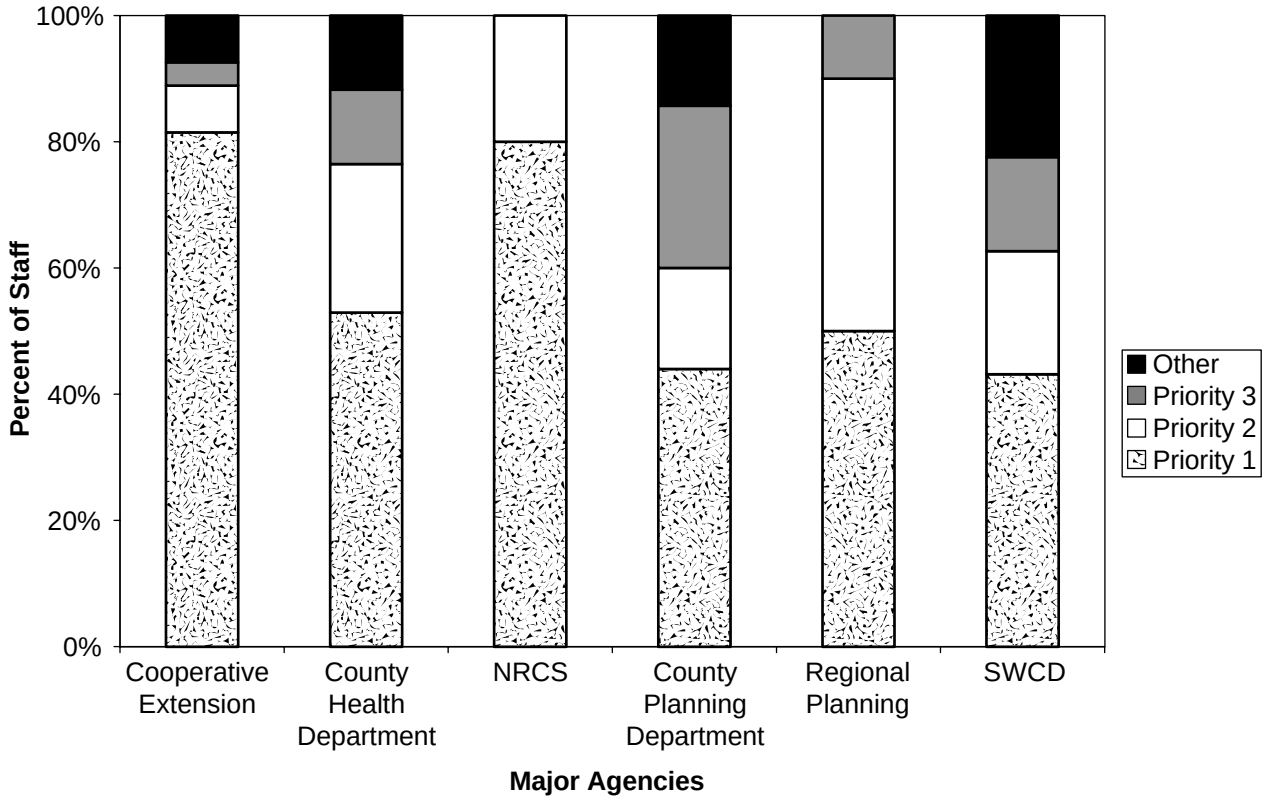

Figure 3A-13. Resource targeting in the Seneca-Oneida-Oswego Rivers basin: Staff assigned to priority areas.

CHAPTER THREE, SECTION B

GENESEE RIVER BASIN PERSPECTIVE

DESCRIPTION OF THE RIVER BASIN

The Genesee River basin encompasses approximately 2,500 square miles of New York and northern Pennsylvania. It is the only major river that completely crosscuts New York State and one of the few large rivers in North America flowing north. Despite being only 163 miles long, the Genesee River is one of the most spectacular rivers in the Northeast; with three large waterfalls and a deep gorge at Letchworth State Park known as the "Grand Canyon of the East", and three waterfalls in the City of Rochester. Because of significant changes in topography, geology, and ecoregion along the length of the Genesee River, this basin of Lake Ontario is often divided at Letchworth State Park into upper (southern) and lower (northern) watersheds (Figure 3B-1).

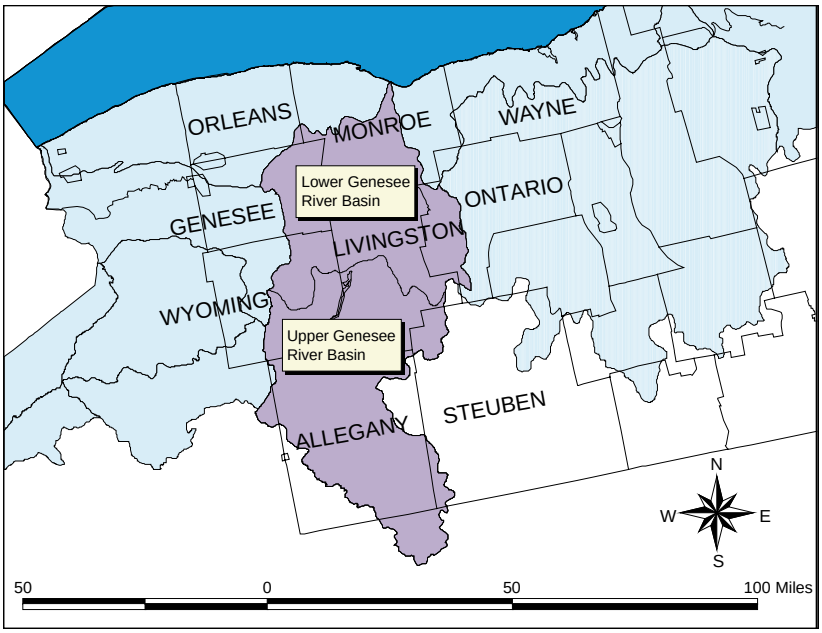

Figure 3B-1 The Genesee River basin.

History and Human Population

Historically, the river dominated activities and movement of people within the Genesee River basin. Following the retreat of the last Ice Age about 14,000 years ago, small bands of nomadic Paleo-Indian hunters settled along the river, where they could net fish in the spring, gather fruits in the summer and hunt deer in the fall (Snow 1989). Later, the Archaic Cultures Indians populated this region of the Great Lakes (Graymond 1988). These native Americans harvested acorns and processed them into nutritious flour. They invented traps, netting weirs and smoking equipment to catch and preserve fish from the lakes and streams (Snow 1989). Eventually, these early Americans cleared areas for agricultural use, first encouraging native plants and later cultivating gourds and squash introduced from the south.

By the late 16th century the Genesee River was the major waterway of the Seneca Indian Nation, its name in Iroquois meaning "pleasant banks" or "pleasant valley." The area's geography features many names of Iroquois origin, including Nunda, Oatka, Geneseo, Canaseraga, and Honeoye. The Senecas fished the river, hunted the forests, and planted corn in clearings along the banks of the river (Figure 3B-2). They developed trails from north to south on both sides of the Genesee River and from east to west along what is today New York State Route 5. In the late 1700s Dutch, French and English settlers moved into the area along these routes. In 1779 the American army under General Sullivan defeated the Seneca Nation and opened up the region to white pioneers.

Figure 3B-2 Seneca Indians had settlements along the Genesee River in the late 16th century.

Source: Merrill, no date; from the State Museum in Albany

The city of Rochester was established along the Genesee River to take advantage of cheap hydropower. In the early 19th century, the fertile Southern Tier of western New York was one of the world's largest wheat-producing areas, feeding many flourmills located in Rochester. Other communities (some of them early Native American settlements) were scattered throughout the river basin including Warsaw, LeRoy, Caledonia, Honeoye Falls, Geneseo, Mount Morris, Dansville, Angelica and Wellsville.

Population of the area increased significantly after 1823 with the opening of the section of the Erie Canal linking Rochester to Albany. The Erie Canal is south of Rochester and crosses the Genesee River. Another lesser-known and commercially less successful canal is the Genesee Valley Canal, which opened in 1861 to provide a barge route from Rochester and the Great Lakes to the Allegheny River at the Pennsylvania border (Van Diver 1985). These barge canals remain important for flood control and recreational uses.

Historically, much of the lower Genesee basin was flooded on a regular basis. According to Van Diver (1985), flooding occurred on a cycle of approximately once in seven years. In 1952, the United States Army Corps of Engineers completed construction of a flood control dam on the Genesee River at Mount Morris. The dam has reduced flooding significantly, although some flooding still occurs in lowland areas south of Rochester.

In the late 1950s the New York State Thruway was completed, making the area more accessible. The population of Rochester and surrounding areas increased from the 1950s to the 1970s. Since the mid-1970s, population of the basin has been relatively stable. Based on the 1990 census, the population for the entire Genesee River basin is approximately 674,600, which is equivalent to 268 persons per square mile, the highest population density among the major basins within the New York Lake Ontario watershed. The population distribution is concentrated in the metropolitan Rochester area of the Lower Genesee River basin.

Land Use

Approximately 52% of the land in the Genesee River basin is agricultural; another 40% is forested (Figure 3B-3). About 4.6 % of land in the watershed is classified as urban, either residential (2%), commercial (0.9%), industrial (0.2%), transportation/utilities (0.7%), industrial/commercial complexes (0.05%), or mixed urban categories (0.7%). Wetlands and water cover two percent of the basin. There are about 42,000 acres of state regulated wetlands within this basin.

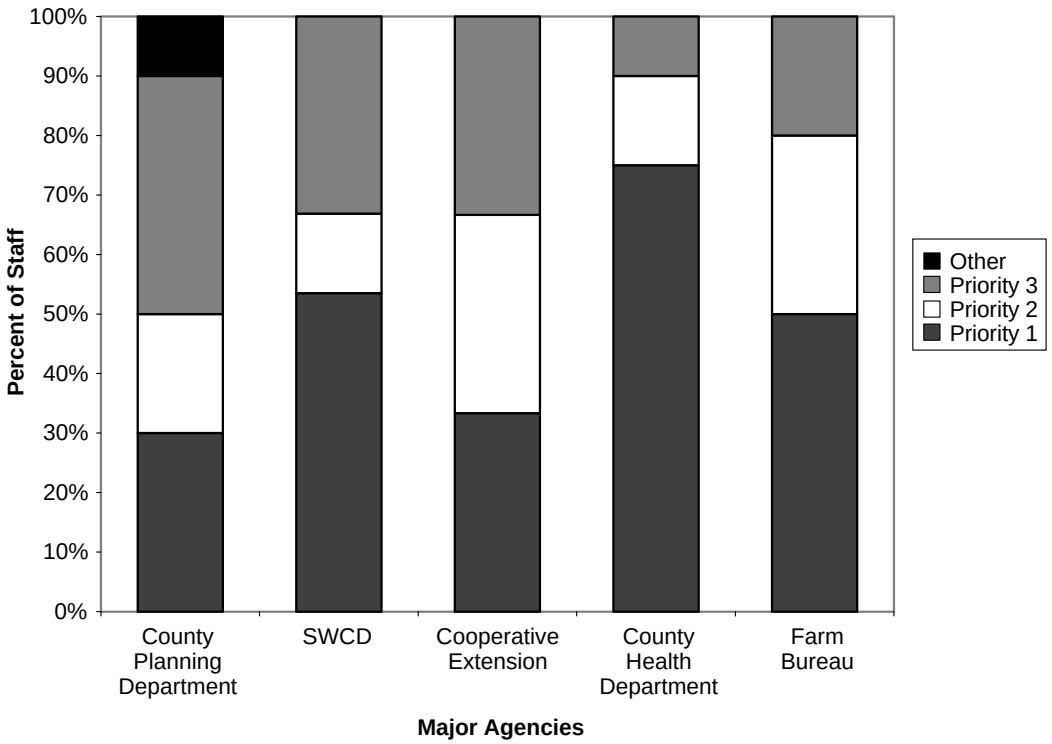

Figure 3B-13. Resource targeting in the Genesee River basin: Staff assigned to priority areas.

Employment

About one-quarter of the labor force in the Genesee River basin is employed in manufacturing (26%) and another quarter in professional occupations (27%). Sixteen percent are in retail. Only two percent are employed in agriculture, working about half the land area of the Genesee River basin.

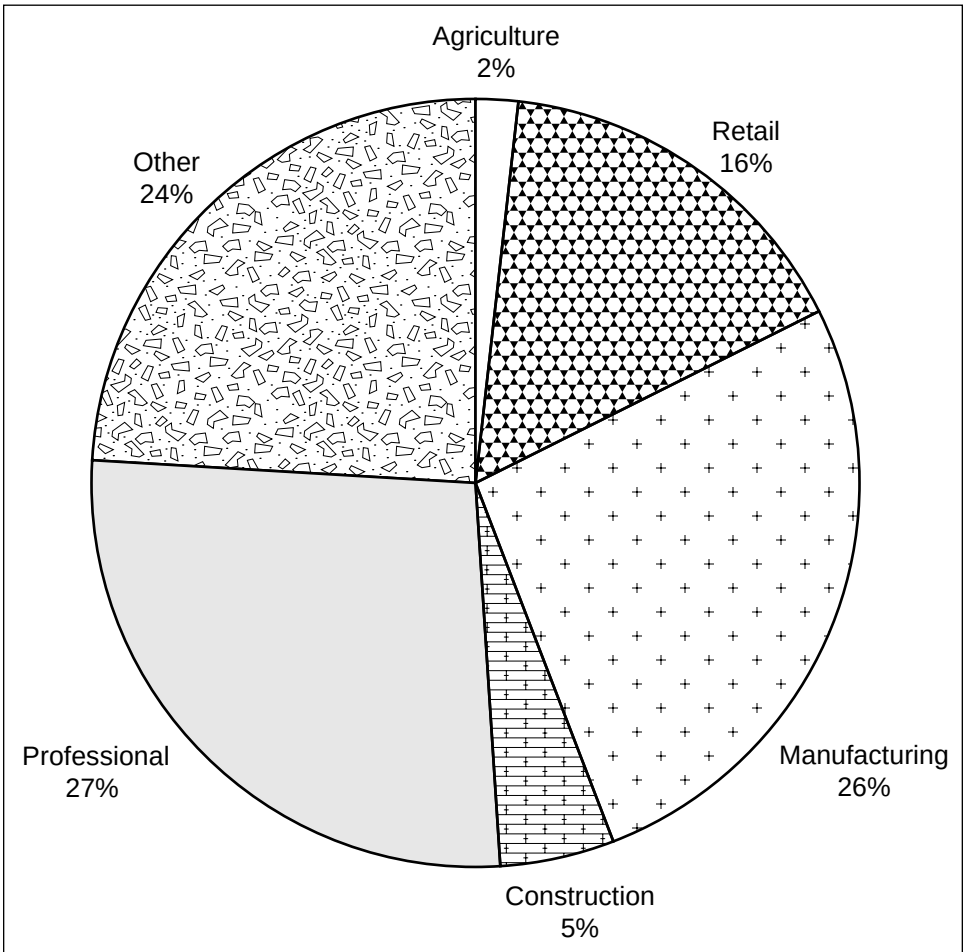

Figure 3B-4. Employment distribution in the Genesee River basin.

Significant Features

Rochester is the major cultural and urban center of the Genesee River basin. Located on both sides of the Genesee River, the city's center is about six miles south of Lake Ontario. The greater Rochester area is the third largest metropolitan area in New York State and is the 69th largest city in the United States. Within the city there are fine examples of modern architecture along with unique historic landmarks such as a distinctive statue of Mercury and the massive Wings of Progress (by architect Ralph T. Walker) above two of the downtown buildings and the Susan B. Anthony House. Other cultural sites of interest in the area include the Margaret Woodbury Strong Museum and the Genesee Country Village and Museum in Mumford that recreates the 19th century in living history.

The city is particularly known for its role in photography. Eastman Kodak Corporation has been a dominant industry leader for over a century. The George Eastman House is devoted to the history of photography and film, and the Rochester Museum and Science Center offers exhibits of the history of photography and related technologies. The Rochester Institute of Technology, one of the nation's leading technical universities, is the only school in the country offering a doctoral program in imaging science. The University of Rochester, and several smaller colleges offer additional educational programs.

The four westernmost Finger Lakes, Honeoye, Canadice, Hemlock and Conesus, are important natural and recreational attractions. Other man-made and natural lakes of significance include Lake LeRoy, Lake LaGrange, Rushford Lake, and Silver Lake. Excellent trout fishing is found in basin streams.

Geology and Ecoregions

The majority of this river basin was flooded 450 million years ago by a shallow inland sea allowing sand, clay and carbonate mud to accumulate, eventually solidifying into the sandstone, shale and limestone bedrock found today. The preglacial drainage pattern was northward, maintained despite diversions and obstructions introduced by continental glaciation during the Ice Age. The river channel was redirected in places by glacial moraines, such as by Portageville, where the river cut through the east-facing escarpment at Mt. Morris creating the Letchworth gorge through years of fluvial erosion.

Geological processes have created four distinct river segments. The headwaters of the Genesee River have very steep gradients over the first ten miles to the Village of Genesee in Pennsylvania. Gradients over the next 60 miles, from the New York State border to Portageville, are very shallow as the river meanders through a wide floodplain between steep valley walls. The third section of the river flows through a narrow 300 to 400 foot canyon at the Letchworth Gorge and over three waterfalls and then continues to meander through a broad floodplain to the upper falls at the City of Rochester. The river drops 232 feet in elevation over three waterfalls as it flows through the City of Rochester to Lake Ontario.

The Letchworth Gorge divides the basin into the upper and lower sections, contiguous with the divide between the two major ecoregions of the Lake Plain (lower watershed) and the Alleghany Plateau (upper watershed). The Lake Plain is comprised of four ecoregion subsections, the Cattaraugus Finger Lakes, Moraine and Hills, East Ontario Till Plain, and Erie-Ontario Lake Plain (Appendix A).

WATER QUALITY STATUS

Extent of Impairment

Of 1,677 stream miles in the Genesee River basin, 883 are included on DEC's 1996 Priority Waterbodies List. In addition, 21 waterbodies are listed, with 3 making the PWL-TMDL list for more degraded waterbodies. The majority of these segments are along the Genesee River, Black Creek, Oatka Creek, Canaseraga Creek and the NYS Barge Canal. Figure 3B-5 shows the location of each of the PWL segments in the two most impaired categories (*impaired* and *precluded*) within the basin.

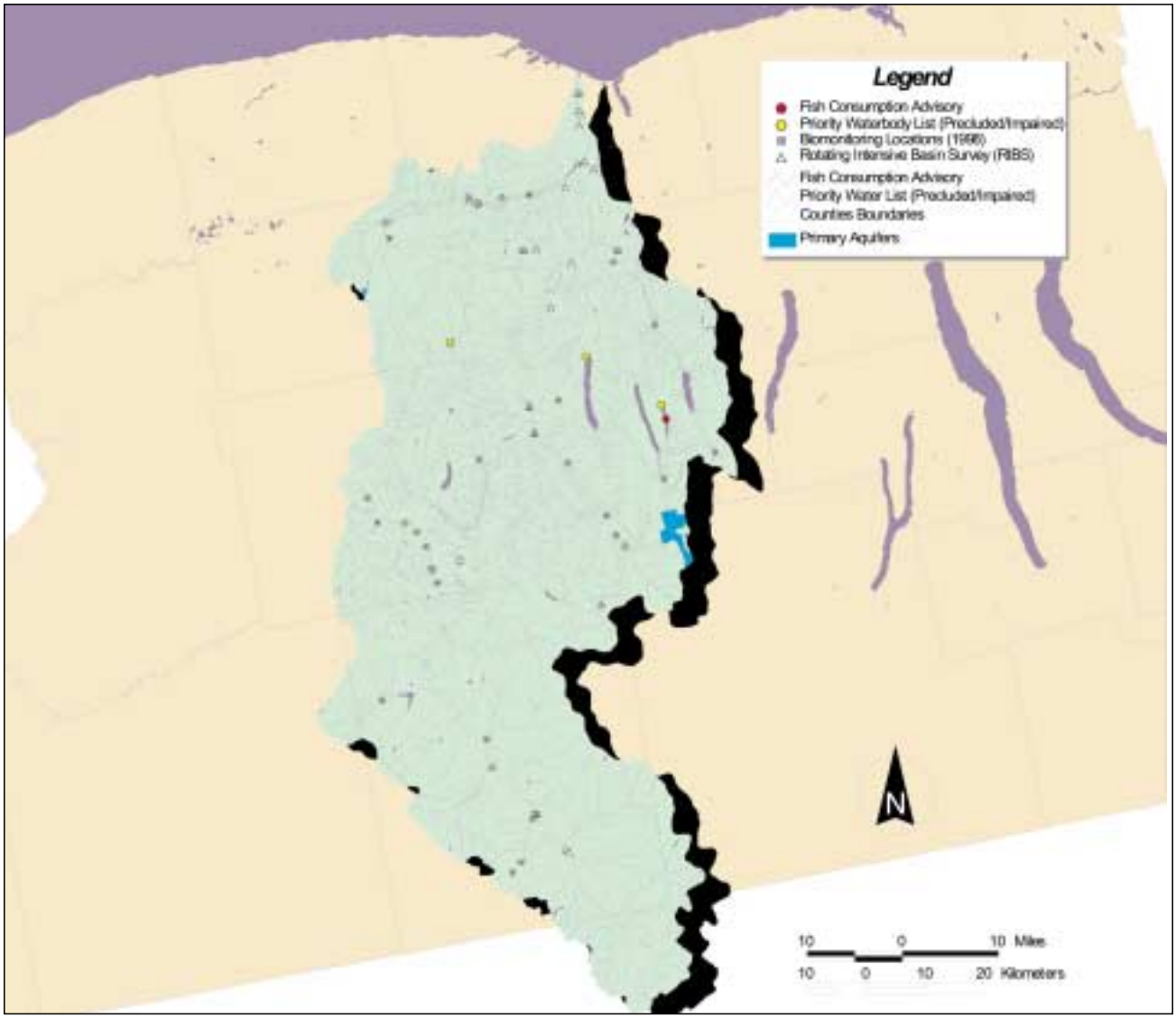

Figure 3B-5 Water body segments classified as Impaired or Precluded in the Genesee River Basin, DEC Unified Watershed Assessment (1998).

The 1996 PWL was compared with counties' (Allegany, Livingston, Steuben, Wyoming, Genesee, Monroe, and Ontario) water quality priorities as documented in the county water quality strategies. There were a few departures. Monroe County has a comprehensive water quality program and most stream and lake segments included as DEC priorities are either being monitored (e.g., Allens Creek, Genesee River, Long Pond, Cranberry Pond, and Northrup Creek) and/or have active water quality improvement projects at the local level. Monroe County relies on monitoring data to establish countywide water quality priorities. Livingston County does not have an active WQCC, but the county water quality strategy last updated in 1992 was based on the DEC's PWL and data from studies conducted locally. Conesus Lake is clearly the priority water body in Livingston County. Three water bodies are listed in the 1996 water quality strategy for Genesee County (Le Roy Reservoir, Oatka Creek, and Upper Bigelow Creek). The Genesee County Water Quality Coordinating Committee reviews PWL information along with local data and assigns priority on a countywide basis. First concern is Tonawanda Creek, the public drinking water supply for the City of Batavia, which drains to Lake Erie. Second priority is the Genesee River with subwatersheds of Oatka Creek, Black Creek, and Canaseraga Creek including Lake Le Roy. The third priority listed in the water quality strategy is Oak Orchard Creek, which is inside one of the Direct Drainage Areas.

Overall, the local water quality priorities as indicated in county water quality strategies include some significant differences in the Genesee River basin from the DEC PWL. Particularly in Monroe and Genesee Counties, the differences are based on local data inputs and constitute a resource-based PWL refinement. In addition, counties can have priorities in more than one basin, clouding the alignment of county strategies with the PWL for a given basin.

Sources of Impairment

The primary source of impairment for seventy percent of PWL-listed lake acres in the Genesee River basin is development, (including storm sewers, combined sewer overflows, and other sources). Other sources affecting fewer acres are contaminated sediment, failing septic systems, municipal sources, hyrdologic modification, and agriculture (Figure 3B-6).

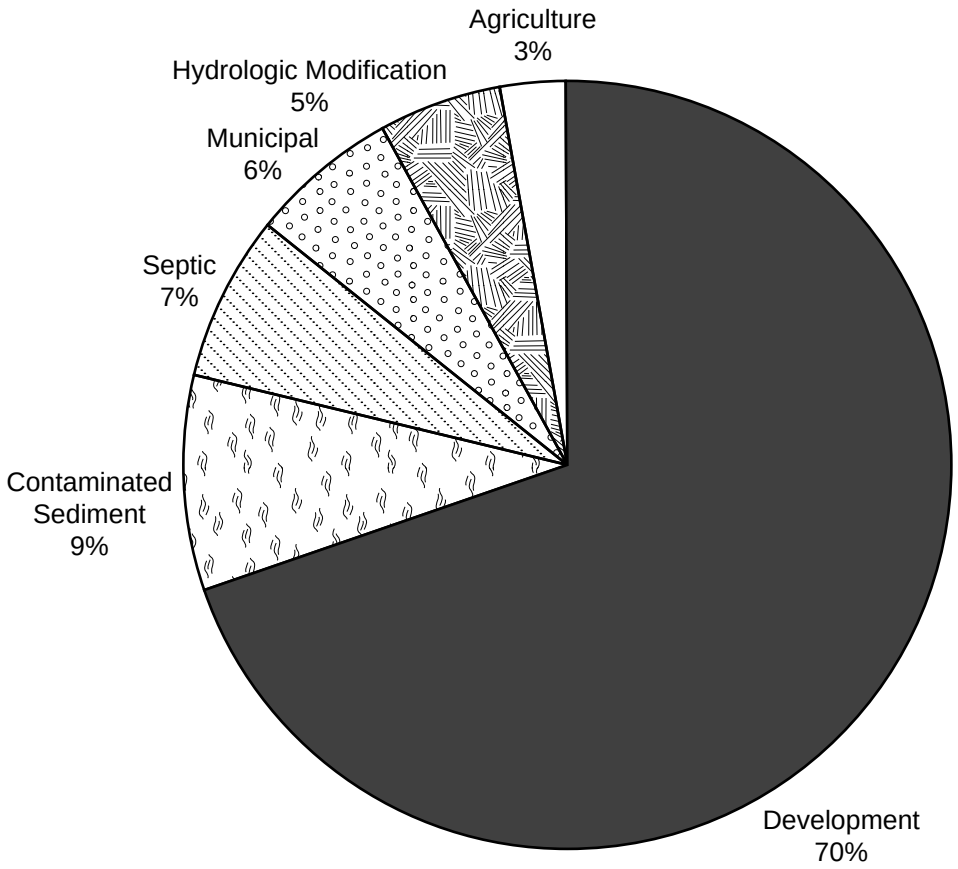

Figure 3B-6. Primary causes of use impairment for lakes of the Genesee River basin.

Source: DEC 1996

Shoreline development is intense around certain area lakes. For example, almost the entire shoreline of Conesus Lake has been converted to residential development. This 180 square kilometer watershed encompasses six towns (Geneseo, Livonia, Conesus, and Groveland, Sparta and Springwater), the village of Livonia and the hamlet of Lakeville. Much of the lake development and recreational pressures occurred relatively early, and the lake consequently served as a sink for municipal wastes and septage as well as agricultural runoff (Forest et. al. 1978). Other area lakes have not experienced the density of development seen on Conesus Lake. For example, land use in the Hemlock Lake watershed is strictly regulated by the City of Rochester, which owns the entire lake shoreline, and uses the lake as a drinking water supply. Hemlock Lake experiences impairments as a result of water level fluctuations, making up most of the five percent of the total lake acres impaired by hydrological modification in this basin.

Primary sources of impairment differ significantly for lake acres and stream miles in the Genesee River basin, according to the PWL. Agriculture affects 29% of stream and river miles while hydrological modification affects 24% (Figure 3B-7). With 52% of the land in the basin being agricultural, this impairment source is not surprising. The agricultural impairments tend to be on smaller tributaries (e.g., VanDerMark Creek, Wiscoy Creek, Little Beards Creek, and Johnson Creek). Hydrologic modifications are the result of a combination of draw down (e.g., Hemlock Lake outlet) or flood control on the Genesee River and NYS Barge Canal. Stream bank erosion and urban runoff are primary impairment sources for 19% percent and 8% of PWL stream and river miles, respectively.

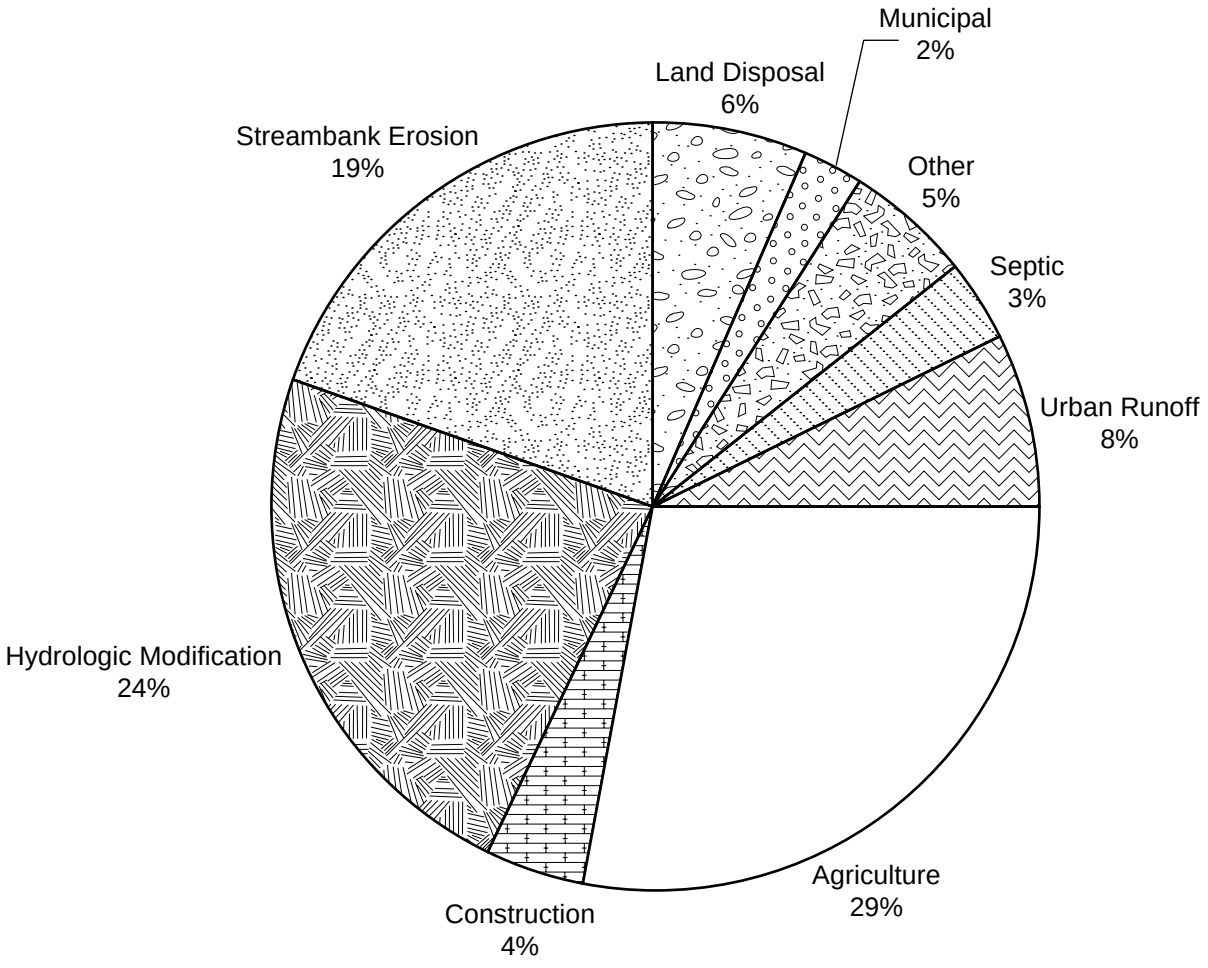

Figure 3B-7. Primary causes of use impairment for rivers and streams in the Genesee River basin.

The sources of use impairments for lake and stream segments in each of the PWL severity classes in the Genesee River basin are shown in Figures 3B-8 and 3B-9, respectively. DEC does not list any lakes or streams as *precluded* in this basin. Lake acres in the impaired category are largely affected by development (e.g., resulting in nutrient inputs to Conesus Lake and pathogens to Rushford Lake). Contaminated sediments are documented in Lake Ontario and Canadice Lakes.

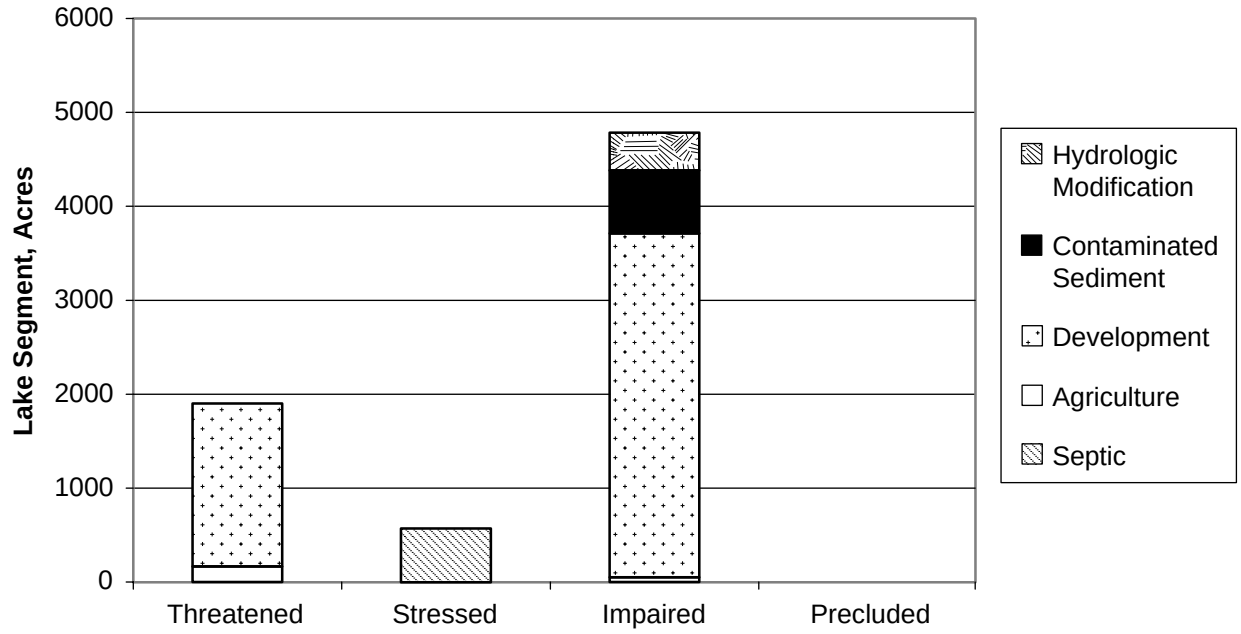

Figure 3B-8. Sources of impairments by PWL severity class to lake segments in the Genesee River Basin.

Source: DEC 1996

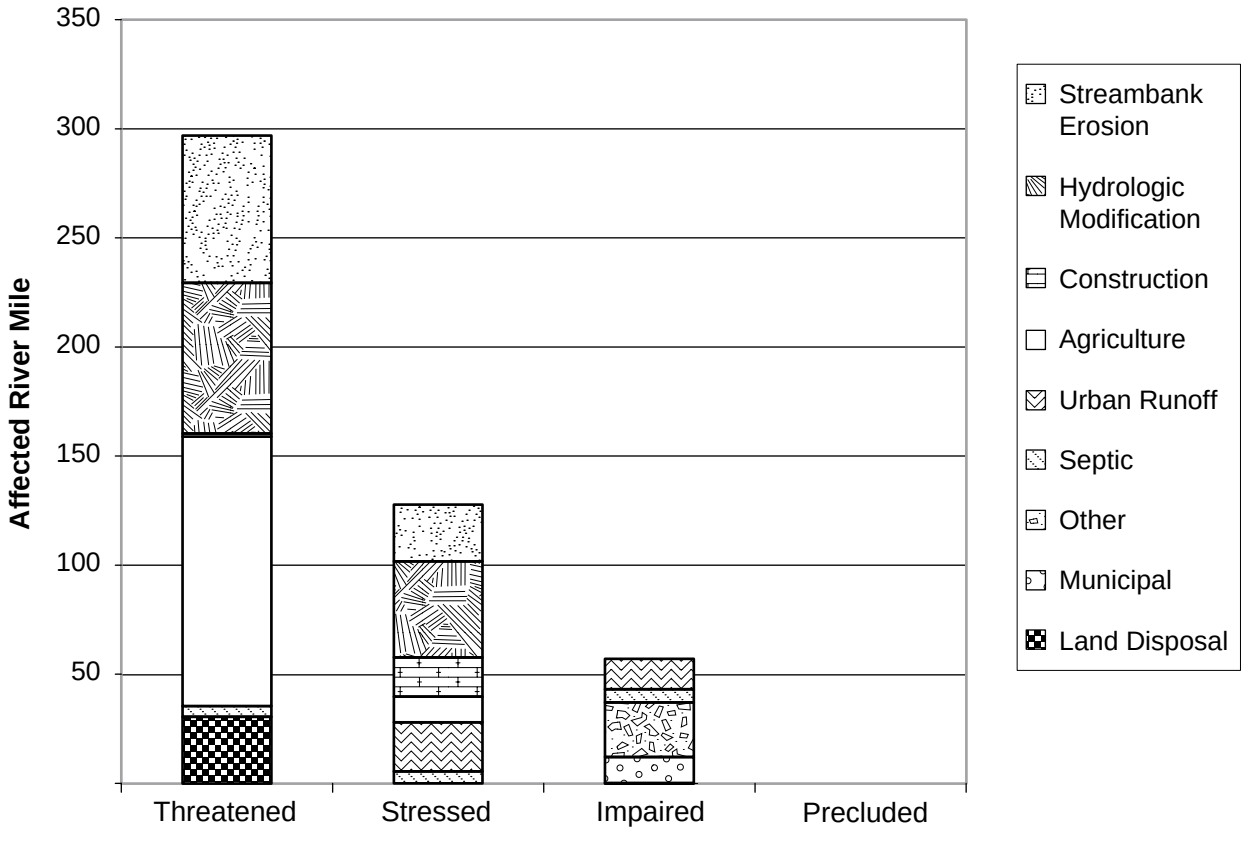

Figure 3B-9. Sources of impairments by PWL severity class for rivers and streams in the Genesee River basin.

Source: DEC 1996

The river miles in the *impaired* category are affected by municipal sources, urban runoff, failing septic systems, and other undefined sources. The majority of PWL river segments listed as *stressed* or *threatened* are affected by sources such as agriculture, land disposal, hydrological modification, and stream bank erosion.

LOCAL PRIORITIES

Genesee River basin agencies participating in the county focus group interviews and completing the written questionnaire indicated overall that groundwater/drinking water, agriculture, eutrophication (e.g., in smaller lakes like Conesus and along the most nearshore areas of Lake Ontario), and development were primary resource issues of concern. (Figure 3B-10). Top agency concerns vary somewhat along the upper and lower portions of the Genesee River, with changing hydrology, topography and land use patterns.

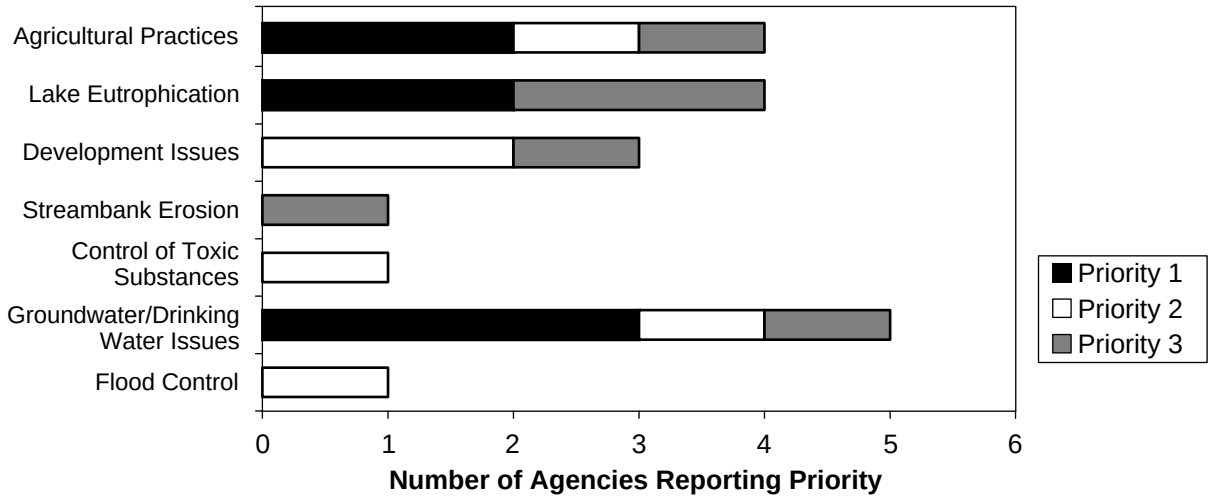

Figure 3B-10. Priorities among water resources agencies in the Genesee River basin.

GAP ANALYSIS: CONGRUENCE BETWEEN IMPAIRMENTS AND LOCAL PRIORITIES

The gap analysis compares the extent of impairment to lakes and rivers from various sources and the number of agencies listing that source as a priority. There is strong association between the PWL-based resource impairments and agency priorities within the Genesee River basin (Figure 3B-11).

Average staffing levels in agencies interviewed across the basin are shown in Figure 3B-12, providing a general picture of human resources dedicated to water quality issues in the basin. These data do not accurately reflect the situation in any one county, but rather an average of the basin counties. The Cornell Cooperative Extension had an average of four full-time persons in each county. The other agencies in the basin averaged two full-time and zero to two part-time persons. Planning departments typically dedicated staff less than full-time to water resources issues. Figure 3B-13 indicates the average percent of staff committed to each agency's top three priority concerns. Staff were clearly committed within the top priorities, with the health and planning departments targeting relatively more staff time to the first priority and the soil and water conservation districts targeting evenly across the top three priorities.

Overall local agency priorities for the Genesee River basin closely track resource impairments. In addition, the ability to target staff resources to the priority areas indicates effective use of resources and close connection to resource impairments.

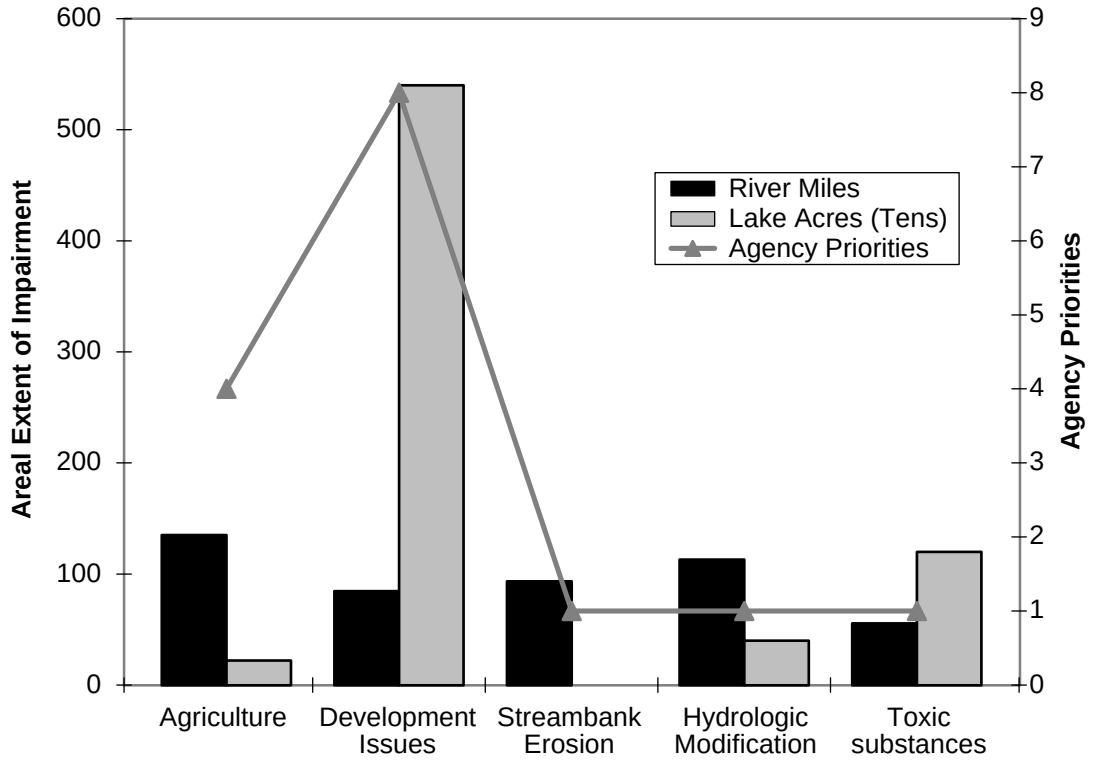

Figure 3B-11. Genesee River basin gap analysis: relationship between agency priorities and resources impairments indicated by the Priority Waterbodies List.

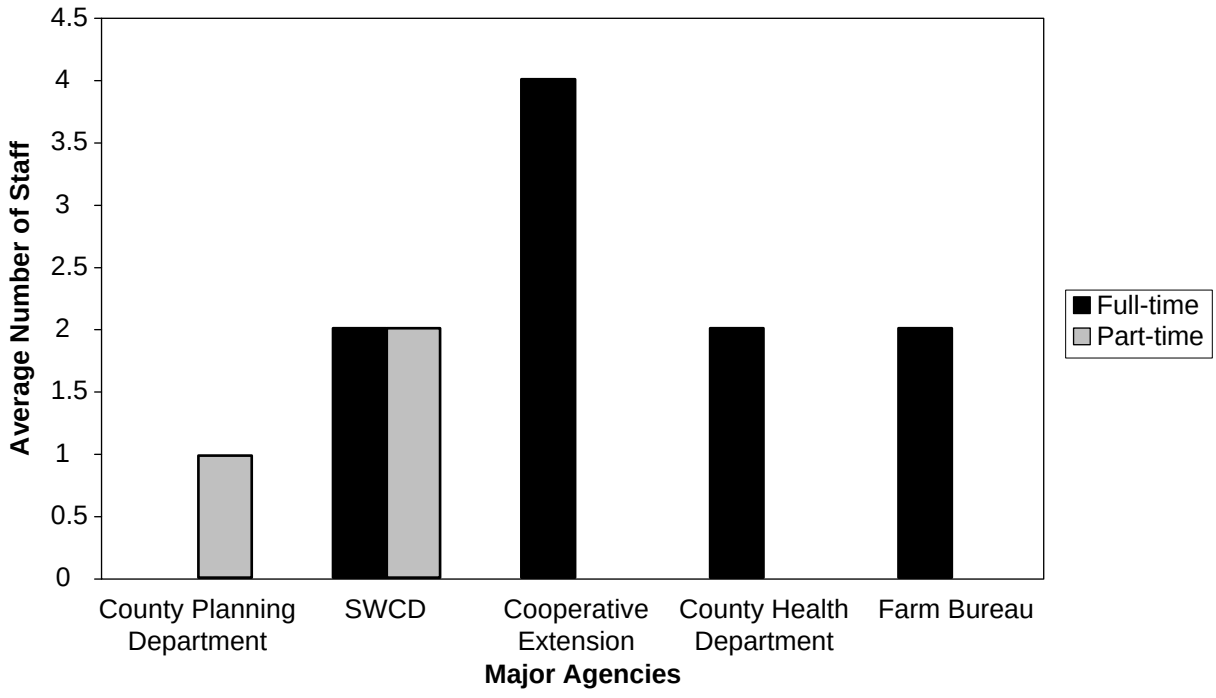

Figure 3B-12. Average staffing levels for water resources agencies in the Genesee River basin.

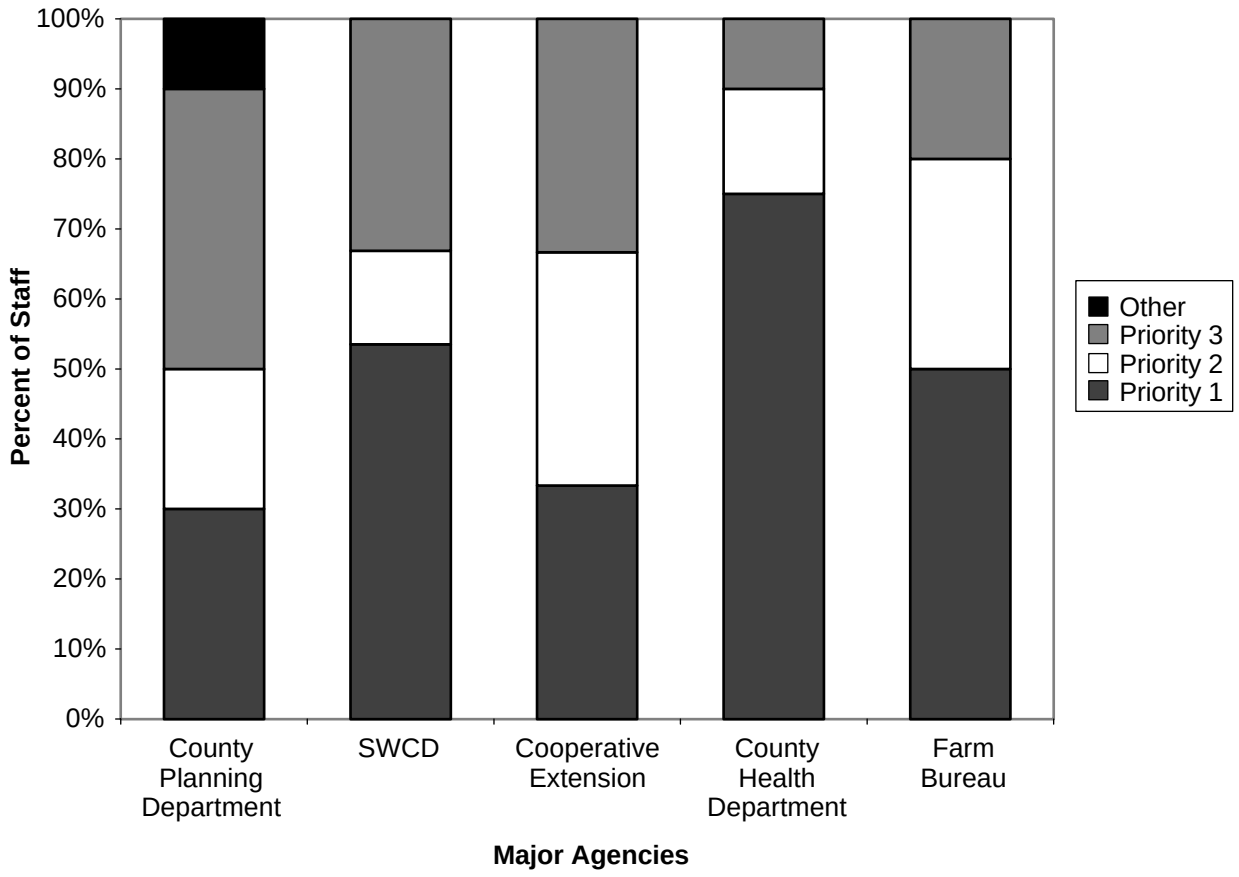

Figure 3B-13. Resource targeting in the Genesee River basin: Staff assigned to priority areas.

CHAPTER 3, SECTION C

BLACK RIVER BASIN PERSPECTIVE

DESCRIPTION OF THE RIVER BASIN

The Black River basin encompasses 2,285 square miles. Among its significant water resource features are the Black River, Fulton Chain of Lakes, Stillwater Reservoir, Perch Lake, Black River Bay, the Chaumont River, and Chaumont Bay[2] (Figure 3C-1). The Black River headwaters begin in Hamilton County in the Adirondack Region. The Black River flows west through the Black River Valley, over a series of waterfalls through the City of Watertown, dropping another 500 feet to the Black River Bay in Lake Ontario. Watertown is the major metropolitan area within the watershed. The Black River basin is mostly forested, dotted with many small lakes.

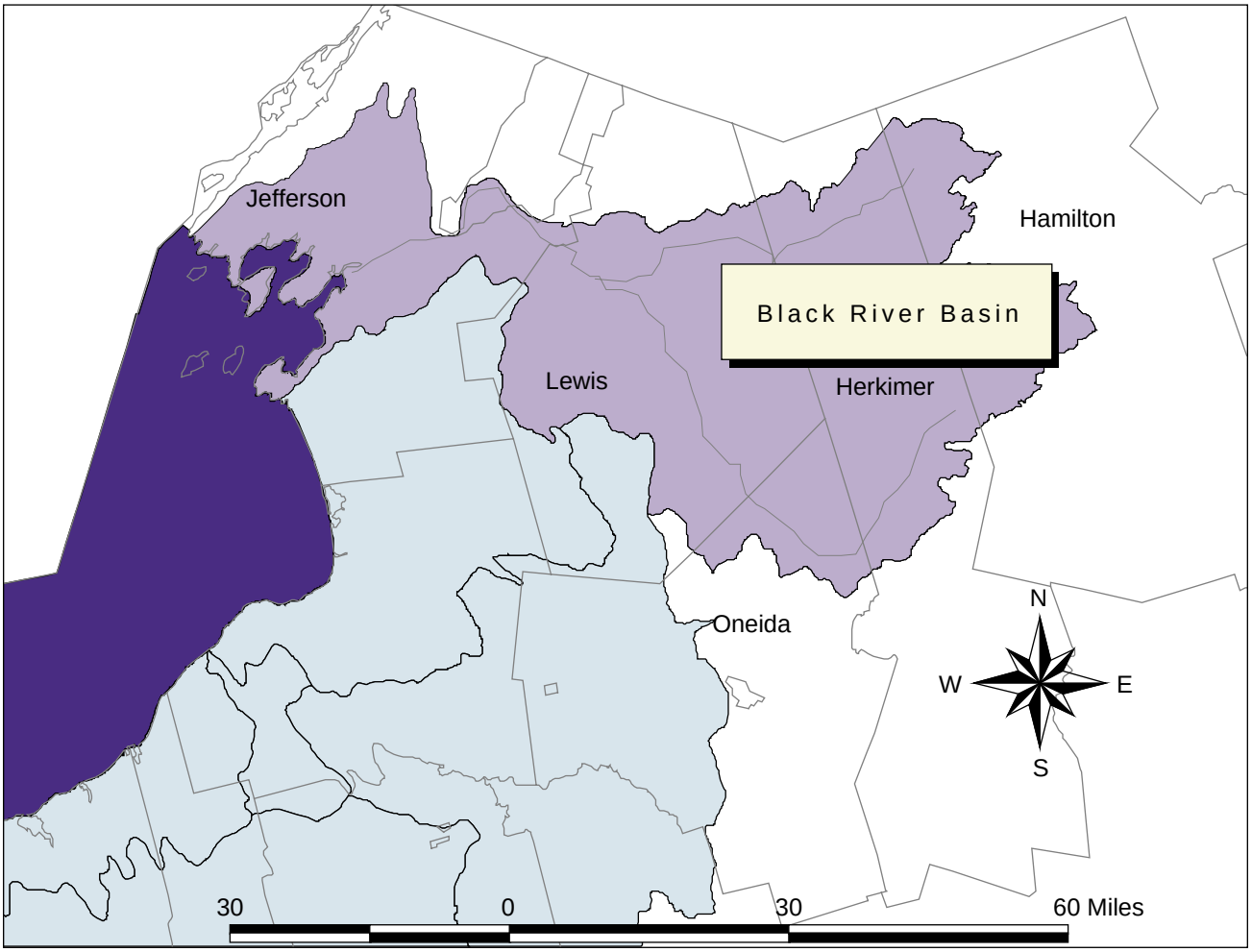

Figure 3C-1 The Black River Basin.

History and Human Development

Two Native American groups, the Mohawks (one of the five nations of the Iroquois Confederacy) and the Algonquins (of Canada), frequented the Black River and a large section of the Adirondacks Mountains for hunting and trapping. They left few traces, using the area for brief periods without establishing permanent settlements. The area provided game during harsh winters and transportation routes via waterways. One major route followed the Fulton Chain of Lakes north to Eighth Lake, with a carry to Raquette Lake, Raquette River, carry west to Saranac Lake and overland to Lake Champlain. Explorers and settlers later used these trails in the 17th and 18th centuries.

[2] Although the Chaumont River watershed drains directly to Lake Ontario, it is grouped with the adjacent Black River basin by DEC for the PWL.

In 1799 the area that is now Watertown was explored by the French crossing the Black River on log rafts using long poles just upstream from today's Mill Street Bridge. Settlers gradually moved into the area, attracted by the abundance of cheap hydropower. Dams were constructed and Watertown prospered through the 19th century as an industrial center, with local paper mills producing most of the nation's newsprint and a variety of paper products.

The upper Black River watershed was settled more gradually due to obstacles inherent to the more rugged, mountainous terrain. Many ambitious individuals moved into the area to seek fortunes in untapped natural resources, such as iron ore and timber. Huge sums of money were invested, though bankruptcy was common before many grand schemes could be realized. The short and unpredictable growing season, destructive power of the spring floods, distances between population centers and mountainous topography contributed to the failure of investment schemes at Old Forge and the Moose and Independence Rivers.

Logging of the forest (particularly for spruce) was one of the main forces that eventually opened the area up to development. Using the method of loose log driving, logs were cut and floated down the Black River to downstream mills. In 1853, a group of timber companies made a request to the State Assembly that rivers in the Adirondacks be declared public highways. That same year, the Black River was declared a public highway, thereby facilitating its use for the transportation of logs. Other laws enacted during this period facilitated the industry by allowing blasting of channels where streams were too shallow and the building of dams where the flow was deemed insufficient.

In 1892, seven years after New York State designated public land in the Adirondacks as Forest Preserve, the State Legislature created the Adirondack Park, with the purposes of protecting timber supply, major watersheds, and providing for the "free use of all the people for their health and pleasure" (Jamieson 1985). In 1894 a constitutional amendment, known as the "forever-wild" amendment, strengthened the preservation of the Forest Preserve by putting a halt to the damming and dredging of streams to float logs and prohibiting the sale or lease of state-owned timberlands or destruction of the timber thereon.

The 1960s witnessed proposals for extensive second-home developments in the Adirondacks. A temporary commission was created by Governor Nelson Rockefeller to make recommendations for the future of the Adirondack Park. The recommendations, which were adopted, classified both state and private land for a comprehensive and stringent zoning plan to preserve wildlands and open space while at the same time safeguarding local economies. The Adirondack Park Agency (APA) administers land use policy within the Park boundaries. The headwaters of the Black River basin lie within the "blue line" that defines the boundary of the Adirondack Park. The most extensive development in this part of the basin is found around the Fulton Chain of Lakes and Old Forge.

Much of the past century's use of the Black as a working river led to water quality decline and habitat destruction. In the 1960s and 70s, construction and upgrade of numerous treatment facilities addressed the major discharges from municipalities and paper mills. Still, the Black River is identified as a significant source of PCBs to Lake Ontario, and sections of the river and its tributaries, in particular from Lyons Falls to Sackets Harbor are listed on the PWL. Recreational interest in the river has grown in recent decades, and a successful white water rafting industry takes advantage of the Class IV rapids afforded by the river.

Based on the 1990 census, the population for the entire basin is about 122,000 people, averaging about 53 persons per square mile, the lowest population density of the basin areas analyzed in this study and about one-fifth the population density of the Genesee River basin.

Land Use

Sixty-four percent of the Black River basin is in forest. Agriculture accounts for another 23% and rangeland two percent. Wetland and water make up almost nine percent, leaving less than two percent of the basin in a category of developed land uses (Figure 3C-2). Stringent land use controls apply to the area of the basin within the Adirondack Park blue line, though intense shoreline development characterizes several local lakes.

Employment

Employment in the Black River basin is distributed mainly within four sectors: agriculture (28%), professional (26%), manufacturing (18%), and retail (17%) (Figure 3C-3).

Significant Features

The Black River basin is rich with diverse natural resources, particularly forest and hydrological resources. Watertown is the major cultural and urban center of the basin, with smaller towns such as Lowville, Carthage, Old Forge and Inlet positioned along the river or basin lakes. There are also several small hamlets, such as Big Moose and Eagle Bay, located along the many lakes in the watershed.

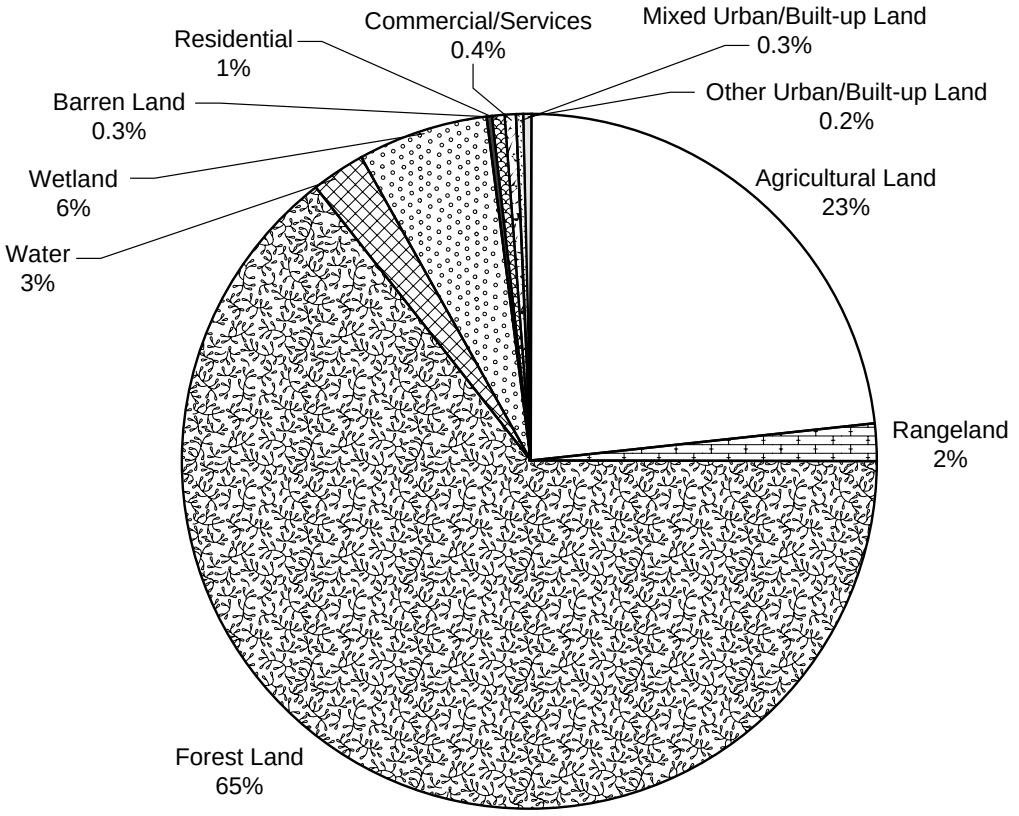

Figure 3C-2. Land use/land cover, Black River basin

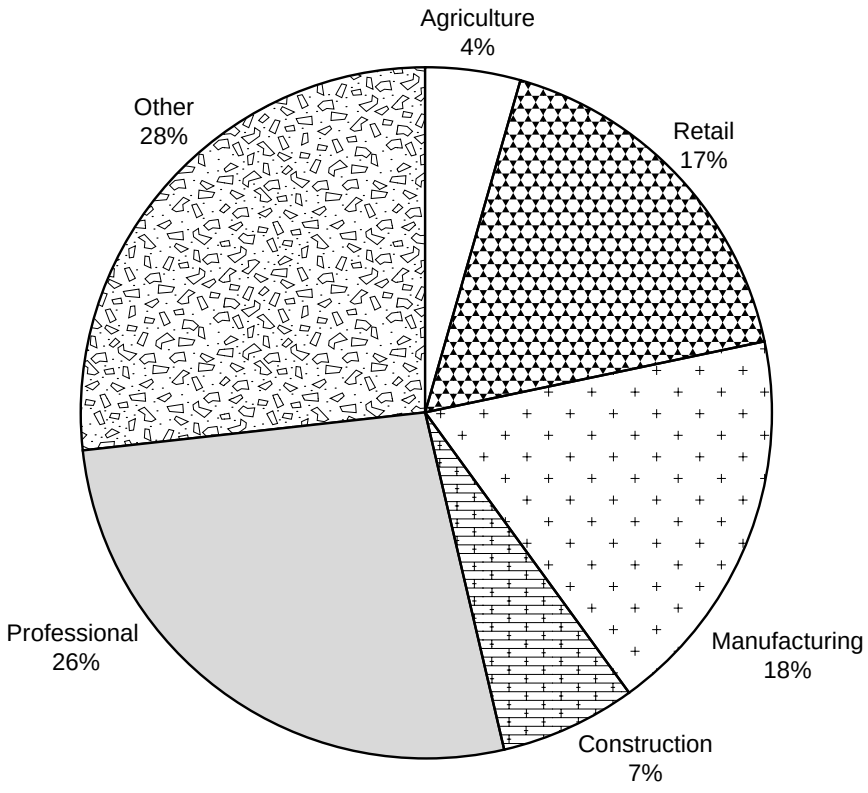

Figure 3C-3. Employment distribution in the Black River basin.

Geology and Ecoregions

Three major ecoregions characterize the Black River Basin and they correspond very closely to topography. The higher elevations in the Adirondack Mountain and Foothills ecoregion is characterized by open hills on a glaciated peneplain ranging from 1,500 to 2,500 feet above sea level. Headwaters flow downstream across the gentle meadowlands of the Black River Plain ecoregion. This Black River Valley region consists of broad valley outwash, numerous escarpments and area of ground moraine. The Chaumont River is within the St. Lawrence Glacial Lake Plain ecoregion. The geology of the Black River basin changes from the metamorphic gneiss (some of the oldest rock on Earth) of the headwaters to the limestone of the Watertown and Chaumont River areas closer to Lake Ontario (Appendix A).

WATER QUALITY STATUS

Extent of Impairment

DEC's 1998 Unified Watershed Assessment for the Black River basin is mapped in Figure 3C-4, showing waters classified as *precluded* or *impaired* and the location of fish consumption advisories. Altogether, about 36 stream miles and 142 water bodies in the Black River basin are included on DEC's PWL. The PWL-TMDL stream areas represent about 1.5% of the total (2,417) stream miles in the watershed. There are seven more degraded water bodies on the PWL-TMDL for fish consumption advisories due to concentrations of metals.

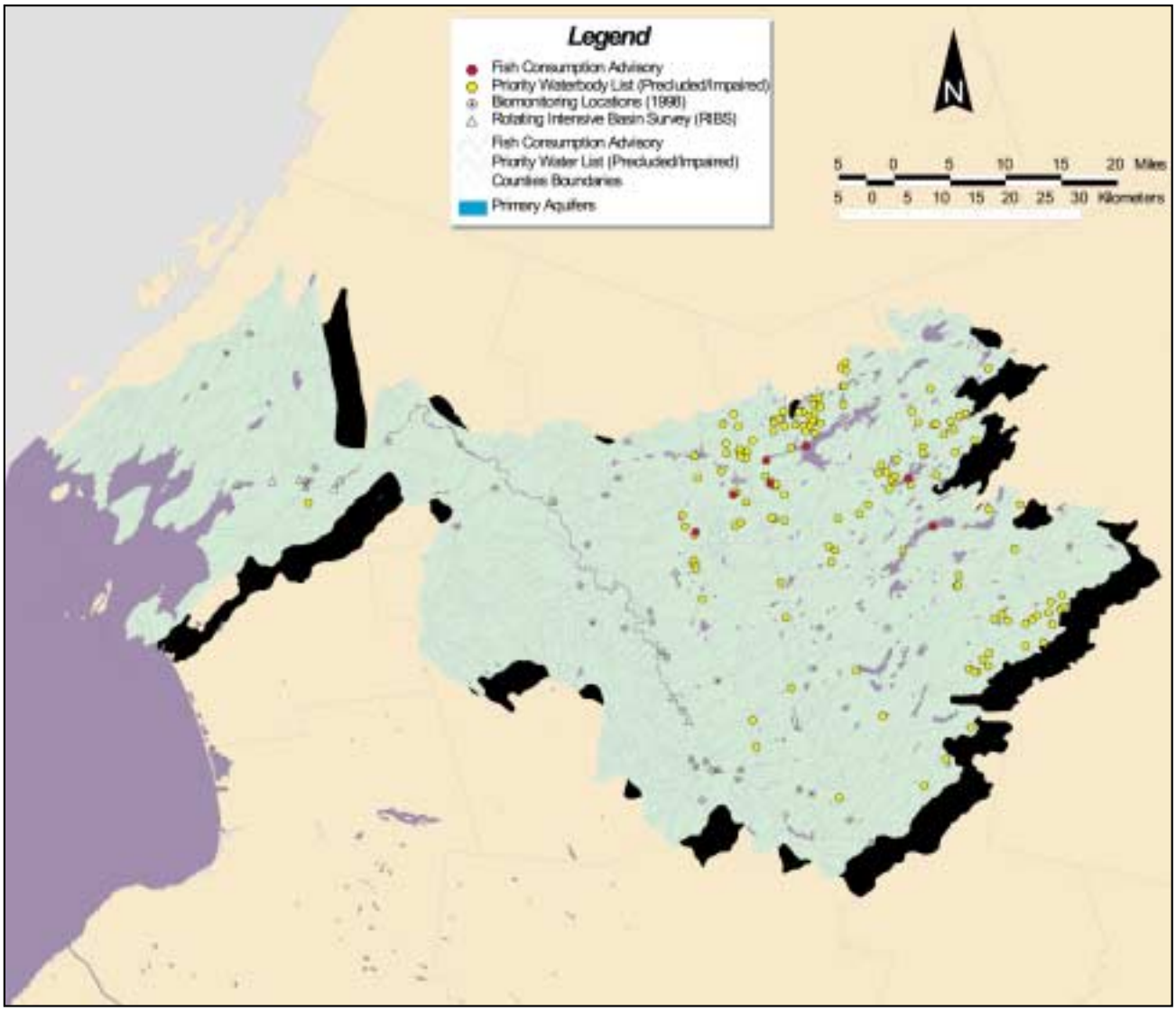

Figure 3C-4 Water body segments classified as *Impaired* or *Precluded* in the Black River basin, DEC Unified Watershed Assessment (1998).

The Black River basin PWL and the PWL-TMDL were compared to the local priorities documented in county water quality strategies (Hamilton, Lewis, Jefferson, Herkimer[3], Oneida, and Oswego Counties). Several counties in the Black River basin have large land areas in other basins or the direct drainage areas. It was common for top priority water bodies in the county strategies to be located outside the Black River basin and, likewise, for some DEC Black River basin priorities to not be listed in local strategies. For example, most Hamilton County lakes are actually located in the St. Lawrence River or Upper Hudson River basins. Of the 13 high priority water bodies listed in the 1999 Hamilton County strategy, only one (Seventh Lake) is in the Black River basin. This lake is listed as stressed for fish propagation resulting from deicing agents. One medium priority (Eighth Lake) and one low priority (Indian River) are also listed. Of the 20 priority watersheds listed for Lewis County, three (Dear River, Beaver River and Moose River) are listed in the PWL for the Black River basin. To compare local priorities to resource impairment, the water bodies appearing on the PWL and in county strategies were selected for the gap analysis.

Sources of Impairment

Sources of impairments for lakes, rivers and streams in all PWL severity categories are shown in Figures 3C-5 and 3C-6. Contaminated sediments account for the greatest percent of impaired lake acres (43%). For example, the Stillwater Reservoir's primary use (fish consumption) is impaired due to metals from contaminated sediments, in this case, mercury exacerbated by a low pH due to acid deposition. The use impairment is manifest in a health advisory on splake, which warns people not to eat more than one meal per month.

Impairment sources for individual large water bodies have a large influence in Figure 3C-5. For example the Stillwater Reservoir is 6,195 acres in size, and about 40 percent of the entire lake acres of the Black River Basin. There are over 50 small ponds with acid deposition as the primary source of impairment but, since they range from one to 20 acres in size, they add up to a small percentage of the total contribution. Agriculture is

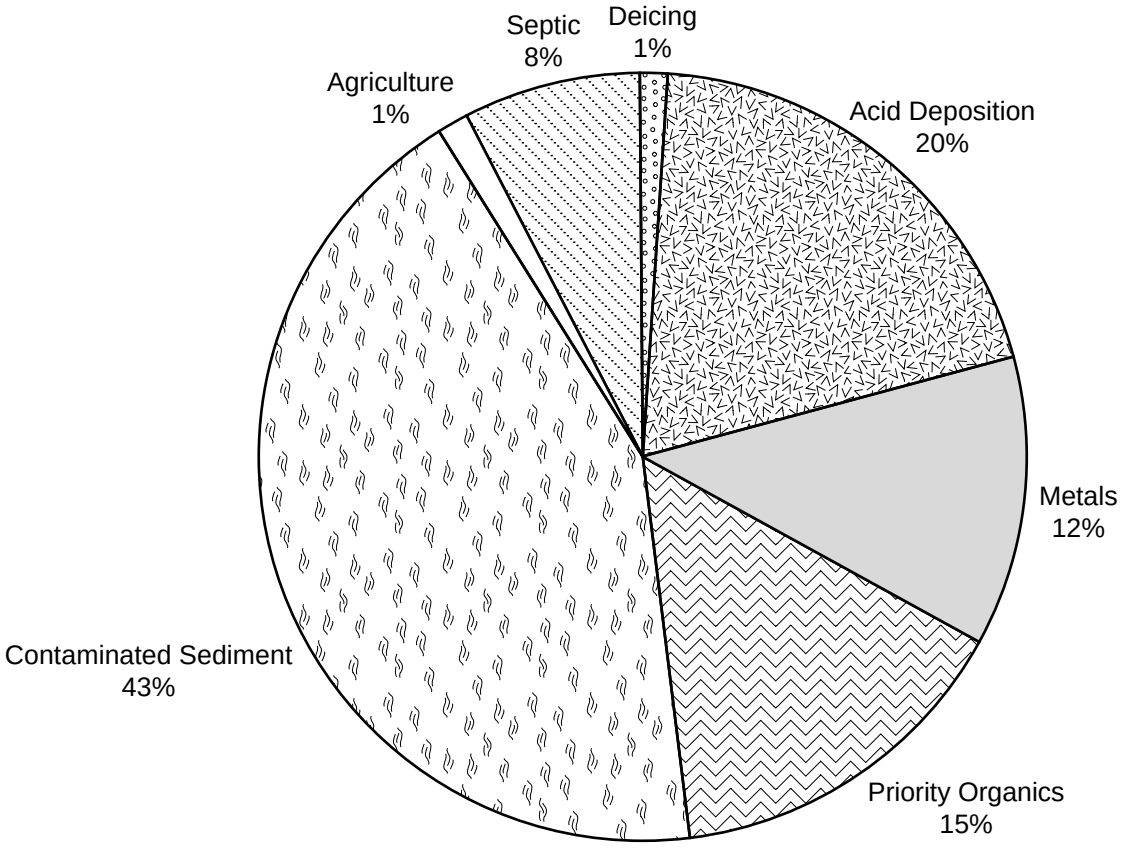

Figure 3C-5. Primary causes of use impairments for lakes in the Black River basin.
Source: DEC 1996

[3]Herkimer County is in the Black River Basin, but at the time of this study was not participating in FL-LOWPA and detailed data were not collected through a focus group interview for this county.

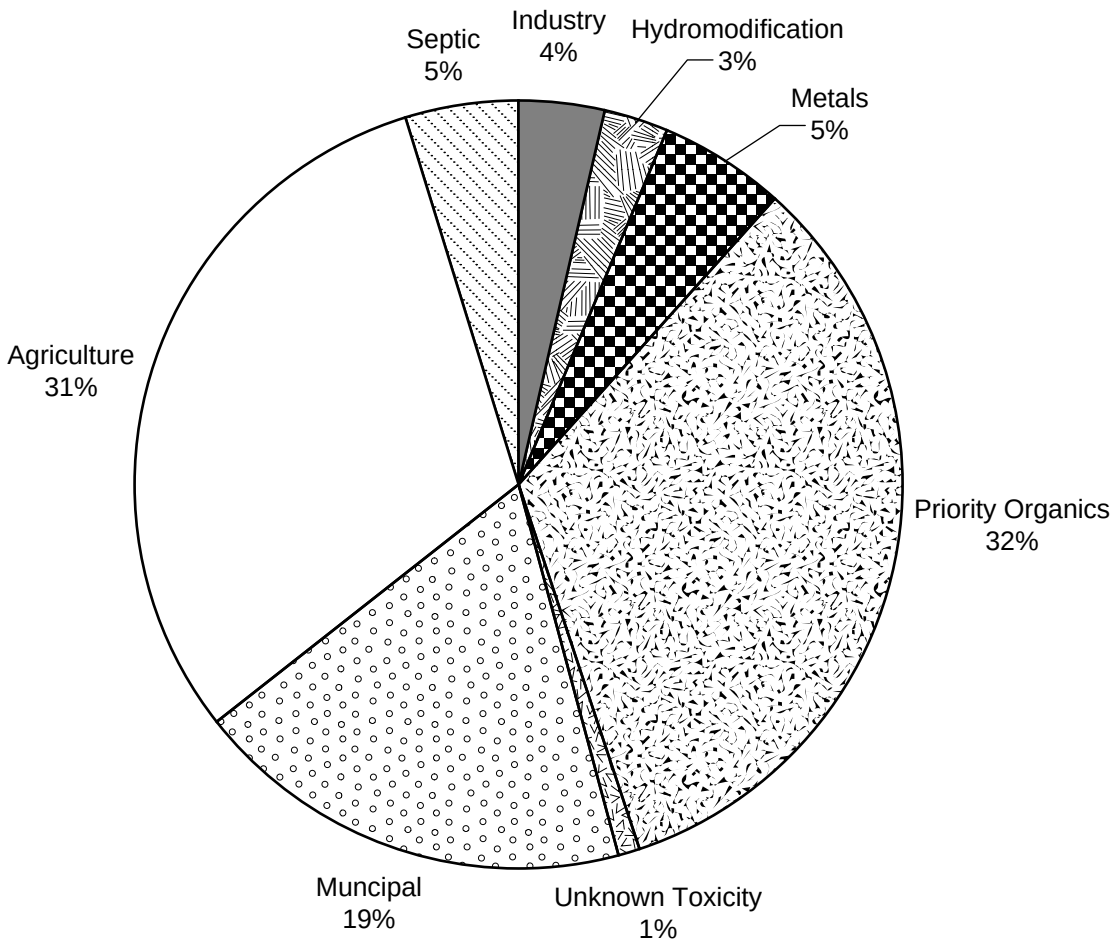

Figure 3C-6. Primary causes of use impairments for rivers and streams in the Black River basin.
Source: DEC 1996

the major source of impairment to rivers in this basin, affecting 31% of river and stream miles. In most cases, the primary agricultural pollutant is nutrients or silt (sediment). Priority organics is the second major source (affecting 32% of river and stream miles) from industry and unknown sources. Municipal sources affect 17% of river and stream miles.

Sources of impairment for PWL segments in each severity class are shown in Figures 3C-7and 3C-8. For lakes in this basin, *precluded* waters are impaired most by acid deposition. Particularly at higher elevations, fishing is precluded due to diminished fish survival. The greatest number of lake acres in the basin on the PWL are classified as *impaired*. Overall, contaminated sediments are responsible for the greatest number of these acres, followed by priority organics, metals, and acid deposition. There are far fewer acres in the stressed and threatened severity class; these are affected by failing septic systems, deicing, and agriculture.

Departing from the lakes in this basin, very few impaired river and stream segments fall into the *precluded* and *impaired* severity classes, though organic chemicals are the primary source precluding these areas. Most of the PWL river segments listed in the Black River basin are in the *stressed* and *threatened* categories. River and stream miles categorized as *stressed* are affected largely by organic chemicals (with some contribution from failing septic systems, metals, and industry) while agriculture and municipal sources are the primary sources of impairment to the *threatened* river and stream miles.

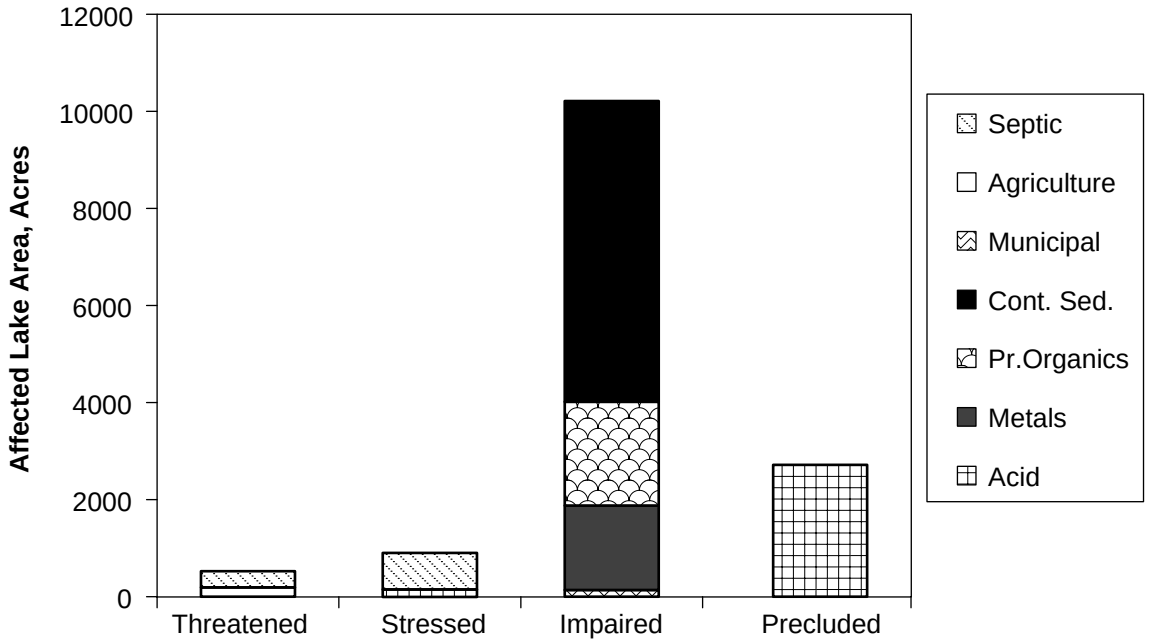

Figure 3C-7. Sources of impairments by PWL severity class to lake segments in the Black River basin.

Source: DEC 1996

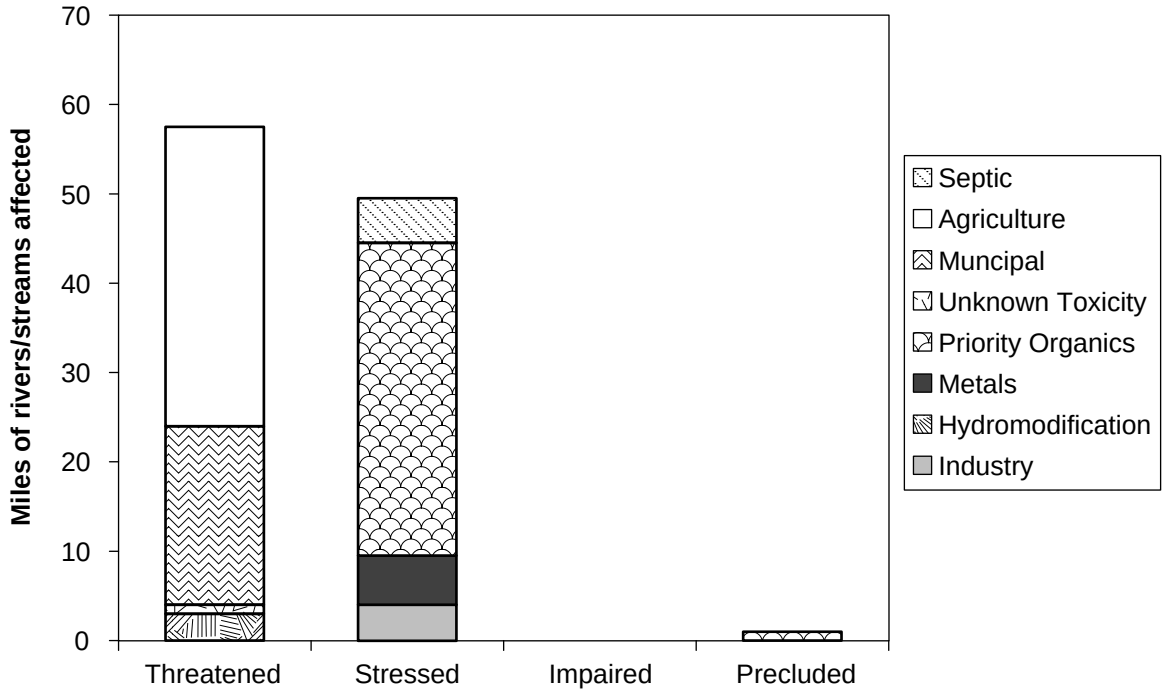

Figure 3C-8. Sources of impairments by PWL severity class to river segments in the Black River basin.

Source: DEC 1996

LOCAL PRIORITIES

Local agencies participating in the focus group interviews in the counties identified three issues as high priority: groundwater/drinking water; development; and agriculture. Stream bank erosion and lake eutrophication were the next highest priorities noted by agency participants (Figure 3C-9).

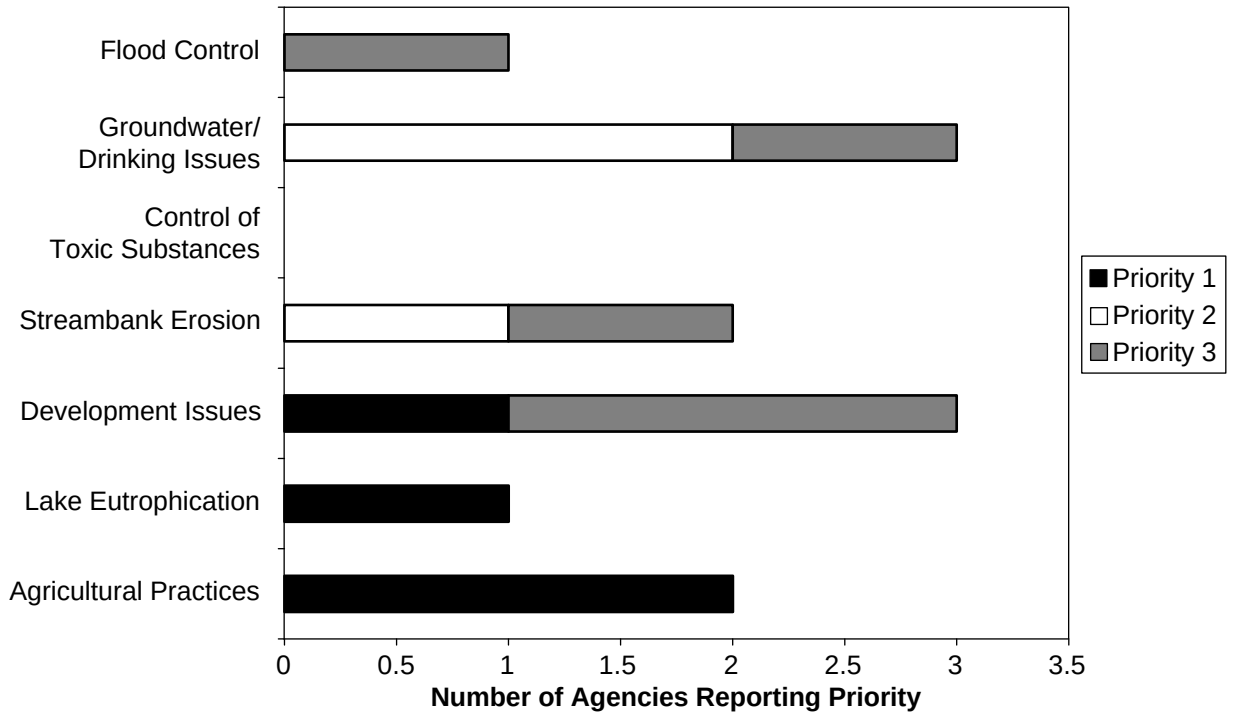

Figure 3C-9. Priorities among water resources agencies in the Black River basin.

GAP ANALYSIS: CONGRUENCE BETWEEN RESOURCE IMPAIRMENTS AND LOCAL PRIORITIES

There is a lack of congruence between local agency priorities to the degree of resource impairments as indicated by the PWL for the Black River basin. (Figure 3C-10) This deviation is explained in the jurisdiction and programs of the agencies interviewed. Toxic substances and acid deposition stem largely from regulated industrial and municipal sources (some of which are unknown or outside the basin) not in the purview of local agen-

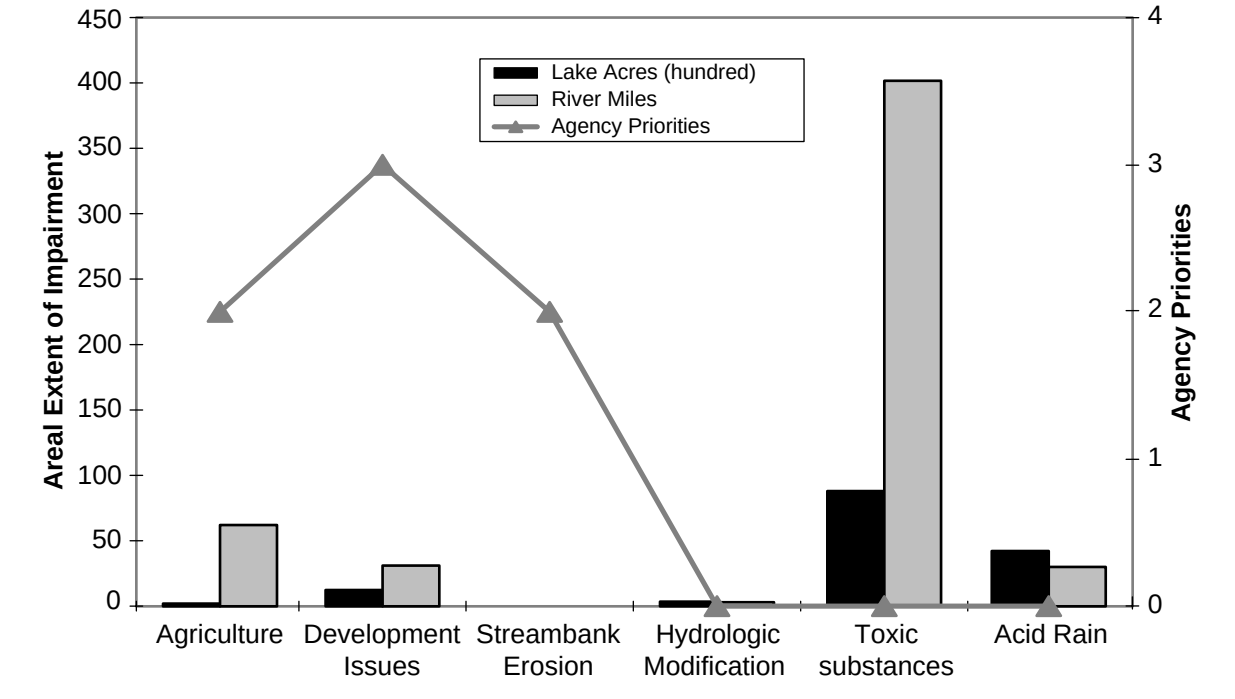

Figure 3C-10. Black River basin gap analysis: Relationship between agency priorities and resource impairments indicated by the Priority Waterbodies List.

cies. These issues fall under regulatory control by agencies like DEC. Local agencies have focused on remaining nonpoint source pollution issues of agriculture, development, and stream bank stabilization (Figure 3C-11 and 12). One exception to this general picture is Hamilton County where, in addition to identifying water quality stressors from local human development, the long term monitoring program on 21 local lakes establishes relationships between pH and alkalinity, and water quality factors confounded by acid deposition. Also, it could be argued that the Black River basin should be analyzed in two units, the high elevation area prone to acid deposition, and the lower elevation valley where physical and geological factors mitigate the influence of acid deposition and other impairment sources dominate.

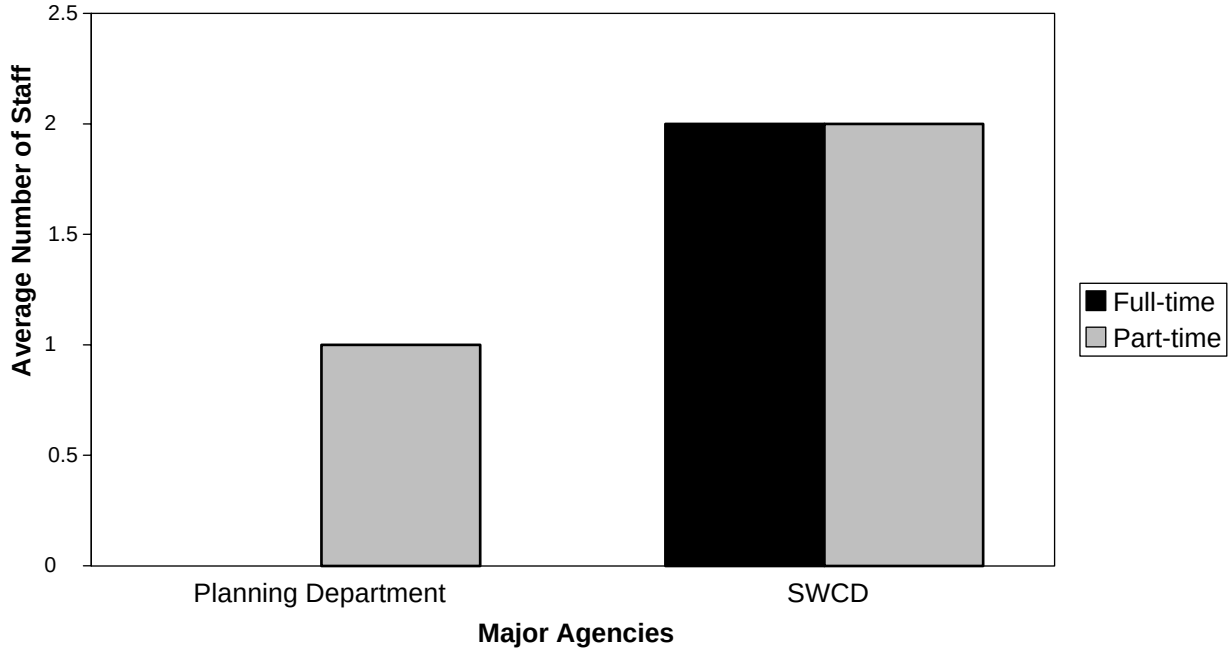

Figure 3C-11. Average staffing levels for water resources agencies in the Black River basin.

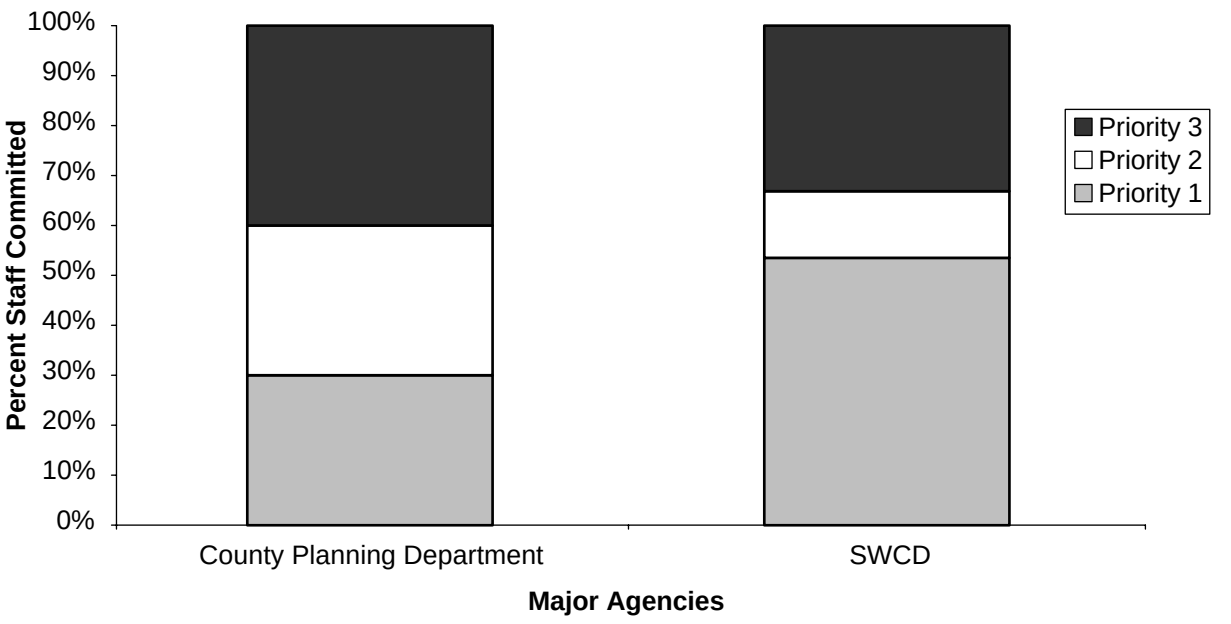

Figure 3C-12. Resource targeting in the Black River basin: Staff assigned to priority areas.

CHAPTER 3, SECTION D

LAKE ONTARIO DIRECT DRAINAGE AREAS PERSPECTIVE

DESCRIPTION OF THE DRAINAGE AREAS

For the purposes of this study, the Lake Ontario Direct Drainage basin is comprised of three distinct land areas that drain directly to Lake Ontario (Figure 3D-1). The areas from east to west are called the Salmon-Sandy Drainage Area, Irondequoit-Ninemile Drainage Area and Oak-Orchard Drainage Area. Combined, they encompass about 2,700 square miles. Unlike the counterpart basins dominated by a major river system, many small watercourses like brooks and creeks flow through the Direct Drainage Areas. Among the significant water resource features in this basin are Irondequoit and Sodus Bays, Salmon River Reservoir, Salmon Creek and some segments of the New York State Barge Canal. There is no one major metropolitan area, but numerous small communities dot the Direct Drainage Areas basin.

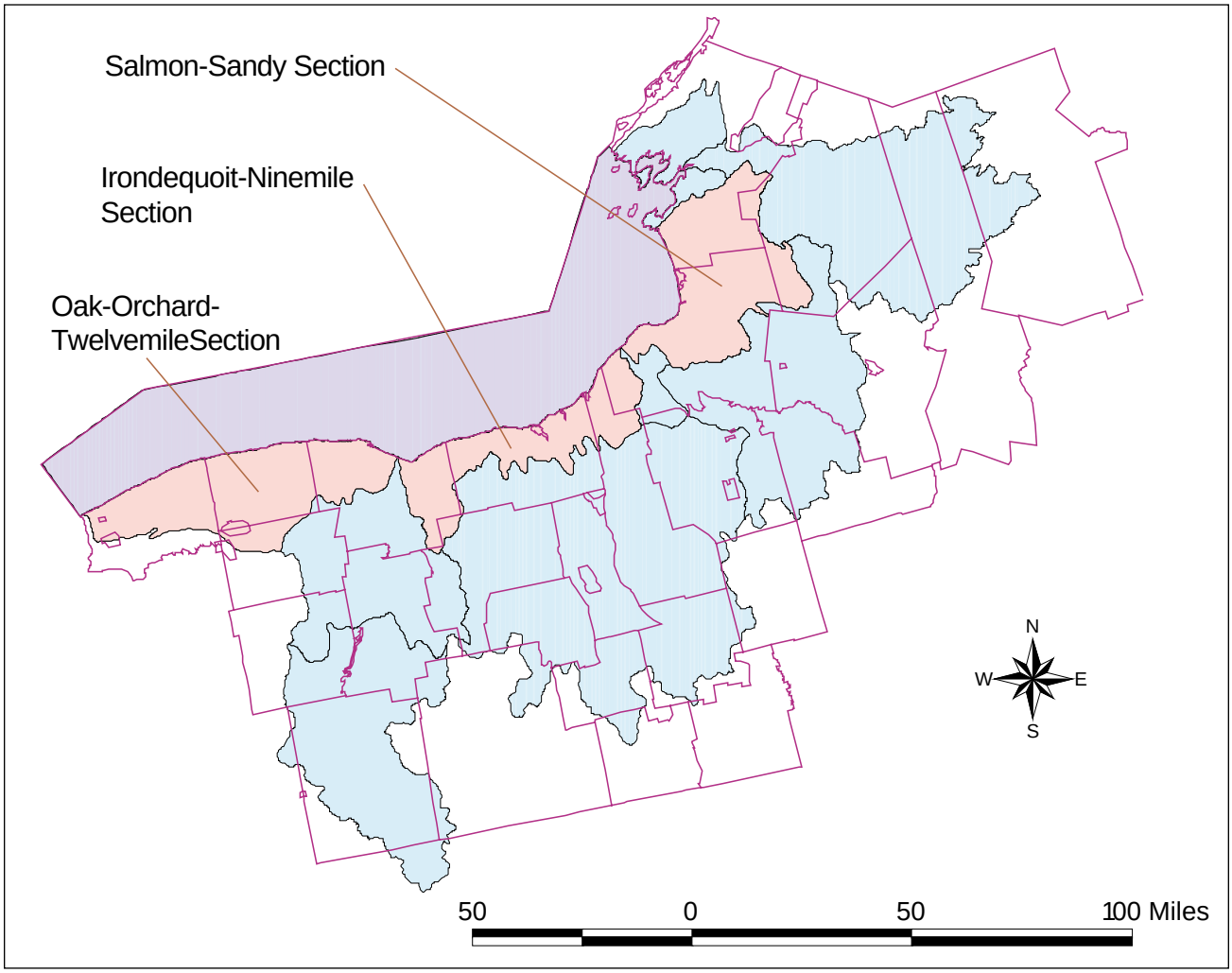

Figure 3D-1 The Direct Drainage Areas.

History and Human Population

Agriculture is the dominant land use and industry. A variety of water related businesses and activities, including charter fishing and tourism attractions, are evident along the Lake Ontario shoreline. The population of the Direct Drainage Areas increased after 1823 when a major portion of the Erie Canal linking Rochester to Albany was opened. Large bays on the Lake such as Irondequoit Bay and Sodus Bay became prime fishing and recreational centers. Based on the 1990 census, the total population for the three drainage areas is about 660,000 people, averaging about 243 persons per square mile, the second highest population density among the watersheds assessed in the New York State Lake Ontario Basin.

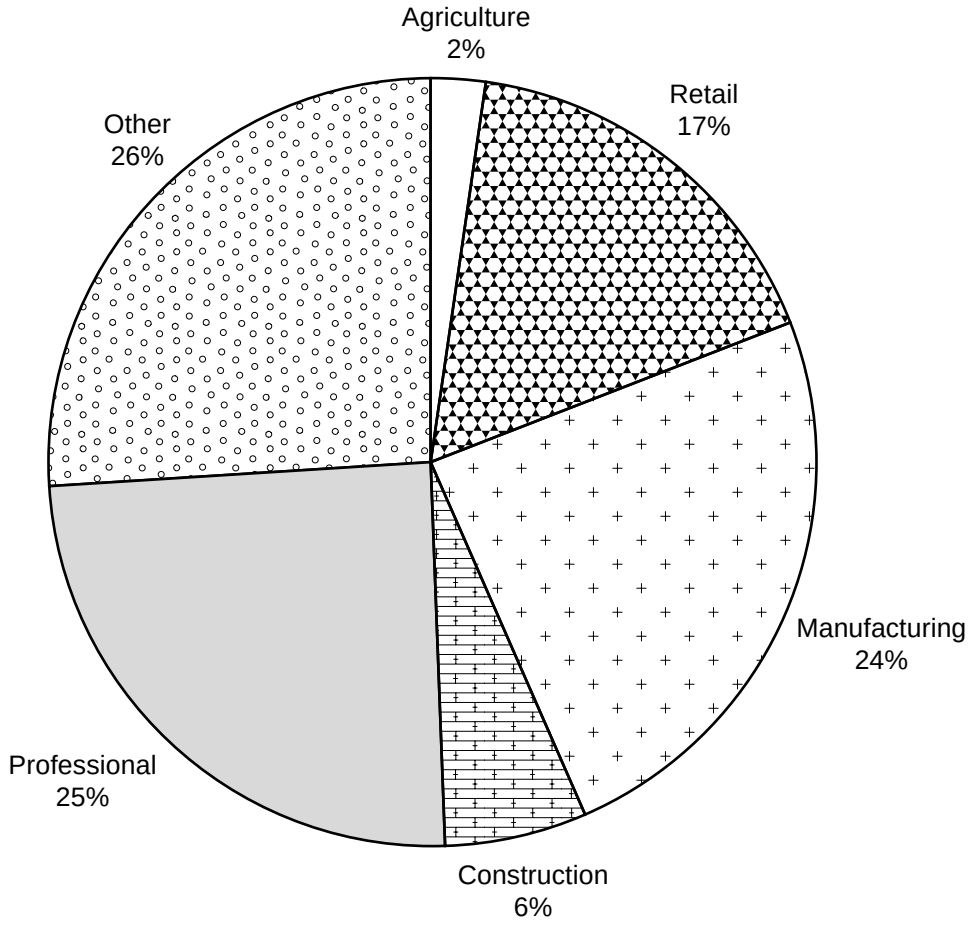

Figure 3D-2. Employment distribution in the Direct Drainage Areas.

Employment

Manufacturing employs almost one-quarter of the workforce while another quarter is employed in professional jobs; 17% are in retail, and just 2% work in agriculture (Figure 3D-2).

Land Use

Major land cover/uses in the Direct Drainage Areas include agriculture (52%), forest (36%), waters and wetlands (5%), urban (5%) and transportation (1%) (Figure 3D-3).

The Direct Drainage Areas have many significant cultural and natural resources, but because they are geographically dispersed along the Lake Ontario shoreline, they lack the regional identity that other drainage basins share by the presence of a major river system. The Niagara River bounds the western edge of the Direct Drainage with nearby Youngstown and Old Fort Niagara State Park on Lake Ontario. Wilson, Olcott, Waterport, Childs, Ontario, Williamson, Sodus Point, Sterling, Henderson, Henderson Harbour, Brownville, and Three-Mile Bay are the cultural and population centers of these mainly rural watersheds.

The Direct Drainage Areas provide for water-based recreation such as boating and ice sailing along the Lake Ontario shoreline; trout and steelhead fishing along the creeks and rivers; automobile stops and walking along the Barge Canal; and passive recreation such as bird watching and sightseeing throughout the area. Orchards are common near Lake Ontario.

Geology and Ecoregions

Most of the underlying geology of the two western Direct Drainage sections was formed in Upper Ordivician as part of the Medina Group and Queenstone Formation. The underlying rocks are Queenstone shale that is composed of red siltstones that lie across the entire southern section of the Lake Ontario Direct Drainage. These siltstones tend to increase in thickness moving from the Niagara River eastward to just south of Oswego. Most

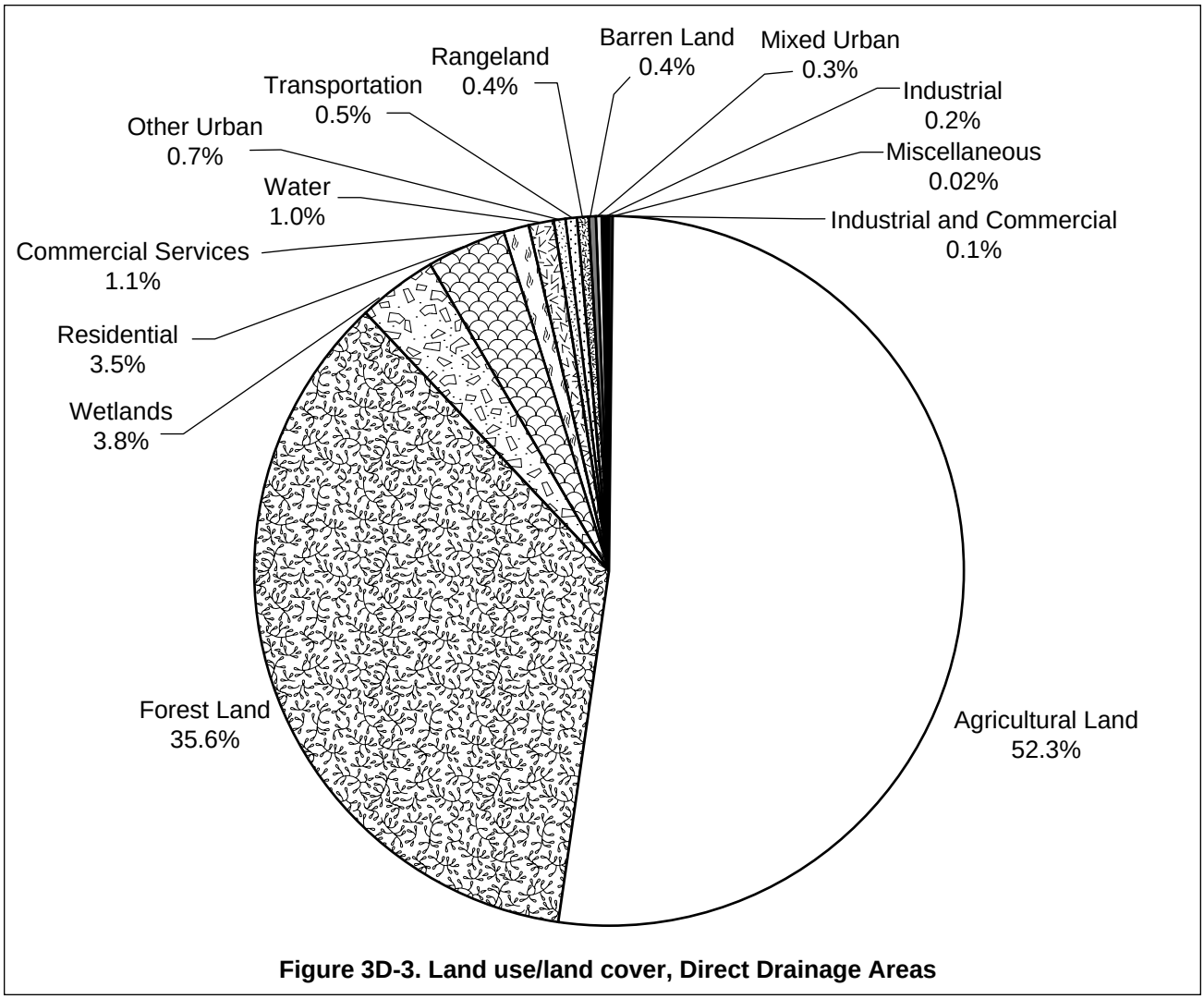

Figure 3D-3. Land use/land cover, Direct Drainage Areas

of the eastern Direct Drainage is part of the Lorraine Group formed a little earlier in the Middle Ordivician. Going north from Oswego, this Direct Drainage Area is characterized by Oswego Sandstone (with thin red or gray shales); Pulaski Formation (tan-gray siltstones, shales, light gray sandstone); Utica Shale (fissile black shales) and the Trenton Group (Cobourg Limestone) in the Henderson Pond/Crystal Lake area.

Most of the Direct Drainage is found in the Lake Erie and Ontario Lake Plain ecoregions, with a small eastern area overlapping the Adirondack Mountain and Foothills ecoregion. The western area falls completely in the Erie Ontario Lake Plain and the central area is split between the Eastern Ontario Till Plain and the Lake Erie Plain. The eastern section includes this Lake Erie Plain, some Black River Valley and the Tug Hill Plateau and Transition (Appendix A).

WATER QUALITY STATUS

Extent of Impairment

About 192 stream miles and four water bodies are included on DEC's 1996 PWL in the three Direct Drainage Areas. The more degraded PWL-TMDL stream areas represent about five percent of the total (3,908) stream miles in the watershed. Ninety-six miles (10.4% of the total miles) are in the Irondequoit-Ninemile Drainage Area; 72 miles (or 4.7% of the total miles) are in the Oak-Orchard Drainage Area, and 24 miles (1.6%) are in the Salmon-Sandy Drainage Area (Table 3D-1; Figure 3D-4).

Table 3D-1. Distribution of PWL segments in the Lake Ontario Direct Drainage Areas.

Direct Drainage Basin Area	Miles of Streams (sq. miles)	Drainage Area (miles)	PWL/TMDL	PWL Waterbodies
Oak-Orchard-Twelvemile	1534	1429	72	1
Irondequoit-Ninemile	921	936	96	1
Salmon-Sandy	1453	1144	24	2
Total	3,908	3,509	192	4

Figure 3D-4 shows the location of PWL segments within the Direct Drainage Areas.

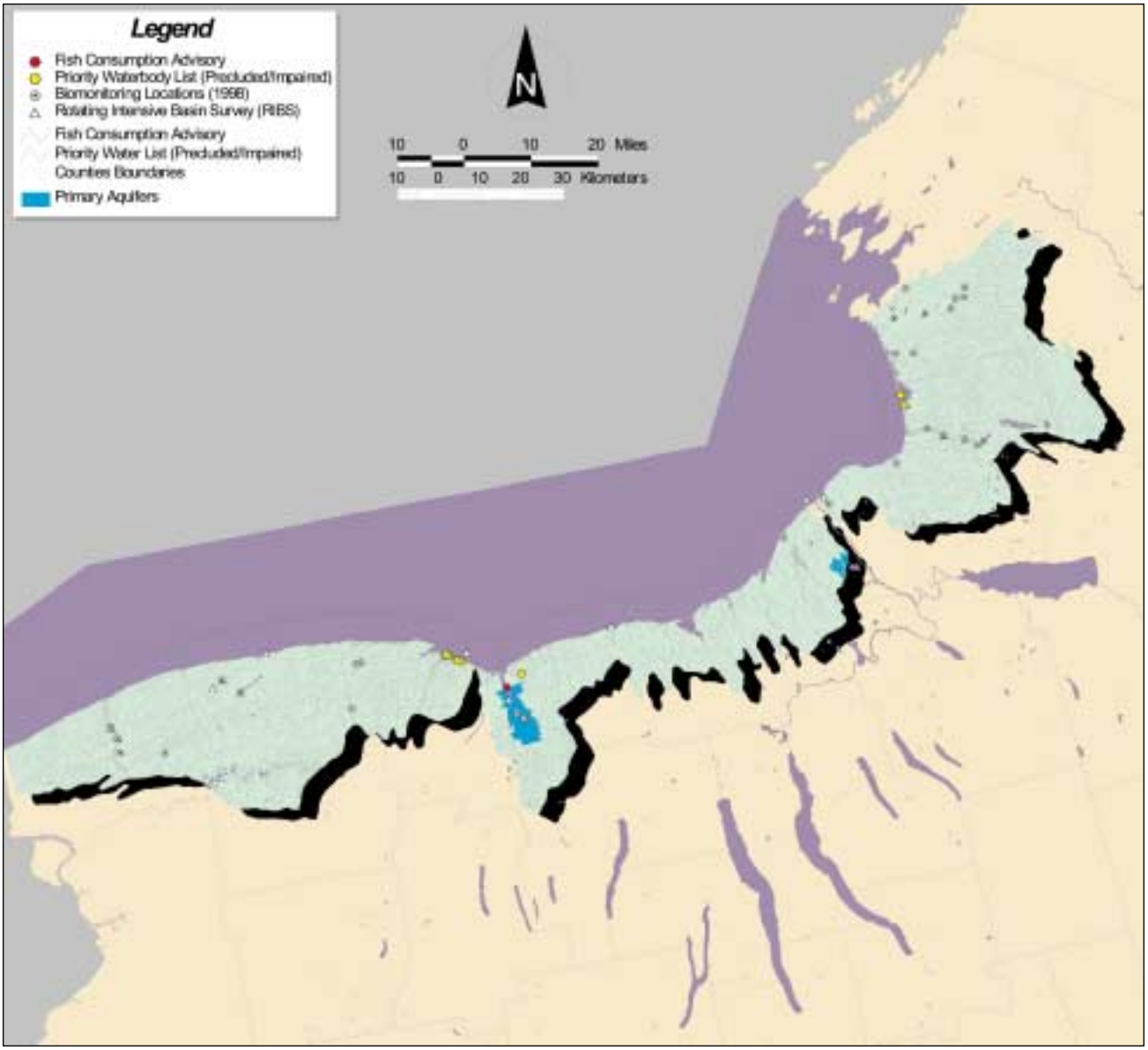

Figure 3D-4 Water body segments classified as *Impaired* or *Precluded* in the Direct Drainage Areas, DEC Unified Watershed Assessment (1998).

The 1996 PWL list was compared to the Direct Drainage counties' (Niagara, Orleans, Wayne, Monroe, Cayuga, Oswego, and Jefferson) priority water bodies as documented in the county water quality strategies. Orleans County dovetailed DEC's PWL with local priorities to develop a more comprehensive list of local water bodies of concern. By this means, Orleans County added Lake Alice, Glenwood Lake, and Holey Wellhead to water bodies included on the PWL. In Wayne County, a quantitative system for prioritizing water quality problems was established and each tributary was ranked based on relative pollutant loadings. Monroe County, discussed in Section B, similarly bases its priorities on local documentation of problems, but these correspond well with the PWL. In the other counties, correspondence between the PWL and county strategies was high.

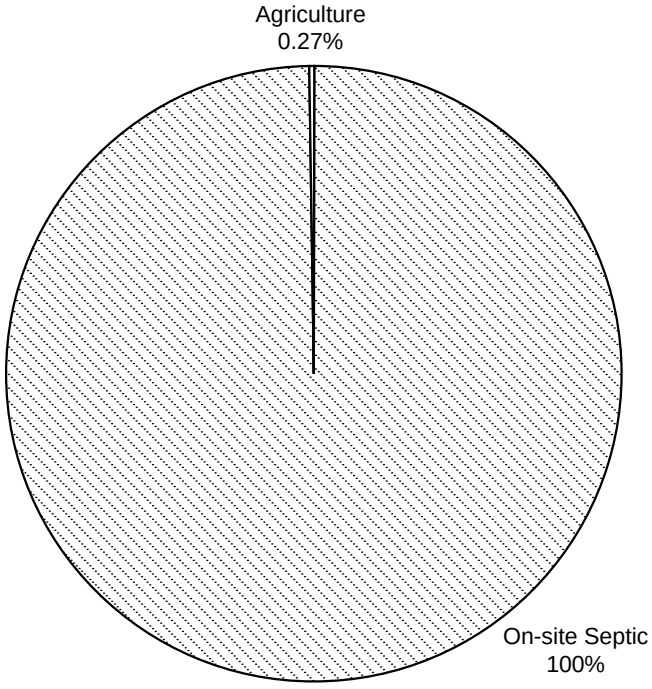

Figure 3D-5. Primary causes of use impairment for lakes in the Direct Drainage Areas.
Source: DEC 1996

Sources of Impairment

In the Direct Drainage Areas, virtually 100% of the use impairment to lakes and bays is from failing on-site septic systems (Figure 3D-5). These lakes and bays are rimmed with residential development. On the other hand, the PWL indicates impairment to stream and river miles is caused by agriculture (66%), followed by failing septic systems (22%), land disposal (7%) and contaminated sediments (2%) (Figure 3D-6). In both lakes and rivers, nutrients are the primary pollutant with some impairment due to pathogens. Examining the sources of impairments for Direct Drainage water bodies within each PWL severity class, land disposal is the key source affecting relatively few stream miles but causing them to be designated *precluded*. Failing septic systems are the primary source of impairment for stream miles in the *impaired* category, and agriculture is the primary source of impairment affecting stream miles in the stressed category (Figure 3D-7). For lakes, measured in the PWL in acres, roughly the same number of acres are listed as *threatened* and *impaired*. Agriculture is the source responsible for the greatest number of these acres listed on PWL (Figure 3D-8). Agriculture is a primary land use (52%) in this area. There are no *precluded* lake acres in the Direct Drainage Areas, and very few categorized as *stressed*.

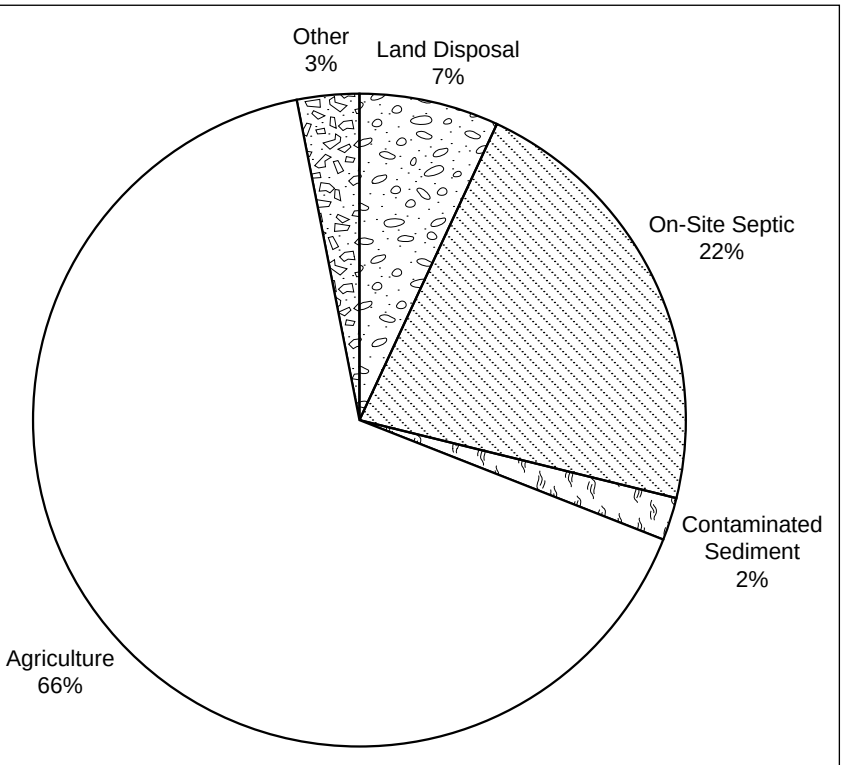

Figure 3D-6. Primary causes of use impairment for rivers and streams in the Direct Drainage Areas.
Source: DEC 1996

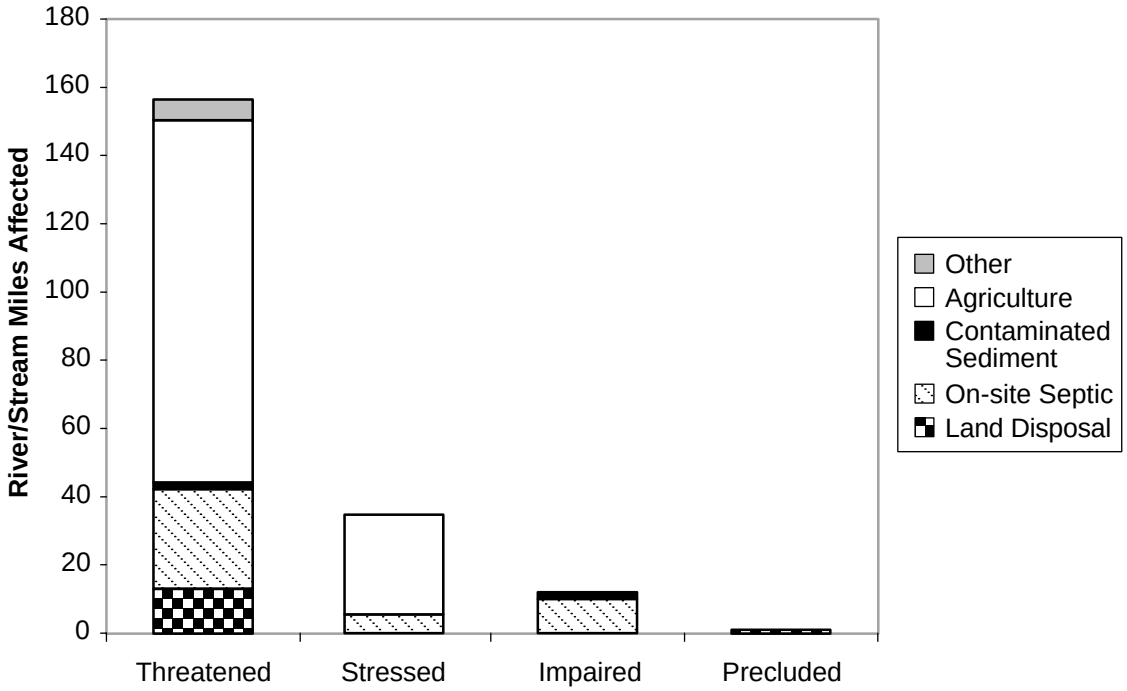

Figure 3D-7. Sources of impairments by PWL severity class to river and stream segments in the Direct Drainage Areas.

Source: DEC 1996

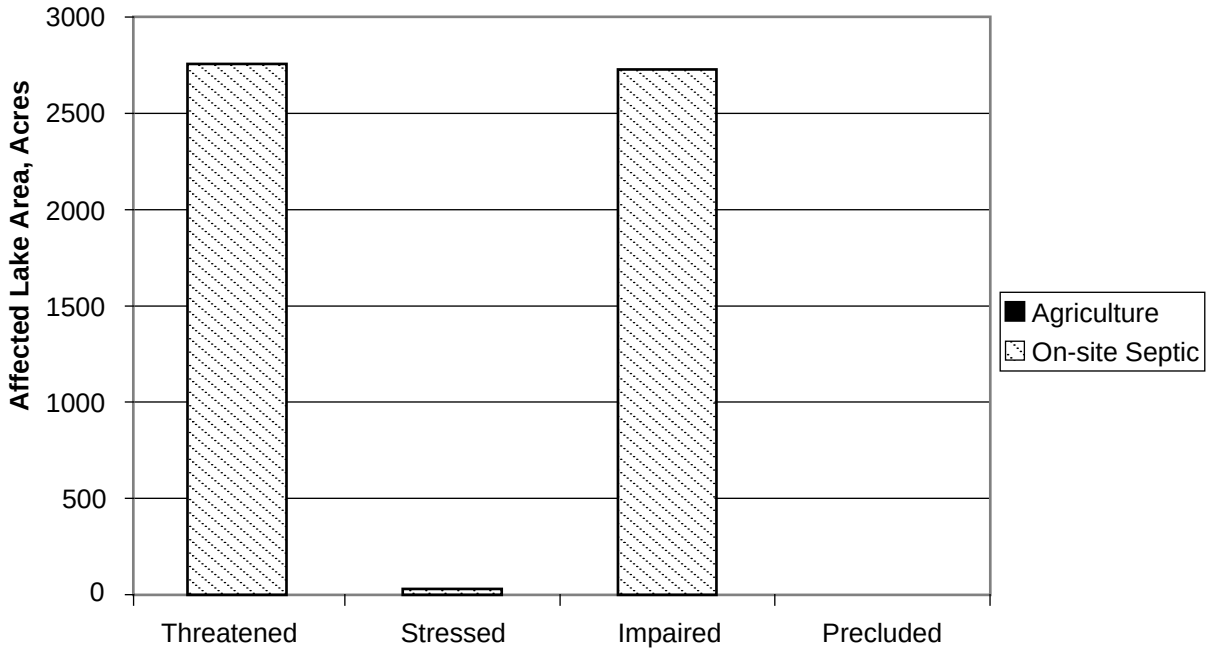

Figure 3D-8. Sources of impairments by PWL severity class to lake segments in the Direct Drainage Areas.

Source: DEC 1996

LOCAL PRIORITIES

Agriculture was clearly the top priority of the greatest number of agencies working locally on water quality issues in the Direct Drainage Areas, based on the written questionnaire completed by participants in focus group meetings at the county level (Figure 3D-9). Groundwater/drinking water, stream bank erosion, and development issues, including inadequate septic systems, were the next priorities. In Monroe County, drinking water in general was not reported to be top concern, but drinking water from groundwater was.

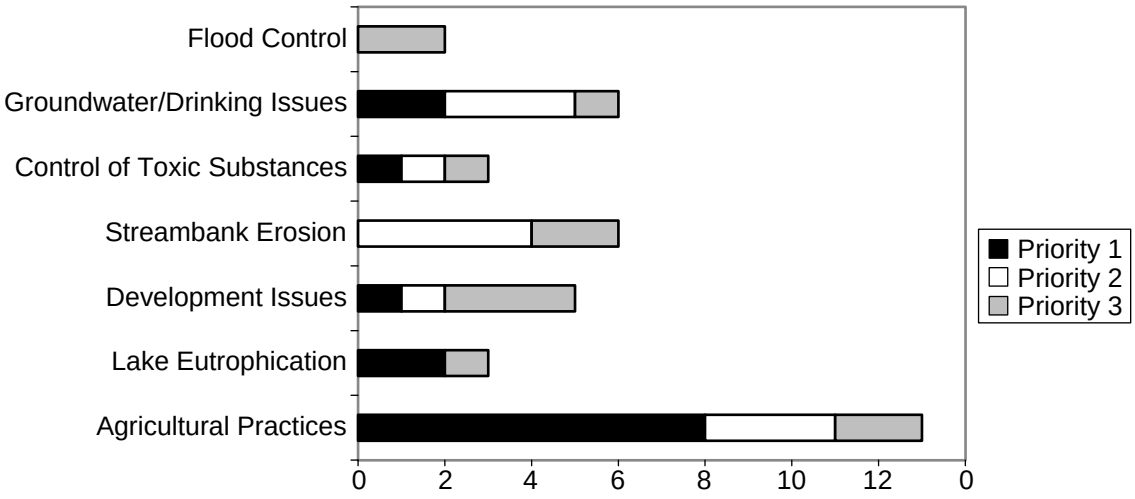

Figure 3D-9. Priorities among water resources agencies in the Direct Drainage Areas.

GAP ANALYSIS: CONGRUENCE BETWEEN IMPAIRMENTS AND LOCAL PRIORITIES

There is a general pattern of alignment between the priorities identified in the Direct Drainage Areas during the county interview process and the extent of resource impairment from various sources as identified in the PWL (Figure 3D-10). There is a high priority placed locally on stream bank erosion, which is not reflected in the PWL for this area. This could be due to a variety of situations, including the existence of more detailed documentation on this problem at the local level; a temporary high priority placed on problem areas until they are remedied (as in the case of Linear Park on Irondequoit Creek in Monroe County); an emphasis on problem prevention; or a local priority ranking system that does not depend on the PWL.

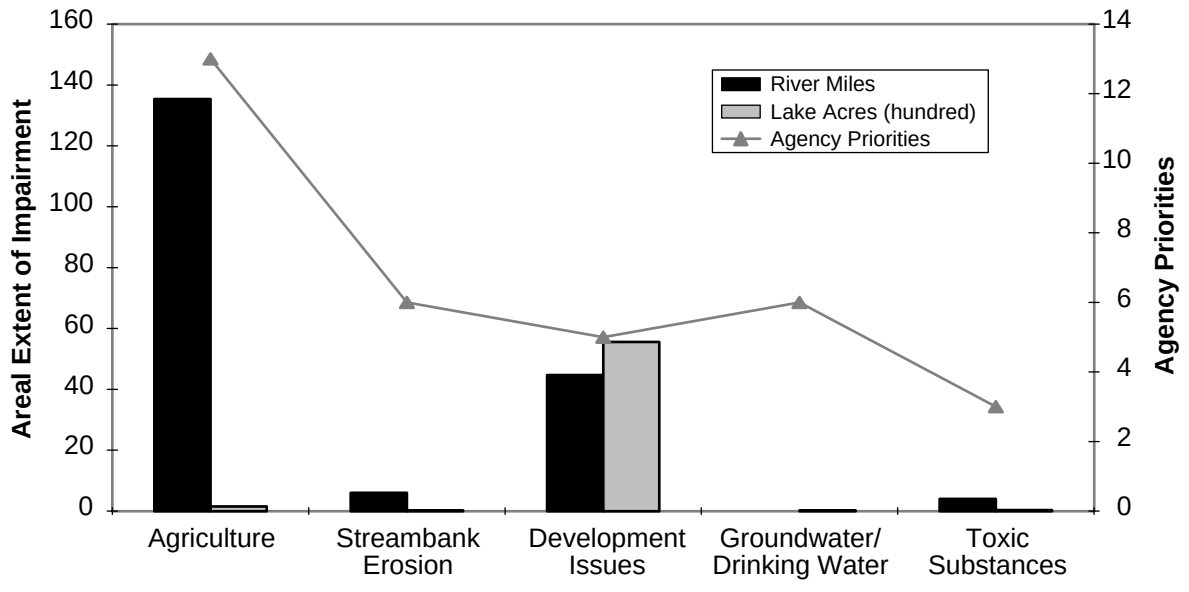

Figure 3D-10. Direct Drainage Areas gap analysis: Relationship between agency priorities and resource impairments indicated by the Priority Waterbodies List.

Staffing levels in various agencies represented in the county interviews and averaged by agency type across the Direct Drainage Areas are shown in Figure 3D-11. These data provide a general picture of human resources available locally for water quality problems in the Direct Drainage Areas. Figure 3D-12 shows the percent of staff committed to each type of agency's top three areas of concern. Most agencies committed about 50% of their staff resources to their first priorities, and about 90% of their staff resources within their top three priority areas.

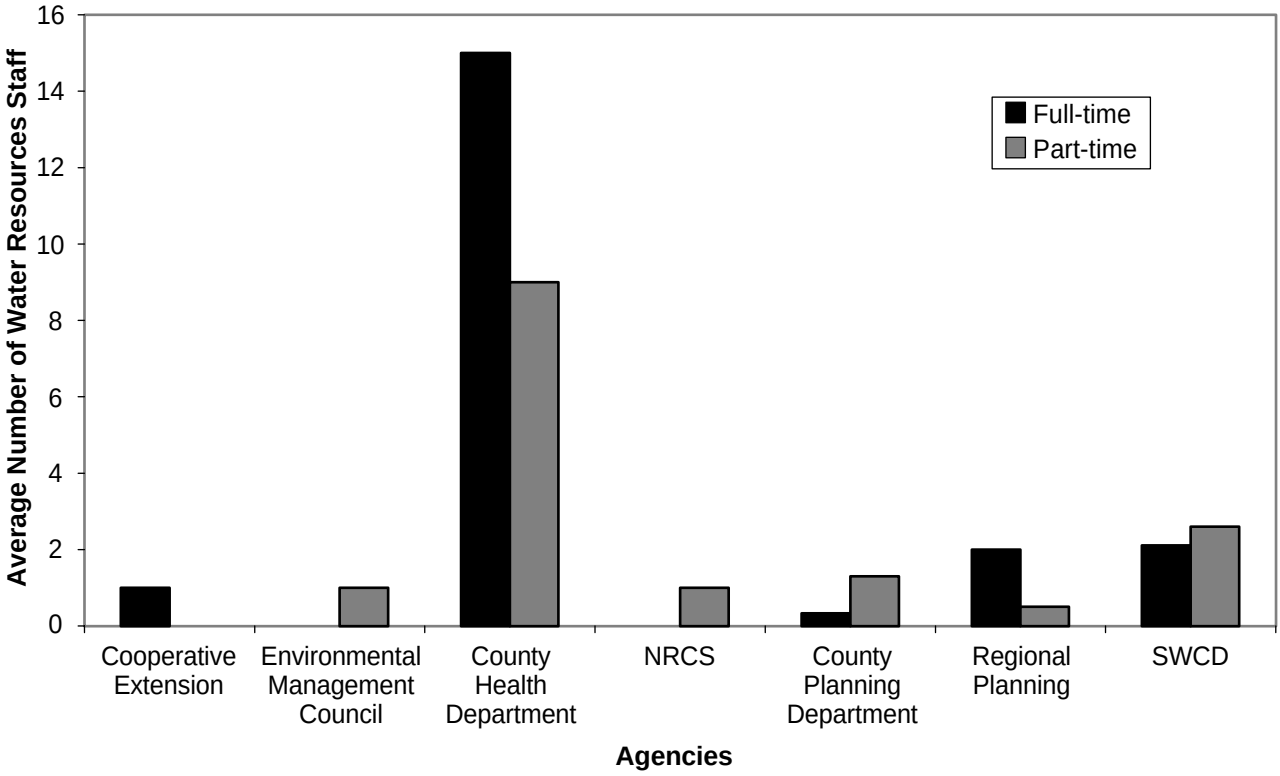

Figure 3D-11. Average staffing levels for water resources agencies in the Direct Drainage Areas.

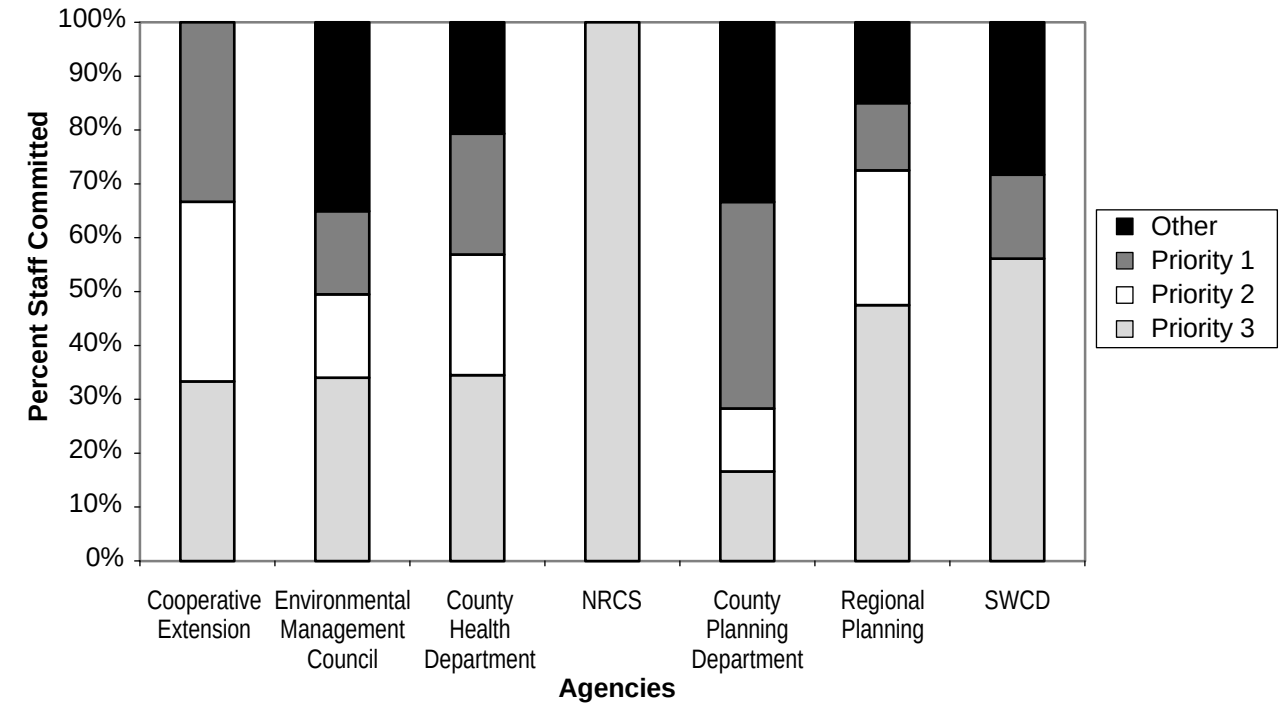

Figure 3D-12. Resource targeting in the Direct Drainage Areas: Staff assigned to priority areas.

CHAPTER 4

CONCEPTS OF WATERSHED PLANNING AND MANAGEMENT

THE WATERSHED APPROACH IN THE LOCAL CONTEXT

Watershed planning and management is a scientifically based approach to environmental protection of both the land and waters within a drainage area. The drainage area in question could be an entire basin, such as the 5,100 square mile Seneca-Oneida-Oswego River basin, or the watershed and lake area of a Finger Lake, like Cayuga Lake, covering about 785 square miles, or a creek with a drainage area of a few square miles. A watershed approach to environmental protection is holistic, recognizing linkages within the ecosystem between land, air, water, and human activities.

According to the Environmental Protection Agency, the watershed approach is a "coordinated framework for environmental management that focuses public and private sector efforts to address the highest priority problems within hydrologically-defined geographic areas, taking into consideration both ground and surface flow" (EPA 1996).

Over the past thirty years, most watershed-wide environmental protection has come in the form of federal and state regulatory programs. Federal laws such as the Clean Water Act, Resource Conservation and Recovery Act, and Safe Drinking Water Act have set the course for water resources protection since the 1970s, and tremendous strides in environmental quality can be attributed to them. Over the last decade, attention has broadened to the largely unregulated and disperse nonpoint sources of pollution that stem from the many ways that people develop land, reside, make a living, and recreate in watersheds. There is a gradual acceptance at the local level, where most land use planning, zoning, and nonpoint source pollution controls are devised and implemented, of the need to work together across jurisdictional boundaries to establish comprehensive plans and uniform standards to adequately protect water resources.

The scope of watershed management planning is broader than the regulatory approach to water pollution control and as such presents its own set of challenges. The watershed approach considers all possible impacts from disperse and often undocumented and unregulated sources of water pollution. This broad scope presents information and data collection challenges. Because most watersheds cut across town boundaries, a watershed approach calls for cooperative decision making to which municipalities are often unaccustomed, though the tide is changing (see case studies in Chapter 5). Watershed management practices often rely on the voluntary action of landowners and resource users, and therefore require widespread public awareness and motivation to protect water resources.

There is no "ideal" process for managing watersheds because each watershed is unique, and what works well in one place may not work as well in another. There are a number of fundamental elements that appear to be present in most successful watershed planning and management efforts. Four major elements are (1) stakeholder involvement and local control, (2) watershed-wide resource assessment and prioritization, (3) resource-based integrated solutions, and (4) evaluation and feedback mechanisms. A fifth component is public education, important throughout a watershed planning and management process.

Figure 4-1. Four important elements of watershed planning.

ELEMENTS OF WATERSHED PLANNING AND MANAGEMENT

Each of the major watershed planning elements discussed below is composed of a number of minor specific components useful for evaluating and comparing programs as well as for planning new ones. The watershed planning cycle of the four major elements is shown in Figure 4-1. The four elements are generally carried out in sequence beginning with stakeholder involvement, resource assessment and prioritization, resource based solutions, and evaluation and feedback. The watershed management cycle may go through a number of iterations as evaluation and feedback allows refinements. Individual tasks associated with the four main elements are shown in Figure 4-2.

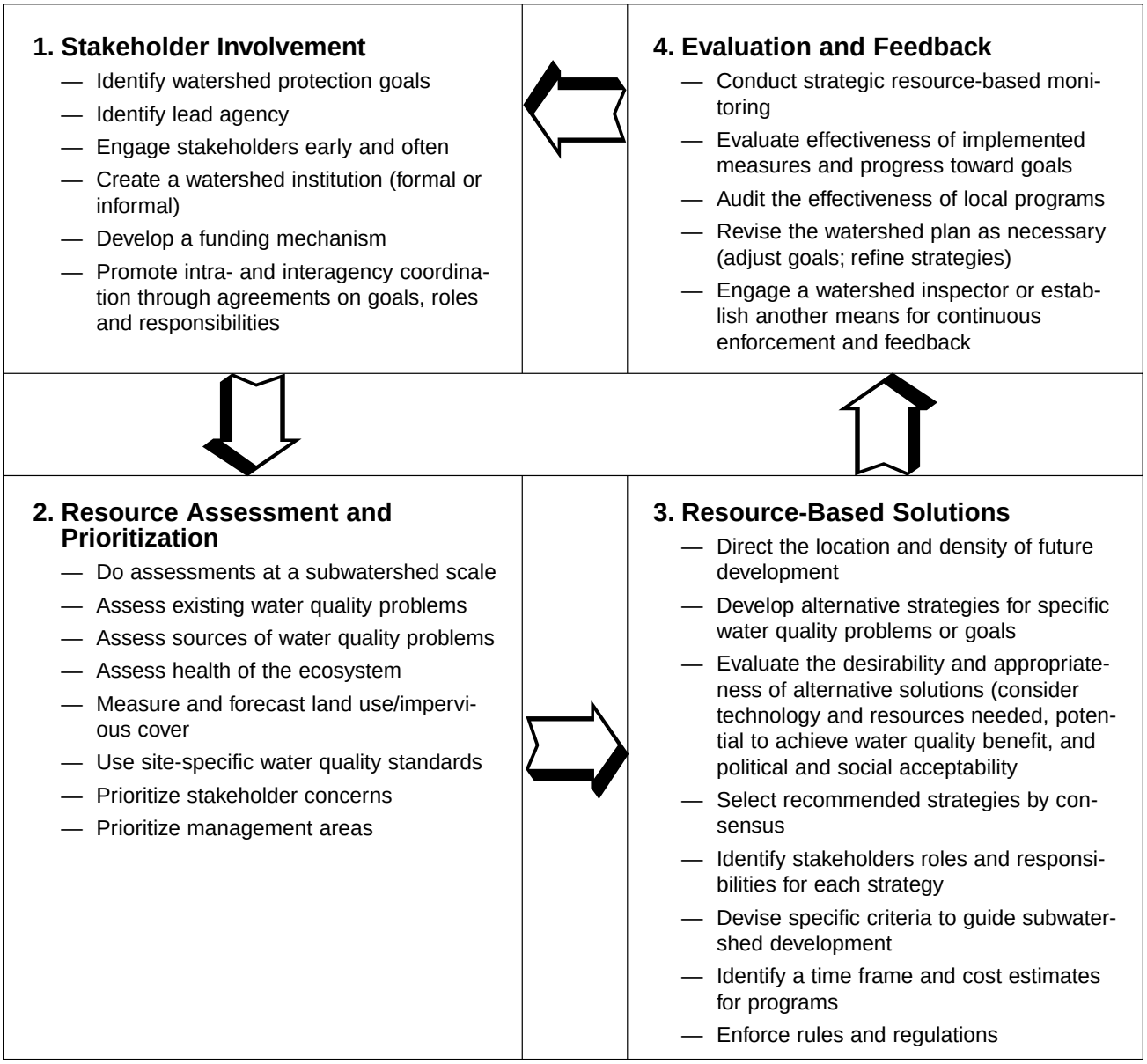

Figure 4-2. Tasks typically associated with the four elements of watershed planning.

Stakeholder Involvement

Who Are the Stakeholders?

Stakeholders can be defined as any agency, organization, or individual that has a role in making decisions for a watershed, or who will be affected by such decisions. Depending upon the local context, potential stakeholders may include representatives from municipalities (planning boards and elected officials); county departments (e.g., planning and health, Cornell Cooperative Extension, soil and water conservation districts, and environmental management councils); WQCCs; recreational user groups; lake associations; business owners; developers; tourism representatives; agricultural producers; environmental and civic organizations; water purveyors; property owners, resource managers from local, regional, state or federal agencies (e.g., Regional Planning Boards, DEC Regional offices, NRCS); interested citizens and others.

The Importance of Local Involvement

In order to develop consensus and obtain the support needed to implement a watershed strategy, it is very important to have a representative group of stakeholders involved early and often. If their involvement is meaningful, stakeholders will take ownership of the strategy, and provide momentum for its implementation. This is particularly useful because voluntary watershed protection strategies often hinge upon the awareness and motivation of stakeholder groups, such as shoreline property owners who might plant certain types of vegeta-

tion to prevent erosion, or homeowners who regularly maintain their septic systems. Local governments are more likely to cooperate with other municipalities in passing more stringent and uniform codes within a watershed context if they have been a party to the process that indicates such controls are needed. Many local governments will fail to support a regional solution or plan unless it factors in their local concerns. Local stakeholder involvement can lead to new partnerships and creative and alternative ways to solve problems and cost-cutting measures. Finally, broad community participation in water quality programs can lead to a more informed public, beneficial for future problem solving initiatives.

Defining the Planning Unit

It is important to define the watershed or planning unit early in the process. In general, watershed strategies seem most effective at a subwatershed scale. Units as large as the Lake Ontario Basin provide a functional spatial unit for integrating watershed management efforts at the state and provincial level. Smaller geographic units (e.g. river basins such as the Genesee or Black) are nested within the Lake Ontario Basin and can function to help coordinate activities at varying scales. These river basins vary in size from 2,000 to 5,100 square miles. A manageable size for developing watershed strategies is found at the subwatershed scale within river basins. This size varies from 40 square miles (e.g., Otisco Lake) to around 785 square miles (e.g., Cayuga Lake). At this scale, watershed data can be mapped with a useful level of detail, where one inch represents from one-half to one-and-a-half miles (1" = .5 to 1.5 miles). Most subwatersheds at this scale in the Basin have a manageable number of stakeholders and their own identity. Another consideration in determining the planning unit is the scope and degree of complexity of the water quality issues to be addressed. A holistic unit is preferred, as long as the water quality issues can be reasonably considered. Practical and logistical considerations are also important, and may include travel time required for stakeholders to meet on a regular basis; level of jurisdictional complexity; existing data and resources, including personnel and funding, available for the project.

Coordinating among Local Entities

The process for developing a watershed strategy must promote coordination and communication mechanisms. A management unit, such as a steering committee, task force, or the creation of a staffed watershed organization becomes critical to determining, delegating and coordinating tasks, and maintaining communication flow and stakeholder involvement.

Leadership

In evaluating the most successful watershed planning efforts in the Basin, it becomes clear that the best ones have a strong project leader who champions the cause and takes responsibility for leading the watershed institution-building process. This person usually has the ability to inspire the participation of a wide variety of stakeholders, guide the process, and continue project momentum over a sustained length of time.

Assessment and Prioritization

Watershed assessments typically include a description of existing water quality conditions (chemical, physical and biological) and water resource uses, extent of ecosystem impairment in the drainage basin, causes of impairments, including known and potential pollutants and their pathways, and quantification of problems. A detailed assessment quantifies nonpoint sources of pollution through tools such as Stressed Stream Analysis or computer simulation models like Generalized Watershed Loading Functions (GWLF) to target and measure or estimate specific pollutant loadings. Sophisticated watershed assessments quantify loadings for specific pollutants (such as phosphorus) and establish relationships between loadings and water quality in the receiving waterbody. Resource-based assessments at this level of quantification require significant commitment of resources and expertise, but are increasing in number under comprehensive subwatershed programs in the Lake Ontario Basin.

Assessments should also characterize the social and economic qualities of the watershed, including population growth (or decline) and density, land use patterns and designations, income and education levels of residents, primary industries, recreational assets, prior watershed programs and activities, economic impact from water-related tourism, the contribution of shoreline properties to the local tax base, etc.

Predicting water quality impacts from changes in land use in a watershed has become easier with tools such as orthophotos and geographic information systems (GIS). Once land use has been mapped, characteristics such as the total percent impervious cover provide useful indicators of watershed health, and can be used to predict changes in water quality.

A defensible, quantified resource-based assessment is the foundation of a good watershed strategy. It lays out what is known about the current state of the watershed, how land use is projected to change in the future, and the potential water quality impacts of those changes. This assessment is not static, but rather an ongoing

process that will occur at various stages in a watershed management cycle. It may differ in scale and approach each time the assessment is carried out. For example, the first stage of assessment may be a watershed characterization. Later stages may involve a more detailed quantification of priority problems or the application of predictive computer models, and later assessments may be used to evaluate the success of pollution control or remedial measures, serving as a feedback mechanism in the watershed management process.

Setting Priorities

Early on, stakeholders will tend to bring their individual interests and biases to the watershed management process. An objective, thorough watershed assessment is essential to establish management priorities that connect well to ecosystem health. Invariably, stakeholder interests play a role in priority setting, as they should. Resources or problems that people care about most may receive disproportionate priority because of the human value we place on certain community and natural assets. Another consideration is the practicality of addressing certain problems (e.g., though atmospheric deposition may be a primary source of water pollutants, a local effort may choose to address other sources it can more readily control). The watershed assessment provides the information to make priority setting objective and resource-based.

Resource-Based Solutions

Transforming Priorities into Strategies

The ability to develop consensus-based management solutions is a direct extension of skillful stakeholder coordination and proficient priority setting based on good information. Alternative solutions for each water quality priority can be weighed against one another for environmental efficacy, political and social acceptability, cost, probability for success, or other criteria selected by the stakeholder group. Recommended solutions for each priority combine to form an action strategy. To increase accountability, each action should explicitly relate to water quality objectives and priorities; roles and relationships of parties responsible for each action should be identified; and a timeline and indication of existing or potential financial or technical resources for implementation of each action should be given. Finally, monitoring and oversight responsibility for the strategy should be assigned, and may be well placed with an umbrella watershed organization or committee.

The implementation of a watershed management plan can become expensive. In both the development and evaluation of alternative strategies, cost-avoidance measures and creative alternatives that emphasize efficient use of funds should be investigated.

Key Components of an Integrated Solution

In the implementation phase, a watershed management plan meets the ground. A number of obstacles may surface, including insufficient resources (human, financial or technical) or lack of public support. It may be necessary to sequence recommendations in phases as resources are available. A watershed organization, committee or coordinator may play a key role in facilitating the pooling of resources and development of requests for funding. Another key to successful implementation is public education and outreach about the need for, and benefits of, recommended actions. Public education should be ongoing throughout watershed management, but takes on a special significance now as residents are asked to do their part. A visual educational tool is a watershed map that shows residents the locations of sensitive resources, areas of concern, and lists recommended actions and anticipated benefits.

Specific Implementation Strategies and Activities

Individual recommended actions may include source reduction practices in the home or business (e.g., recycling or composting nutrient-rich wastes); erosion or sediment control strategies; habitat restoration; outreach and education programs; development of land use guidelines or ordinances; issuance of permits; various voluntary or mandatory Best Management Practices, in-lake treatments to improve water quality conditions, and others.

Multiple actions may be necessary to implement water quality solutions across the potentially many legal and institutional structures in a watershed. For example, if a limit on impervious cover has been recommended for the watershed, this limit should be incorporated into each town's ordinances and site development review process.

Evaluation and Feedback

The Importance of Measuring Effectiveness

The evaluation and feedback component of watershed management is the final link in the watershed management cycle that gauges how well strategies are working, and measures progress toward goals. The specific measures for evaluating effectiveness and progress should be clearly outlined before implementation.

Monitoring Programs

A strategic, resource-based monitoring program that quantifies the effect of implemented actions is the best means for evaluating the impact of a watershed strategy. Monitoring programs are expensive in terms of personnel time and can use up a good portion of the watershed management budget, reducing the number of strategies that can be implemented. Innovative and efficient ways of monitoring changes in water quality are needed, and may include, e.g., the use of traditional water quality indicators and biological indicators, such as macroinvertebrate or fish assemblages, using volunteer and school groups and computer modeling.

BARRIERS TO EFFECTIVE WATERSHED PLANNING

While the last section outlined some of the elements of developing a watershed strategy, there are some significant process barriers worthy of discussion. Focus group interviews with water quality coordinating committees and/or water resource managers in the 25 FL-LOWPA counties and facilitated workshops with regional groups of FL-LOWPA members were used to identify barriers to watershed management. These barriers fall into four categories: institutional, technical, financial, and communication.

Institutional Barriers

The paradox of watershed planning and management for the public good is that ordinary public institutions in New York State are not set up to function on a watershed basis. Federal and state standards for water quality are met through action at the local level for nonpoint sources of pollution, but counties and municipalities are not oriented by watershed. The New York State Constitution sanctions "home rule", granting land use control to towns and villages and decentralizing authority for decisions affecting water quality within watersheds. Under this scenario, the only way to use the watershed as a management unit for nonpoint source pollution is to bring parties together in a cooperative forum that breaks down political and jurisdictional boundaries.

Political Fragmentation

In general water quality problems in the Lake Ontario Basin are not at a crisis level where constituents are asking for action. Local elected officials may see little incentive to work cooperatively on a watershed basis where they may lose independence and control. Exacerbating this obstacle is a sluggish economy in upstate New York relative to other areas of the country over the last decade. For many local governments, increasing tax base and spurring economic development are primary concerns. Unless a clear connection is made between watershed health and the economic value of water resources (like a public drinking water supply or water-related tourism revenue) local governments are not likely to see the benefit of participating in a watershed planning process.

Jurisdictional and Issue Fragmentation

The watershed approach is interdisciplinary and integrated – calling for a broad perspective based on varied expertise and knowledge bases. Many agencies have service areas that are politically defined, such as a statewide interest in soil and water resources (New York State Soil and Water Conservation Committee), multicounty (regional planning boards and DEC regional offices), single county (soil and water conservation districts and health departments); or municipal (planning boards). When it comes to managing a watershed, a variety of institutions at all these levels may be involved, though no one agency has primary responsibility for watershed health. Clearly there are benefits to a diverse group – the process may be richer as expertise, resources, and perspectives are shared. The challenge is to develop a flexible, synergistic group that can overcome traditional roles and define new relationships. This is often difficult, as institutions can be inflexible, unwilling to give up power, and/or constrained by political and jurisdictional limitations. Further, agencies may be more concerned about their own viability than watershed sustainability.

Issue fragmentation occurs when many discrete programs are developed to address related aspects of a large problem, and lack of communication between programs leads to inefficiency and redundancy. This fragmentation becomes a barrier to coordinated watershed planning. Issue fragmentation may be perpetuated by the fact that each existing agency has a vested interest in protecting its "specialty." Watershed planning and management is a unifying discipline calling, for example, for flooding, surface water, groundwater, and stormwater to be viewed as pieces of the larger hydrological picture.

Competition among Stakeholders

Another obstacle that impedes watershed management is a sense of competition among stakeholders for grant funding. By pooling their requests for funding under a watershed strategy, competitors can become cooperators and share more success. True collaboration and cooperation simply does not come naturally for many public agencies. News of many successful collaborative efforts is spreading across the Lake Ontario Basin (see

Chapter Five) and the barrier of competitive posturing may finally break down. At this point, it remains an impediment to be recognized.

At a minimum, clear definition of agency roles and open communication are needed to overcome the barriers of political, jurisdictional, and issue fragmentation and competition among stakeholders. Development of a shared vision under a watershed umbrella framework, in which stakeholders are partners rather than competitors, can also be helpful in overcoming these barriers.

Technical Barriers

Technical barriers to watershed planning and management include incompatible technologies (e.g., GIS systems and databases); shortage of GIS hardware and software; and lack of user-friendly software. One of the reasons that water quality monitoring is not more common is that it requires a significant amount of equipment (e.g., boats and instruments) and trained staff. It is evident that technical barriers are closely related to financial barriers.

Financial Barriers

Although watershed strategies may bring long-term economic benefits, they require a significant commitment of resources over a period of years (and perhaps indefinitely to maintain strides in water quality improvement and protection). For local agencies and municipalities to contribute resources, they must have increased funding levels, raise revenue, or adjust priorities to make room in level budgets for these commitments.

Fortunately, grant funding at this writing is available in New York State for watershed projects. A lack of expertise or time to write grant proposals to acquire outside funds can contribute to the financial barrier for less developed programs, especially since much of the program funds are already stretched to cover ongoing and necessary activities. Operating on grants alone poses challenges for watershed efforts. Funding is uncertain and requires continual effort to secure more. Grant moneys may have many administrative and reporting requirements attached, which take time away from other tasks. It is difficult to find grant money for general operations for a watershed program, and individual grants often need to be meshed to have enough resources to implement strategies.

Communication Barriers

The size of the watershed being addressed may present an obstacle to communication. Travel time and the logistics of meeting around a large waterbody can inhibit participation. A barrier to getting stakeholders involved is simple competition for their attention and time. In addition, agencies have other commitments competing for their time.

Public Education

If there is one area in watershed management that could benefit from being more fragmented, it is public education. There ought to be more appreciation for the different information needs of various public audiences, rather than a blanket educational approach for “the general public.” In other words, effort needs to go toward identifying what different constituencies need to know, and then providing that information to them through vehicles they readily use in a manner they understand. This form of strategic public education and outreach is a major undertaking, a science and a craft, and often resources are not adequate to do it well.

THE IMPORTANCE OF LOCAL CONTEXT

No model approach or process will bring about the same results in different watersheds – the role of local context is too influential. Factors all watershed program managers should consider in designing programs include the history of public interest in the watershed; presence of effective leadership and/or a catalyst group to champion the cause; adaptability of the institutions set up to govern land use in the watershed; technical capability of agencies and organizations within the watershed; technical scope and complexity of the issues to be addressed and the immediacy and degree of conflict surrounding those issues; quality of existing knowledge; the tangible link between high water quality or watershed protection and public health or economic assets (such as a public drinking water supply or sport fishing industry); and logistical matters such as the size of the watershed and financial resources available for the project (Landre and Knuth 1993).

Influential factors are listed in Table 4-1. Those interested in initiating new watershed planning programs, or stymied in some way in existing programs (both inside and outside the Lake Ontario basin) can use these contextual factors to evaluate their own programs and identify potential needs.

Table 4-1. Local context factors influencing watershed planning and management programs.

- Leadership: Presence of a "Spark Plug" Facilitator and Technical and Process Expertise
- Level of Water Resource Use and/or Sense of Community Pride in Local Water Resource
- Public Interest in Watershed Protection and/or Solving Water Quality Problems
- Compatibility of Economic and Environmental Goals
- Credibility of Lead Planning Organization(s) and the Process Used to Develop the Plan
- Jurisdictional Complexity and Size of Watershed
- Quality of Relationships among Stakeholders
- Mechanisms for Balancing Diverse Interests and Working through Conflicts
- Scope and Complexity of the Water Quality Problems to be Addressed
- Quality and Quantity of Data Available for the Watershed
- Financial and Human Resources
- Quality of Communications, including Media Attention

CHAPTER FIVE

COMMUNITY-BASED WATERSHED PLANNING AND MANAGEMENT ACROSS THE NEW YORK LAKE ONTARIO BASIN

INTRODUCTION

This section attempts to depict the regional breadth and depth of watershed programs developed at the local level in the Lake Ontario Basin in New York State. A tremendous number of watershed programs are newly underway in the Basin over the last decade, and there has been significant growth especially in the last few years. This section should serve to provide information to connect programs and activities to one another, and suggest how various elements of watershed planning and management can be incorporated into real-life programs. A major limitation of the information presented here is that programs evolve quickly over time and new milestones are reached regularly. Readers should be aware that the following information is abridged and time-sensitive. The contacts listed in Appendix B should be used for more complete information on any program described in this section.

The sheer number of programs necessitated some categorizing and filtering. Community-based programming defined as projects developed locally with significant stakeholder involvement are emphasized. The selected projects are divided into groups based on their primary function: comprehensive watershed management planning; watershed restoration; monitoring and assessment; and site-specific nonpoint source pollution control. These categories are not mutually exclusive; it should be noted that by definition projects in the first two categories (comprehensive watershed planning and restoration) incorporate elements of the latter two categories, assessment and implementation. The projects were identified through focus group interviews with water resources stakeholders in the FL-LOWPA counties and literature review.

COMPREHENSIVE WATERSHED MANAGEMENT PLANNING PROJECTS

Projects described in this chapter are aimed at holistic watershed management through development and implementation of a comprehensive plan with community buy-in. In many cases, barriers to watershed planning and management described in Chapter Four have been overcome, though in different ways. Some programs are built on top of existing institutional and legal frameworks, while others enacted new laws and/or created new water quality organizations or structures. In other cases, existing laws have been revised and organizations refocused.

The most successful of these examples have a few key attributes in common. One attribute is a dedicated individual who provides energy and focus to the process and skill in both the technical and people-oriented aspects. Another common attribute is the sustained commitment on the part of a small number of key stakeholders to work through the series of steps and challenges inherent in watershed planning. Associated with this attribute is the long-term commitment of competent personnel to the technical tasks and communication and coordination functions that are critical in the development of a comprehensive watershed management plan. In the best examples, this core work group has the vision, cohesion, and tenacity to both develop funding streams for a long-term project and methodically accomplish the work itself.

Selected community-based watershed planning efforts in the New York Lake Ontario Basin are mapped in Figure 5-1. Several are described in case studies in a following section, with many from the Finger Lakes Region which has proven over the last decade to be a virtual laboratory for community-based watershed planning.

WATERSHED RESTORATION PROJECTS

The watershed restoration programs included in this chapter are aimed at water quality or habitat restoration (Figure 5-1). They are comprehensive in that they address multiple sources within a watershed boundary and emphasize local stakeholder involvement. The programs typically involve a number of components and stakeholders over time to address an enduring problem.

Long-term restoration initiatives for Irondequoit Bay and Onondaga Lake are included as case studies. Other restoration projects mentioned include Remedial Action Plans for three IJC-designated Areas of Concern (Eighteenmile Creek, Oswego River, and Rochester Embayment/Genesee River) and a few additional local programs.

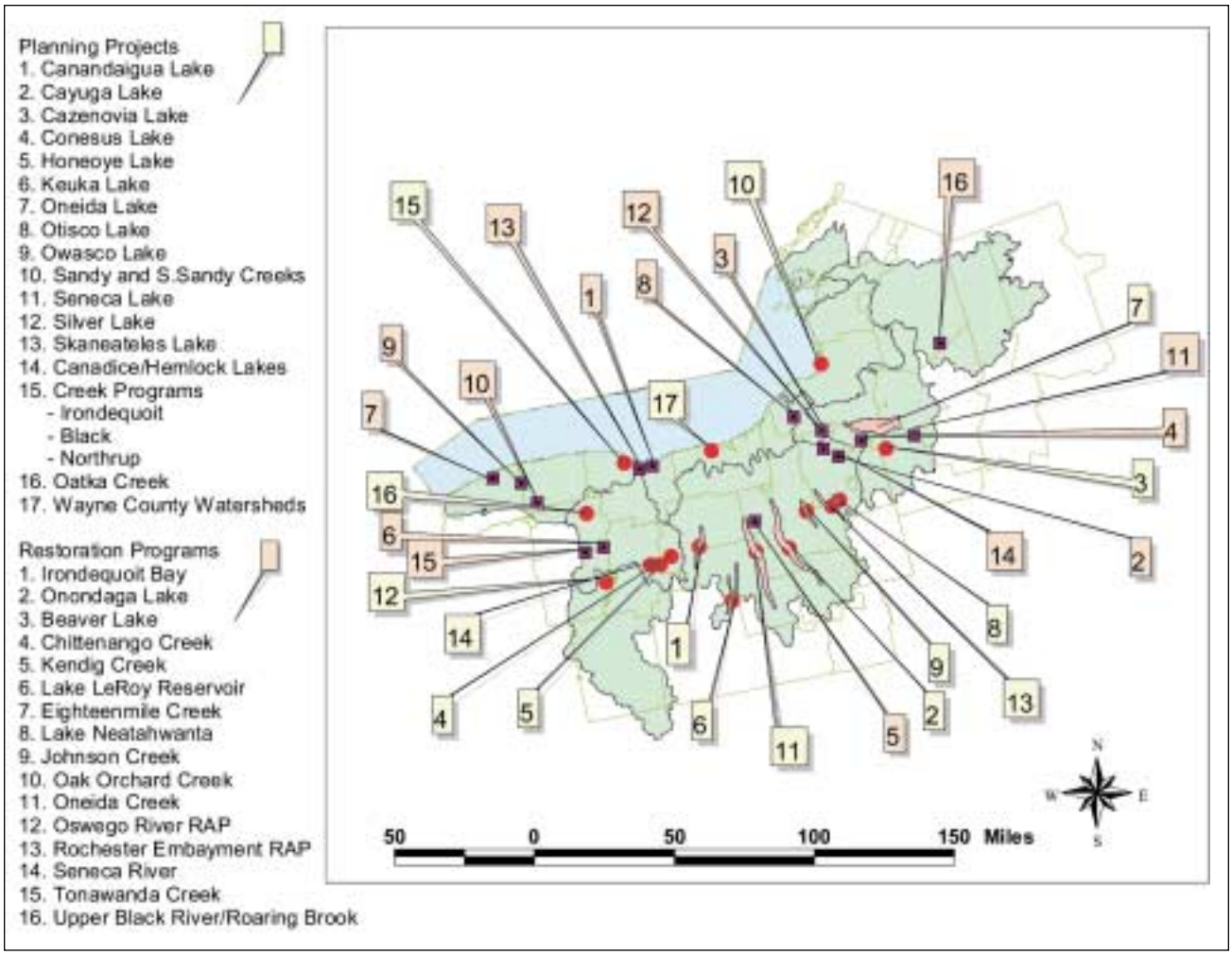

Figure 5-1. Locations of comprehensive watershed management planning and restoration projects in the New York Lake Ontario Basin.

CASE STUDIES AND PROJECT DESCRIPTIONS

Watershed Plans

The case study descriptions that follow are loosely structured around the theoretical watershed planning elements—stakeholder involvement, assessment and prioritization, resource-based solutions, and evaluation and feedback – discussed in Chapter 4 and shown in Figures 4-1 and 4-2.

1. Canandaigua Lake

The Canandaigua Lake watershed is often considered a forerunner to community-based watershed management planning in the Finger Lakes region of the Lake Ontario Basin. The effort served as a local field test for watershed planning guidelines developed by DEC. The project has since served as a model for other more recent comprehensive Finger Lakes watershed projects, particularly Cayuga, Seneca, and Honeoye Lakes.

Stakeholder Involvement

Obtaining stakeholder involvement was complex due to the multiplicity of jurisdictions in the watershed: four counties, thirteen towns, two villages, and one city. The City of Canandaigua started the process in 1988 by holding a series of meetings on planning for the lake. These meetings led to the formation of the Canandaigua Lake Watershed Task Force, which served as an umbrella group for lake and watershed protection. At its inception, the Task Force Ad Hoc Committee tried to promote intra- and interagency coordination. The committee involved representation from many organizations, including DEC, Natural Resources Conservation Service, County Cornell Cooperation Extension Associations, Soil and Water Conservation Districts, and Planning Departments, Canandaigua Lake Pure Waters Association (a lake association), and concerned citizens.

Under the umbrella of the Task Force, a strategic proposal titled "Effecting a Clean Land and Water Strategy for the Canandaigua Lake Watershed: 1991-1992 Plan of Work" was submitted to DEC in 1991 and awarded a grant ($50,000) to locally field-test DEC's water quality planning guidelines. About $97,000 of in-kind dollars were contributed to this effort by local, county, and state agencies and Task Force volunteers.

Initial work of the Task Force included extensive watershed characterization and assessment. Existing data were integrated and new data collected and analyzed for the project. The four-year study resulted in a 600-page report, the *State of the Lake Report*, published in 1994. Each of the 34 subwatersheds in the Canandaigua Lake watershed was described, assessed, and evaluated for sixteen potential sources of nonpoint source pollution. The Task Force was the driving force behind the completion of the *State of the Lake Report*, with a number of people who represented local agencies on the Task Force providing the commitment and momentum necessary to complete the comprehensive assessment.

A critical step for building stakeholder support was the Canandaigua Lake Watershed Compact, published in 1995 and called a "shared vision of the present and future condition of the watershed's lands and waters." The Compact was distributed by the Task Force to local, state, and regional government agencies, municipalities, business associations, lake associations, and other stakeholder groups for formal adoption and signature. The Compact defined the geographic area of interest (174 square mile watershed) and outlined goals stressing a comprehensive, participatory approach. For example, a few of these goals were:

- To protect and enhance the quality of Canandaigua Lake;
- To encourage and improve management practices in the watershed;
- To successfully complete a locally-driven program of public policy education for water quality improvement by local adoption of a watershed compact and management plan;
- To provide an educational program to increase awareness and appreciation and foster responsible use of watershed resources.

In addition, resource-related values were quantified (e.g., assessed real estate value of lake-influenced properties; numbers of farms and acres in agriculture; fiscal impact of tourism in the watershed; and number s of residents using Canandaigua Lake for drinking water). Non-quantifiable values, such as aesthetics, were also mentioned. Several watershed principles related to hydrology, human interactions with the land and water, importance of stewardship, and the efficacy of local involvement in a management process were also stated. With government agencies, lake associations, business leagues, municipalities, and other stakeholder groups signing on to the Compact, a consensus vision set direction for and broadly legitimized the comprehensive management planning work that followed.

In 1995 through 1998, the findings of the *State of the Lake Report* were reviewed in the form of Remedial Action Worksheets developed for each of 16 potential sources of pollution identified in the *State of the Lake report*. The RAWS were intended to distill information from the sizable *State of the Lake* into an abbreviated, focused format for each pollutant source for decision-making purposes. The worksheets identified alternative measures to prevent or remediate each pollutant source.

The Watershed Council (at the time called the Local Government Watershed Policy Committee), comprised of elected officials representing watershed municipalities, reviewed the Remedial Action Worksheets with assistance from the Policy Support Committee (comprised of technical people from local agencies). The committee of local elected officials met monthly to review ultimately more than 100 alternative measures, and made recommendations with conceptual approval. During the process of reviewing the content for the management plan, the Watershed Council determined the need for specific types of information and stakeholder opinion on certain topics. Committees were formed for agriculture, forestry, and navigation, which served primarily in advisory roles. The agriculture committee, made up of producers in the watershed, has taken the lead after three years in advancing agricultural recommendations for the watershed. While the Watershed Council and ancillary committees were reviewing Remedial Action Worksheets, public information meetings were held by the Policy Support Committee to apprise the watershed public of the process.

In 1999, the Watershed Council and the Policy Support Committee worked with a Project Manager subcontracted to produce a draft watershed management plan based on the previous work. The plan established five-year priorities and was formally adopted by the watershed municipalities at the end of 1999. The independent Project Manager played a critical role in securing or maintaining the municipal support during the development of the plan by meeting with town boards individually over several months, listening to concerns, answering questions, and working to have concerns addressed. For example, these meetings with the Project Manager

facilitated a resolution to a long-standing contentious issue regarding how much each municipality should pay annually for a watershed monitoring program. Factors such as acres in the watershed, watershed assessed value, gallons used for drinking water, tourism dollars generated by the lake, miles of shoreline and population density were weighted to develop a formula agreed to as fair and equitable.

The municipal representatives made the final decision regarding the ultimate makeup of the formula. In February, 1999, 27 publicly elected representatives came together through a workshop, and unanimously agreed to the funding formula. Many municipalities have said that this meeting was a turning point in terms of their commitment to the watershed management program.

Resource Assessment and Prioritization

As discussed above, the 34 subwatersheds in the Canandaigua Lake watershed were individually described, assessed, and evaluated for 16 actual and potential sources of pollution under the State of the Canandaigua Lake watershed assessment. Where possible, locations of actual sources were identified, and subwatersheds were prioritized. Water quality monitoring data, watershed inventories and field surveys, and computer simulation modeling to estimate pollutant loadings (using the Generalized Watershed Loading Functions model) were the primary sources of information for the watershed assessment.

An ongoing water quality sampling program monitors conditions and provides more in-depth information for high priority tributaries such as Sucker Brook and Naples Creek. Ten sites are sampled in Canandaigua Lake during the summer months and 20 tributary sites are sampled monthly and after storm events. Stressed stream analysis techniques are used to pinpoint sources in subwatersheds. SUNY Brockport and Finger Lakes Community College assist the Watershed Council and the Task Force in the watershed sampling program. The program is funded in large part by watershed municipalities.

Resource-Based Solutions

Specific watershed management strategies were recommended in the watershed management plan, based on the watershed assessment and review process. For each measure recommended, the roles of responsible parties and a timeline for action were identified. A full time watershed manager was hired to coordinate the implementation of the Plan. The Manager is responsible for working with the various implementers, overseeing the monitoring program, serving as spokesperson for the Watershed Council, interacting with the public, writing grant applications, and evaluating the success of the watershed program.

The plan calls for a five-year implementation effort in order to complete all 80 protective actions. Capital improvement projects are also being undertaken. Sewers are currently being extended into areas of high density development, septic system failures, and high fecal coliform readings. The Watershed Program received nearly a million dollars in State funds to implement a habitat restoration project, agricultural Best Management Practices, and stormwater control measures.

Implementation of some recommendations, for example in the case of development of uniform ordinances, can require their own policy process with several steps. Some of the prerequisite work for uniform ordinances is completed or underway. For example, the forestry committee has recommended regulations for commercial timber harvest to municipalities and a navigation law committee is reviewing docks and moorings regulations. In addition, independent programs, like New York State's Agricultural Environmental Management (AEM) whole farm planning initiative, have been integrated to reinforce the management plan. More than 90 percent of the farms in the watershed have completed farm assessments, and 18 farms are completing farm improvements.

The Task Force has promoted public education through an extensive and strategic set of programs. A few examples include watershed signage; development of curricula for use in local schools; dramatic programs presented in schools; storm stenciling and tree planting; public meetings and information booths at public events; brochures and newsletters; workshops; surveys; and more.

Evaluation and Feedback

The Enhanced Testing and Sampling Program provides a mechanism to evaluate the effectiveness of watershed management strategies. Pre and post implementation monitoring will measure actual changes in pollutant loadings.

Contacts:

Canandaigua Lake Watershed Management Plan, Kevin Olvany (716) 393-2990

2. Cayuga Lake

Although Cayuga Lake has the largest drainage basin of the Finger Lakes, the watershed management plan was one of the last to be initiated. This delay could be a major advantage to the watershed planning effort in that both the successes (the factors that worked) and the problems experienced in other watersheds have been analyzed and publicized. Particularly in Canandaigua and Keuka Lakes cases, lessons learned have been discussed and shared in conferences, seminars and meetings with stakeholders in other watersheds in the Finger Lakes region and across the state. In addition, resource people involved in the Cayuga Lake watershed process have been involved in programs for other watersheds in the region – contributing to the level of practical experience going into the project. As a result, the Cayuga Lake watershed planning process started deliberately with stakeholders involved early and local governments assuming a primary role in water quality planning decisions.

The formal process to develop a comprehensive management plan began in 1998 with the goal of completing the plan in three years. Several water quality education, research, and grassroots organizing efforts (including two temporary lake associations) occurred prior to 1998, but these activities had not coalesced into a watershed-wide program. The comprehensive planning effort began with a grant to the Town of Ledyard from New York Department of State and consists of four main components: (1) an intermunicipal organization representing the watershed, (2) a draft management plan, (3) education, and (4) public participation. The Central New York Regional Planning and Development Board is coordinating activities under the grant. Genesee/Finger Lakes Regional Planning Council supplies technical support. Additional initiatives have followed by other stakeholders. For example, the City of Ithaca is pursuing a monitoring program in conjunction with Cornell University and counties. The Cayuga Lake Watershed Network, a citizens group formed in 1998 to advocate wise management of the watershed and water quality protection, has received a five-year grant from the Park Foundation to support the hiring of a "watershed steward". While these individual initiatives are not yet coordinated under a single watershed planning initiative, the level of interest in the watershed is impressive, and the potential for a truly comprehensive plan is strong.

Stakeholder Involvement

At FL-LOWPA's 1997 sustainable watershed conference, about 50 people participated in a facilitated session to identify major watershed values and issues, and begin to develop a vision for the future desired state of the Cayuga Lake Watershed. Later that year the Cayuga Lake Watershed Mini-Conference was sponsored by the Cayuga Nature Center to further consensus on a watershed vision. Both sessions demonstrated strong interest in the watershed but that more dialogue was needed to further develop consensus on a vision among diverse stakeholders. In 1998, a public participation meeting was held for the Cayuga Lake Watershed Management Plan at the Second Annual Neighbors around the Cayuga Lake Watershed Mini-Conference. Also that year, Cayuga Lake Watershed Network conducted a survey of stakeholders to identify primary watershed concerns and appropriate roles for the Network.

In October 1998 the Intermunicipal Organization (IO) was formed and currently meets monthly. The IO is composed of representatives from each of the municipalities within the watershed that have signed a Call for Cooperation and Resolution to Endorse a Watershed Study for Cayuga Lake. IO meetings are publicized and open to the public. Presently there are four standing subcommittees of the IO: Education/Public Participation, Technical, Finance and Agricultural. The education and public participation components of the project have included forums, workshops, mini-conferences, tours, press releases, and the development of an internet web site, project brochure, watershed fact sheet, slide show, and three-panel display. The Technical Committee has largely overseen the development of the Preliminary Watershed Characterization and the interim implementation recommendations. The Agriculture Committee is in the process of implementing a structure for producer involvement in the watershed management planning process.

Resource Assessment and Prioritization

A number of water quality studies have focused on Cayuga Lake. The Genesee/Finger Lakes Regional Planning Council, with assistance from a consultant, compiled the draft Cayuga Lake Preliminary Watershed Characterization, describing the current understanding of the state of the watershed and the history and status of the watershed management planning process. This report became available for review late in 1999.

Resource-Based Solution

The planning process will extend over a three-year period with recommendations and solutions slated for the year 2001. In order to take advantage of grant and funding cycles, however, the watershed IO has prepared some immediate implementation projects to be submitted for funding.

Contacts

For further information about the Cayuga Lake watershed management process visit the Cayuga Lake Watershed Management Plan internet web site at www.gflrpc.org/Cayuga.htm or contact:

Central New York Regional Planning & Development Board, Pam O'Malley, Kathy Bertuch (315) 422-8276

Genesee/Finger Lakes Regional Planning Council, Dave Zorn (716) 442-3770

Cayuga Lake Watershed Network, Janet Hawkes (607) 273-6260 or Stephen Lewandowski (607) 272-3700

3. Cazenovia Lake

Although Cazenovia Lake is relatively small, with a lake area of 1.8 square miles (466.7 ha) and watershed 8.65 square miles (2240.7 ha), it has a long history of lake assessment and management.

Stakeholder Involvement

The Cazenovia Lake Association represents landowners within the watershed and meets on a regular basis. While Lake Association members are the voting members, other stakeholders within the town and surrounding area are informed of the Lake Association activities via a news bulletin called LakeLine, an annual meeting open to the public and articles in the local newspaper. The Lake Association interacts with other agencies, such as the Cazenovia Planning Association, Madison County Planning Department, Soil and Water Conservation District, and Water Quality Coordinating Committee, and DEC. Both Madison County Water Quality Coordinating Committee and DEC provide data (e.g., regarding land use) and technical services to the Cazenovia Lake Association. The Lake Association also participates in the Citizens Statewide Lake Assessment Program (CSLAP), a volunteer-based water quality monitoring program coordinated by DEC.

Resource Assessment and Prioritization

The lake has been the subject of numerous studies going as far back as 1847, when the State did a bathymetric survey. This survey has been updated several times. Comprehensive or partial lake limnological studies were done in 1977, 1987, 1989, 1991, and 1992. The most recent included a restoration and management plan.

Resource-Based Solution

A Lake Restoration and Management Feasibility Analysis was performed in 1992, and its results became the basis of the recommendations incorporated into a management plan (Coastal, 1992). Watershed management recommendations included septic system and stormwater management measures. In-lake restoration measures were suggested, including intensive aquatic harvesting, drawdown (for macrophyte control), rotovation (mechanical destruction of aquatic weeds similar to rototilling), and selective withdrawal (withdrawal from the hypolimnion for phosphorus control) and alum injection. In addition, a public education and involvement program was outlined. The Lake Association began and continues a macrophyte harvesting program, purchasing its own harvester and contracting the services of a watershed manager. The Association has recently begun a stream testing program for major tributaries and potential problem areas.

Evaluation and Feedback

In 1998 the Lake Association hired Princeton Hydro to revisit the 1992 Coastal Report and developed "Prioritization of Management Restoration Alternatives for Cazenovia Lake". This plan is posted on the web site www.Cazenovia.com. In 2000 the Lake Association is working with a local strategic planner and has formed workgroups for Safety Issues, Public Education/Relations, Lake Management, and Environmental Sensitivity Concerns. The 1992 report recommended that the effectiveness of remedial measures be assessed.

Contacts

Cazenovia Lake Association, Sharye Skinner, President, (315) 655-4371 or sharyeskinner@usadatanet.net
Dick Ford, Lake Manager (315) 655-4212 or cazlake@aol.com

4. Conesus Lake

The Town of Livonia, applying on behalf of Livingston County, received approval from the New York State Department of State, Division of Coastal Resources for an Inter-municipal Waterbody Management Planning Grant for the development of a Conesus Lake Watershed Management Plan (CLWMP). A signed Project Agreement between the Town of Livonia and Department of State was approved on April 2, 1999. The Livingston County Planning Department serves as lead agency for the anticipated three-year project.

The purpose of the CLWMP is to create a framework for improving the water quality conditions in Conesus Lake and its watershed. Increasing development pressure, degradation of the water quality in the lake, and more stringent federal and state standards for public drinking water supplies have made clear the need for a comprehensive watershed management approach. The Conesus Lake Watershed Management Plan is being developed in two phases. Phase I includes: 1) watershed characterization of Conesus Lake; 2) development of a project management structure that brings all involved municipal governments and agencies together to work collaboratively on water quality issues and concerns; and 3) activities to improve public awareness of water quality concerns and increase civic involvement in the planning process. Phase II includes development of three components: 1) watershed management strategy; 2) implementation and monitoring plan; and) public outreach program (continuing from Phase I).

The CLWMP process is designed to make maximum use of existing information about the lake and watershed, encourage continued cooperation and coordination among the participants, and ensure public involvement.

Stakeholder Involvement

The CLWMP includes the participation of diverse stakeholders. The Policy Committee is the inter-municipal body responsible for making major project decisions. The voting membership includes the elected officials for the watershed municipalities (including the Towns of Conesus, Geneseo, Groveland, Livonia, and Sparta and Village of Livonia) two public water suppliers (the Villages of Avon and Geneseo), and Livingston County. Non-voting advisory members include the Conesus Lake Association; several county agencies and organizations (Livingston County Water and Sewer Authority, Planning Board, Environmental Management Council, Cornell Cooperative Extension of Livingston County, Farm Bureau, Chamber of Commerce, Soil & Water Conservation District, Planning Department, Department of Health, Conesus Lake County Sewer District, Highway Department, and Sheriff's Department/Navigation Patrol); state and federal agencies (NYS Department of Transportation, USDA Natural Resources Conservation Service, USDA Farm Services Agency).

The CLWMP Planning Committee is responsible for the technical work inherent in the development of the plan and for advising on technical aspects related to policy decisions. The Planning Committee includes representation from the County Planning Department, County Department of Health, County Soil and Water Conservation District, Conesus Lake County Sewer District, Genesee/Finger Lakes Regional Planning Council, DEC Region 8, and Conesus Lake Association. A Public Education Subcommittee was formed to develop educational materials, press releases, and other programs which contribute to informing the public of project activities and which promote public involvement. This Subcommittee includes representation from the Planning Committee (Planning and Health), Policy Committee (Chairman), Cornell Cooperative Extension of Livingston County, an intercounty solid waste management committee, and a volunteer member from the public.

Assessment and Prioritization

Water quality conditions and nonpoint sources of pollution have been documented over the years for Conesus Lake, primarily through the work of educational institutions including the State University of New York at Brockport and Geneseo and University of Buffalo.

State and federal agencies including the State Department of Health, State Department of Environmental Conservation and United States Geological Survey also conduct some level of research or monitoring in the watershed.

The Conesus Lake Compact of Towns was formed in 1983 to operate the Lakeville Dam at the Conesus Lake outlet at the north end of the Lake. In addition to this charge, the Compact serves as a forum for dealing with other water quality issues and concerns.

Beginning in August 1998, the Conesus Lake Watershed Inspection Program administered by the County Department of Health enforces the Conesus Lake Watershed Rules and Regulations. Primarily this includes conducting testing and research in response to citizen complaints and providing public education about protecting the watershed.

There are two public water suppliers (Villages of Avon and Geneseo) which conduct state mandated monitoring in Conesus Lake. In addition, extensive digital data sources have been developed for the watershed by the Livingston County Planning Department.

Resource-Based Solutions

The CLWMP is in the favorable position of building upon previous studies of the lake and watershed and well-established inter-municipal cooperation. The CLWMP will allow Livingston County and affected municipalities

to maximize and integrate existing programs including the Conesus Lake Watershed Inspection Program and Conesus Lake Aquatic Weeds Strategy described below.

Conesus Lake Watershed Inspection Program. The Conesus Lake Watershed Cooperative was formed in 1998 under an inter-municipal agreement. The agreement calls for the two public water suppliers (Villages of Avon and Geneseo), Livingston County, and the watershed towns of Conesus, Geneseo, Groveland, Livonia and Sparta to work together to protect Conesus Lake and to financially support a watershed inspection program. Watershed rules and regulations were updated and accepted by the involved municipalities and water purveyors in 1998. The New York State Department of Health is reviewing the regulations but, in the interim, the inspection program was designed and is being implemented through the services of a full-time watershed inspector. The watershed inspector is charged with enforcing the watershed rules and regulations accepted in 1961 until the new regulations are accepted by the State Department of Health.

Conesus Lake Compact of Towns. Inter-municipal cooperation predates the watershed inspection program for Conesus Lake watershed, going back to 1983 with the Conesus Lake Compact of Towns. The Compact is comprised of the four towns surrounding the Lake (Conesus, Geneseo, Groveland and Livonia) and is responsible for operating the Lakeville Dam at the outlet of Conesus Lake. The Compact is responsible for controlling water levels, maintaining the shoreline, and keeping the outlet channel clear of debris to reduce flooding potential. Each town contributes financially to the Compact, based on its amount of shoreline. Though its original charter is limited to water flow control, the Compact has also served as a forum over the years for the discussion of many lake and watershed issues, including shoreline development, aquatic vegetation control, and water quality.

Conesus Lake Aquatic Weed Strategy. The Conesus Lake Compact of Towns reviews and approves the Conesus Lake Aquatic Weed Strategy funded through FL-LOWPA. This program provides essential support to the Conesus Lake Watershed Plan and the Watershed Inspection Program. Funds have been used for many water quality protection efforts, including but not limited to mechanical weed harvesting, upland treatment of agricultural lands, hydroseeding, updating the County soil survey, public education efforts (brochures, workshops), water quality research and GIS mapping.

Contacts:

Livingston County Planning Department, David Woods, Planning Director and Angela Ellis, Planner (716) 243-7550

5. Honeoye Lake

The Honeoye Lake Watershed Task Force formed in 1997 after the Honeoye Valley Association (a lake association) expressed interest in the development of a management plan to prevent further degradation of Honeoye Lake and improve water quality in the watershed. Ontario County Soil and Water Conservation District facilitated Task Force organization. The goal of the Task Force is the development of a uniform approach to managing the environmental quality of the Honeoye Lake watershed through voluntary action and education.

Stakeholder Involvement

The Task Force is comprised of a voting member from five watershed towns, appointed by their town boards, and one voting member of the Honeoye Valley Association, a 400-plus member lake association for Honeoye Lake. Other members of the Task Force include Ontario County Soil and Water Conservation District, Finger Lakes Community College, DEC Region 8, and others who have provided technical assistance.

Assessment and Prioritization

A watershed assessment is underway. Existing digital data have been compiled for the watershed, and data gaps are being filled by county agencies. Aquatic plant and fish communities have been studied by faculty at Finger Lakes Community College and DEC Region 8. A lake and tributary monitoring program is also underway through the SWCD with funding from FL-LOWPA. Sediment core samples are being taken. Compilation of existing zoning ordinances and stormwater and sanitary codes in the watershed townships is underway.

Resource-Based Solutions

Public education is ongoing, with the recent publication of the Honeoye Lake Book, a citizen's guide modeled after similar publications for other Finger Lakes (Canandaigua, Keuka, and Skaneateles Lakes). Land protection efforts have preceded and accompanied the work of the Task Force. Approximately 2000 acres including wetlands and the Honeoye Lake inlet are protected through a joint venture of DEC Region 8 and The Nature Conservancy. The Finger Lakes Land Trust is also active in land protection in the watershed, and hosted a series of public educational presentations on the watershed in 1999.

Contacts:

Honeoye Lake Watershed Task Force, Jack Starke, (716) 223-4425

Ontario County Soil and Water Conservation District, Tanya DeNee, (716) 396-1450

Honeoye Valley Association, Jim Kersting, (716) 367-2301

6. Keuka Lake

The Keuka Lake watershed plan is one of the more comprehensive planning efforts in the Lake Ontario basin, despite the fact that the lake itself is relatively small (18 square miles), as is its watershed (172 square miles). The Keuka Lake watershed project began after the Canandaigua Lake watershed plan, and some of the county agency staff worked on both projects, bringing breadth of experience to the process. The Keuka Lake watershed, however, had its own unique history of public interest in water quality that spurred the watershed management planning process.

Stakeholder Involvement

The Keuka Lake Association (KLA) is a lake association formed in 1956 with over 1900 members today. In 1989 the KLA commissioned a survey that indicated a watershed protection program was the top priority among the organization members.

With a straightforward goal to "protect and improve the purity of the waters in the Keuka Lake watershed," the Keuka Lake Association spearheaded the three-year Keuka Lake Watershed Project. Grant moneys in excess of $180,000 were secured by KLA from corporations, individuals, and the New York State legislature for the initial work, and an independent, full-time project coordinator was hired. The project coordinator worked closely with KLA members throughout, but stakeholder involvement was broadened early on to include town officials and other interests in the watershed community, and county, state and federal agency representatives who provided technical information and services.

The key mechanism for municipal involvement early on was the Town Watershed Advisory Committees (TWAC) set up for each of the ten towns and two villages in the watershed. Meetings were held with TWACs over two and a half years to identify concerns, share information, establish a consensus direction for the watershed management program, and develop trust and commitment. During a 30-month public policy development period, more than 30,000 brochures with the catch phrase "Listen to the Lake" were mailed to watershed residents informing them of the project, and public meetings were held. The desired direction of the program was cooperative and uniform watershed management.

One issue that may be encountered in pursuing cooperative and uniform watershed management is that towns and village may express the need for program boundaries; they may be unwilling at the outset to commit to a comprehensive watershed program that touches on many areas of their budgets and operations. The Keuka Lake Watershed Project selected one major issue in the watershed - septic system management – to address first, creating program boundaries. Notably, the KLA was quick to agree to pursue this issue, though its own members would likely be the first watershed residents expected to bear the economic burden of watershed management measures. This move by the KLA, pointing its finger at itself rather than at other stakeholders, helped to develop respect among diverse stakeholders involved in the project.

In December 1993, after exploring alternative mechanisms, eight municipalities signed an intermunicipal agreement which formed the Keuka Watershed Improvement Cooperative (KWIC) to cooperatively and uniformly manage septic systems in the watershed. A model septic system ordinance, more stringent than New York State Department of Health standards, was developed, reviewed by state and local agencies, and adopted by the municipalities. The KWIC did not establish a new layer of government, nor does it have taxing authority, two concerns expressed by municipalities. It is governed by a board of elected officials, funded by participating municipalities, and staffed by a full-time professional watershed manager who oversees watershed inspectors in each of the participating municipalities. Progress in implementation of the new sanitary code is monitored monthly by the KWIC directors.

The KWIC established a mechanism for local government cooperation and consensus building that paved the way for the development of a comprehensive watershed management plan. A grant was secured from the New York State Great Lakes Protection Fund to initiate a comprehensive watershed assessment and management plan.

Assessment and Prioritization

The assessment and prioritization component of developing the management plan mirrored in several ways the process used for Canandaigua Lake. Sixteen actual and potential sources of pollution were analyzed in subwatersheds using data from GIS watershed inventories, water quality monitoring, computer simulation modeling (*Generalized Watershed Loading Functions*), and landowner surveys.

Five years of lake monitoring data were available for the watershed assessment and prioritization. The KLA cosponsors the monitoring program with local agencies. The ongoing monitoring program operates year-round and includes storm sampling (particularly for coliform bacteria) and trophic state indicators (total phosphorus, Secchi disk, and chlorophyll a) and invertebrate, fisheries, and fish tissue sampling. A survey of agricultural producers was used to quantify agricultural practices and help establish priorities for agricultural lands in subwatersheds. The watershed assessment information was compiled into the report *Keuka Lake Looking Ahead*, printed in 1996.

Resource-Based Solutions

As in the Canandaigua Lake case, Remedial Action Worksheets for each of the 16 sources of pollution were developed to assist local elected officials in recommending actions for the management plan. Each worksheet was three to five pages in length and included the 1) management goal; 2) problem description; 3) impaired resource uses being addressed; 4) other use impacts and concerns; 5) existing measures; 6) alternative remedial actions; 7) estimated effectiveness of alternatives; 8) technical feasibility of alternatives; 9) political/behavioral feasibility; 10) possible sources of funding; 11) bibliography; and an 12) action matrix (with roles and responsibilities). The KWIC reviewed the worksheets with assistance from county agencies and a representative from the KLA and recommended actions for inclusion in the watershed management plan.

Having a strategy with local buy-in provides a framework to integrate additional resources and secure funding. The Agricultural Environmental Management (AEM) program is integrated into the Keuka Lake watershed management plan, addressing targeted farms in high priority subwatersheds first. Grant dollars in excess of $1 million have been secured for implementation of specific recommended measures.

Public education is ongoing. For example, a colorful summary of the management plan in layman's terms was produced and mailed to every landowner in the watershed in Steuben and Yates counties.

Evaluation and Feedback

The Keuka Lake monitoring program is ongoing and provides a means to track water quality changes. The KWIC is the oversight mechanism set up to monitor implementation of the management plan and the sanitary code. Close associations with county agencies and water quality coordinating committees keep financial and technical resources focused on the plan.

Contacts:

Keuka Lake Association, Alexander Wahlig, (607) 868-3218

Keuka Watershed Improvement Cooperative, Paul Bauter, (315) 536-0917

Cornell Cooperative Extension, Yates County, Peter Landre, (315) 536-5123

Yates County Soil and Water Conservation District, Jim Balyszak, (315) 536-5188

7. Oneida Lake

Oneida Lake is the largest water body wholly within New York with a lake area of 80 square miles (206.7 sq km) and watershed of 1,377 square miles (3,579 sq km). The lake has been a the focus of a series of aquatic studies dating back to 1916, with a concentration of work on limnology and fisheries in the 1960s and 70s. Cornell University's Biological Field Station (at Shackelton Point on Oneida Lake) has taken the lead in this research, but others have contributed (e.g., DEC and USGS and the Soil and Water Conservation Districts in Oneida, Onondaga, Madison, Oswego and Lewis Counties). However only recently has there been a comprehensive program focused on the entire watershed.

Stakeholder Involvement:

The Central New York Regional Planning and Development Board met with watershed stakeholders in 1997 to identify critical issues and lakewide problems as an initial step toward the development of a comprehensive management plan. Regional partnerships have been strengthened since through the Oneida Lake and Watershed Task Force, a five-county alliance of agencies, organizations, elected officials and citizens interest-

ed in the protection of water resources in the Oneida Lake watershed. Many Task Force members take an active role in watershed projects by serving on Technical, Education/Outreach, Land Use and Executive committees.

Regional watershed issues of concern include flooding, sediment and nutrient runoff to the lake from the southern tributaries, and increasing impacts to water resources from agricultural and urban land uses. Oneida Lake issues of concern are water level regulations, overuse of recreational opportunities, a decline in fisheries, and the wide-reaching impacts of cormorants and invasive aquatic plants.

Primary focus for the Oneida Lake and Watershed Protection Project is the in-depth review of environmental, regulatory and land use issues in the southern watershed region, including portions of Onondaga, Madison, and Oneida counties. This area was selected as a priority due to increased development pressures, greater population growth rates, and significant water quality concerns in the southern tributaries.

Information has been collected on human influences such as population trends and economic impacts, and maps of the natural setting have been generated using geographic information system technology. Data collection has also included an assessment of agricultural and urban impacts to water quality. This information will be applied to a computer model that will eventually serve as an educational tool for local municipalities.

Water quality monitoring has been implemented in the southern watershed tributaries. The monitoring strategy includes the collection of water chemistry data for baseline and storm-event samples, shoreline erosion inventories along southern region streams, and a water resource education program for water chemistry and biological monitoring in eight schools throughout the region.

Educational workshops, brochures, newspaper coverage and project newsletters have been distributed throughout the watershed to keep Task Force partners well informed. Survey information has also been gathered to document user perceptions, computer resources, and long-term water quality monitoring goals. A "lake users' guide", containing recommendations for the protection of Oneida Lake and its watershed, was produced and distributed in 2000.

The southern region strategy represents the first phase of a long-term lake and watershed management plan. Priority is on generating additional local, state and federal funds to expand this project into the remaining portion of the watershed.

Contacts:

Central New York Regional Planning and Development Board, Anne Saltman, (315) 422-8276 or asaltman@cnyrpdb.org.

8. Otisco Lake

Stakeholder Involvement

Water quality and lake issues first received considerable attention in Otisco Lake in the early 1980s. Comprehensive monitoring and the development of the first Otisco Lake watershed management effort provided a remediation and protection mechanism to deal primarily with drinking water turbidity issues.

The watershed goals for Otisco Lake were defined in the 1995 "Water Quality Management Plan" by a group of watershed participants (e.g. Onondaga County Cornell Cooperative Extension, Health Department, and Soil and Water Conservation District). Drinking water source protection and the reduction of agricultural impacts were the primary foci.

The Onondaga County Water Authority (OCWA) owns and operates a filtration plant with withdrawals close to 20 million gallons/day for a portion of Onondaga County's drinking water supply needs. The Otisco Lake Watershed Education Program, as part of Cornell Cooperative Extension (CCE) of Onondaga County, has an active public education program. This included a recommendation to publish *The Otisco Lake Book: A Citizens Guide to Protecting Otisco Lake.* CCE has conducted private well supply protection and testing workshops in the watershed.

Assessment and Prioritization

There has been an ongoing assessment of water quality problems, particularly water supply monitoring and watershed inspection with enforcement of water supply and watershed rules and regulations under OCWA. Collection of data on tributaries to the lake is also done on a less intensive basis. The goal is to complete a comprehensive assessment in two years. In 1998 the assessment was updated and prioritizing of assessment areas was initiated.

Resource-Based Solutions

An Agricultural Environmental Management (AEM) program has been established. Between 1997 to 1999 the Onondaga County Soil and Water Conservation District (SWCD) updated agricultural farm plans, with virtually all farms in the watershed participating. The program provides cost sharing to farmers for the development of AEM plans.

Evaluation and Feedback

Onondaga County SWCD conducts strategic resource-based monitoring in an effort to evaluate the effectiveness of the watershed management plan. OCWA has continued to expand its baseline monitoring program, which will also help track zebra mussel impacts. Since 1996 the Onondaga County SWCD and NRCS in conjunction with the County and State Health Departments and USGS have been evaluating the effectiveness of Best Management Practices through a farm monitoring station on Spafford Creek.

Contacts:

Onondaga Cooperative Extension, Sheila Meyers, (315) 424-9485

Onondaga County Department of Health, Russ Nemecek, (315) 435-6600

Onondaga County Soil and Water Conservation District, Walt Neuhauser, (315) 677-3851

9. Owasco Lake

Stakeholder Involvement

The Cayuga County Water Quality Management Agency is comprised of county agencies (SWCD, Planning, Health and Cornell Cooperative Extension) and has spearheaded an effort to develop a comprehensive watershed management plan for Owasco Lake. In 1997, a grant was received from DEC, a watershed manager was hired, and a watershed assessment was started. The watershed manager spent considerable time meeting individually with town officials to inform them of the assessment and identify their concerns and issues. A survey was used to identify water quality and land use concerns among watershed residents. Area businesses were surveyed through the Chamber of Commerce to determine their perceptions about local economic trends and priorities. The Owasco Watershed Lake Association (OWL) was also a partner in the process.

Assessment and Prioritization

A scientist was hired to compile and analyze existing data about the lake and watershed. Some data sets dated back to the 1970s and were compared to more current data. Special investigations were included to determine the sources of high coliform bacteria counts resulting over the years in public beach closures during the summer. Data was compiled into a State of the Lake Report in 1999. A digital database was further developed for the watershed.

Resource-Based Solutions

Some general recommendations were developed prior to the completion of a management plan. These include measures such as developing riparian buffer zones and constructed wetlands, expanding monitoring into subwatersheds (in addition to Dutch Hollow Brook) and conducting a water circulation study. Agricultural Best Management Practices have been implemented on several watershed farms.

Contacts:

Cayuga County Planning Department, David Miller, (315) 253-1276

Cayuga County Water Quality Management Agency, Ann Moore (315) 252-7011

www.co.cayuga.ny.us/wqma/owasco for the State of the Lake Report

10. Sandy and South Sandy Creek Watersheds

Stakeholder Involvement

The Jefferson County Cornell Cooperative Extension and SWCD facilitated the Sandy Creek Watershed Outreach Project for the14.8 square mile Sandy Creek watershed. The effort began in 1995 when a group of representatives from local agencies met with residents to identify goals for water quality improvement. The project is oriented toward farm outreach and youth education. Other partners in the project include NRCS, Farm Service Agency (FSA), NYS Tug Hill Commission, NYS DOH, DEC, and the Jefferson County Water Quality Coordinating Committee.

Assessment and Prioritization

The SWCD coordinates a water quality monitoring program in the Sandy Creek watershed to identify problems and track conditions.

Resource-Based Solutions

The SWCD's Agricultural Environmental Management (AEM) program has been focused in this watershed, and farms have been enrolled in the USDA Environmental Quality Incentives Program (EQIP).

Evaluation and Feedback

Until recently, the Sandy Creek watershed was the top priority of the Jefferson County Water Quality Coordinating Committee. With the agricultural program largely in place in the watershed, the Committee is turning its attention to its next priority, the Black River watershed.

Contact:

Jefferson County Soil and Water Conservation District, Jay Matteson, (315) 782-2749

11. Seneca Lake

Seneca Lake is the largest and deepest of the Finger Lakes with a predominantly rural watershed of approximately 750 square miles spanning 5 counties (Chemung, Ontario, Schuyler, Seneca, and Yates). The watershed is drained by approximately 130 tributaries, which along with groundwater flow account for most point and nonpoint source pollution. Classified as AA on the DEC Priority Waterbodies List, Seneca Lake provides drinking water for over 70,000 people and generates over $1 million annually in tourism related revenue. The watershed is divided into 29 subwatersheds, and includes one city, 28 towns, and 11 villages.

Stakeholder Involvement

Seneca Lake Pure Waters Association, (SLPWA), a lake association, initiated a watershed planning process for Seneca Lake in 1995 with a $4,000 grant from the Rural New York Grant Program (administered by the Open Space Institute) to complete the *Seneca Lake Watershed Study: Developing an Understanding of an Important Natural Resource* (1996). The project emphasized an ecosystem approach to developing a management plan that would maximize quality of life, develop a healthy economy, and sustain a natural and clean environment. The watershed protection goals were defined early: To protect and enhance the quality of Seneca Lake and its surrounding watershed.

A significant effort was made to actively engage stakeholders and include the public early and often. In 1996, Seneca Lake Pure Waters Association met with stakeholders of five counties, who represented state and county agencies, regional planning organizations, municipalities, academic institutions and other stakeholder groups. From initial meetings, the Seneca Lake Area Partners in Five Counties (SLAP-5) was formed with representation from 44 organizations. SLAP-5 became the central watershed management working group for Seneca Lake. Within SLAP-5 four committees, Oversight, Finance, Education, and Technical, carry out different elements of the program.: A full-time technical coordinator and part-time education coordinator were employed by SLAP-5 and based in the offices of Seneca Lake Pure Waters Association.

Intra- and interagency coordination was encouraged through SLAP-5's broad-based agency participation and the role of the Oversight Committee. Between 1997 and 1998 Memoranda of Understanding were developed with water quality coordinating committees and municipalities, and educational outreach was initiated. In 1998, a public forum series was held throughout the watershed entitled "Setting the Course for Seneca Lake". Information on progress of the watershed project continues to be provided through SLPWA's quarterly newsletter, *Lakewatch*.

Assessment and Prioritization

Numerous studies from 1978 to the present have been conducted to collect lake limnological data. Hobart and William Smith Colleges in Geneva, New York regularly conduct limnological studies of the lake. The State of the Watershed assessment entitled "Setting A Course for Seneca Lake" was completed in 1999 and is the first comprehensive assessment of 29 subwatersheds of Seneca Lake. Extensive land use and soils mapping for the watershed was completed for this assessment. This technical document will provide the basis for identifying priorities and recommendations for preventative and remedial actions.

Resource-Based Solutions

While still in the technical research and fact-finding stage of watershed management planning, grant funding has been received to implement solutions for road bank erosion, agricultural nutrient management planning and best management practices.

Contact

Seneca Lake Pure Waters Association/Seneca Lake Area Partners in Five Counties, Marion Balyszak, (315) 789-3052 or slpwa@eznet.net

12. Silver Lake

Silver Lake is a highly productive, 825-acre lake in Wyoming County. The shoreline is ringed by homes, and also includes a golf course and Silver Lake State Park and boat launch. The lake supports a notable bass fishery and provides a public drinking water supply to four municipalities.

Stakeholder Involvement

The Silver Lake Watershed Commission has existed for more than 25 years, and is responsible for making recommendations for protection and improvement of Silver Lake and its watershed. Members of the Commission include the towns and villages that surround Silver Lake and those which receive drinking water from the lake. The Silver Lake Cottage Owners Association also has a voting representative on the Commission. The Wyoming County Soil and Water Conservation District provides technical assistance to the Commission. Recommendations from the Commission are considered for adoption by the individual towns and villages.

Assessment and Prioritization

The Silver Lake Watershed Commission contracted the consulting firm F.X. Browne to prepare an assessment of Silver Lake with recommendations for action. Following this report, a more extensive water quality monitoring program was begun in the 1990s by the Wyoming County SWCD with FL-LOWPA funding. Recently, the Commission has contributed additional funds to the monitoring effort. Sediment sampling is expected in the near future to assess sediments for possible dredging to improve lake flow direction. DEC Region 9 also monitors Silver Lake under its CSLAP program, primarily to assess fish habitat.

The Silver Lake Watershed Commission recently surveyed lakeshore property owners about their top lake priorities. Chief concerns were the need for more monitoring and aquatic weed (Eurasian watermilfoil) removal.

Resource-based Solutions

A variety of agricultural Best Management Practices have been implemented in the Silver Lake watershed as recommended in the F.X. Browne report or subsequent assessment. An emergency response plan has been completed for Silver Lake, which details an action strategy in the event of a spill on the lake. Public education efforts have incorporated fairs and special events, including demonstration of emergency response technologies. The Commission is interested in parlaying existing studies and information into a single comprehensive watershed plan for Silver Lake.

Contact

Wyoming County Soil and Water Conservation Distict, Greg McKurth, (716) 786-5070

13. Skaneateles Lake

Unlike many watershed efforts, the Skaneateles Lake Watershed Management Program was not a response to declining water quality or serious water quality problems but rather was an effort to preserve the excellent water quality in this oligotrophic lake. The impetus for this effort is protection of the quality of drinking water for the City of Syracuse. In January 1998 the comprehensive "Skaneateles Lake Watershed Management Plan" was completed. Final errata were issued in October 1999.

The lake's high water quality in conjunction with its relatively small watershed has made the lake ideal for use as a water supply for the City of Syracuse. As a result, the City of Syracuse (with its 235,000 water customers) has taken the lead in spearheading a very comprehensive watershed protection and management program similar to the model used by New York City and its water supply watersheds.

Stakeholder Involvement

The primary goal, particularly in the beginning, was maintenance and improvement of water quality of the lake as part of the City of Syracuse's filtration avoidance program. Other issues of concern identified by stakeholders include habitat protection, maintenance of ecological diversity, open space protection, and private wellhead protection.

Watershed protection programs triggered by filtration avoidance tend to have narrower involvement by watershed residents, particularly in this case because the primary stakeholder, the City of Syracuse, is not located within the Skaneateles Lake watershed. Both the Village and the Town of Skaneateles also use the lake as a primary or partial source of drinking water and therefore have worked cooperatively with the City of Syracuse from the inception of the watershed protection effort. Public meetings were held to identify concerns among additional stakeholders.

No separate watershed management institution was established for the watershed program. Because the main focus of the protection program is filtration avoidance, the City of Syracuse, which is the water supplier, is the lead agency for the watershed protection program. Similar to the New York City watershed program, most of the financial support and coordination comes from the City of Syracuse. The City draws from an unfiltered supply under a five-year conditional filtration waiver. The Village of Skaneateles has a filtration waiver tied to the continuing success of the City of Syracuse program. The NYS DOH is the lead agency for the Skaneateles waiver and set the filtration avoidance criteria. The Town and Village of Skaneateles adopted a Joint Comprehensive Plan to comply with certain requirements for filtration avoidance.

Intra- and interagency coordination began in 1995. Following the City of Syracuse's effort to take a proactive approach to watershed protection, meetings were held with the representatives from the six municipal governments to discuss watershed and water quality-related issues. In addition, workshops have been held throughout the watershed to gather input from various interest groups on the watershed management plan. This information is reflected in the plan's recommendations for action.

The Skaneateles Watershed Agricultural Program (SLWAP) was formed in 1994 and was contracted through the Onondaga County SWCD. The majority of the funding comes from the City of Syracuse with additional funds from USDA, EPA, and the State Environmental Protection Fund.

Today there is an extensive educational program carried out by Onondaga County Cornell Cooperative Extension, Isaak Walton League (Project Watershed Program), Tri-County Lake Association, SLWAP, City of Syracuse, and Onondaga County Health Department.

Assessment and Prioritization

Water quality problems were evaluated as part of the filtration avoidance program. The City of Syracuse performs dye testing of on-site disposal systems every four years. In addition, watershed inspectors randomly inspect properties about twice each year.

In 1995 the SLWAP team mailed a questionnaire to farmers to collect basic operation and resource information and identify potential water quality concerns. Based on this survey, the SLWAP team was able to assess potential pathogen sources and prioritize farms for gathering more information on their need for whole farm planning.

In the same year, the Land Protection Plan for the Skaneateles Lake watershed was prepared for the City of Syracuse. The filtration avoidance criteria required sufficient land use controls in the critical areas of the watershed to assure high water quality. The primary assessment tool was the identification of hydrologically sensitive areas and critical management zones. This assessment was largely based on existing information, including USGS topographic maps, DEC Freshwater Wetland Maps, U.S. Fish and Wildlife NWI maps, NRCS soil survey maps, FEMA flood insurance rate maps, and aerial photography. Since 1995, ortho photographs and vector coverages on many subjects have been completed for the entire watershed. Black and white aerial photographs (scale 1:12000) were available for the entire watershed, and partial coverage of digital ortho photographs was available for the Village and Town of Skaneateles and part of the Town of Spafford.

The assessment identified "areas which contribute surface water runoff to Skaneateles Lake or its tributaries and areas that contribute surface water to groundwater resources that potentially discharge into the Lake" (City of Syracuse 1996). These areas included floodplains, intermittent and perennial streams, barnyards, farm and roadside ditches, ponds, wetland systems, compacted soils, saturated soil areas, steep-slope land forms, areas drained by stormwater systems, and impervious areas (e.g., roads, buildings). In addition, the assessment identified and mapped pollutant-loading areas throughout the watershed. The pollutant loading areas

were defined as locations where an existing or planned farm practice results in potential for water contamination due to the application, intentional or otherwise, of contaminants to the soil or crops.

Management Areas were prioritized in the 1995 study. Once the Land Protection Plan identified pollutant-loading areas with hydrologically sensitive areas, critical management zones could be identified. These were areas with a high potential for pollutants to enter watercourses, groundwater, or the lake. Based on these critical management zones and their distance to the City of Syracuse water supply intakes, six levels of protection priority were established. These priorities could then be used by the City of Syracuse to focus their land protection program.

Resource-Based Solutions

The Land Protection Plan is designed to shift the location and density of future development through a variety of land protection tools. The Finger Lakes Land Trust initially partnered with the City of Syracuse to implement the land protection program. Over a ten-year period, the City intends to place up to 5,000 acres of sensitive lands into conservation easements. In some cases the City may purchase property outright or development rights. The City is attempting to focus these easements and purchases to maintain buffer zones along tributaries and other hydrologically sensitive areas. The goal is to encourage development in suitable areas.

The resource management strategies developed in this case study are clearly tied to the specific water quality goals and objectives. For example, agricultural use, at 48 percent of the watershed land area, has been identified as one of the major sources of water quality degradation. Farms that do not have whole farm plans in place progress through the Agricultural Environmental Management program (via SLWAP), where either a farm plan is developed or water quality problems are addressed through individual Best Management Practices. The watershed protection program has an enforcement component. The City utilizes three watershed inspectors who patrol the watershed by truck, boat, and on foot.

Evaluation and Feedback

One outstanding aspect of the Skaneateles Lake watershed plan is the degree of monitoring and evaluation of the watershed plan itself. The priority of concerns has been ranked as pathogens (particularly cryptosporidium), sediment, nutrients, and pesticides. Efforts have been focused on the evaluation of the effectiveness of the watershed riparian buffers in restricting the movement of cryptosporidium and giardia. Based on this evaluation and results of future research, the buffer widths will be revised.

Contacts:

Cornell Cooperative Extension of Onondaga County, Sheila M. Myers, 315-424-9485
City of Syracuse Department of Water, Lee Macbeth, 315-473-2634
Onondaga County Environmental Health Council, Russ Nemecek, 315-435-6600

A few additional watershed initiatives are worthy of mention, though they do not fit squarely into the grouping of case study programs above. These are watershed planning and management efforts that are different in scope or stakeholder involvement, or preliminary efforts.

14. Canadice and Hemlock Lakes

The City of Rochester uses Hemlock and Canadice Lakes for public drinking water supply. The City owns roughly 20% of the watershed, including all shoreline property as a primary strategy for water quality protection. As a second strategy, the City operates a water treatment plant at Hemlock Lake. The City is the primary sponsor and/or stakeholder in a variety of watershed management programs. Efforts include resource inventory and mapping in conjunction with The Nature Conservancy, Finger Lakes Land Trust and Ontario County Planning Department; educational programming; and implementation of a forest management plan.

Contact: Donald Root, City of Rochester, Hemlock Operations Center, (716) 367-3160

15. Creek Programs

Irondequoit Creek

The municipalities in the watershed initiated the Irondequoit Creek Watershed Collaborative planning group and eventually adopted an intermunicipal agreement among two counties, two soil and water conservation districts, five towns and three villages. The municipalities adopted a consistent set of stormwater management practices and created a uniform packet of forms and guidelines for developers to be used by all the municipalities.

Contact: Carole Beal, Monroe County Department of Health, Water Quality Planning Bureau, (716) 292-3935 or cbeal@mcls.rochester.lib.ny.us

North Chili Tributary of Black Creek

The Town of Chili and Monroe County, which have an intermunicipal agreement, initiated watershed planning due to water quantity and quality problems in the town. The planning group has identified the sources of the problems and potential actions to address them. The group is poised in 2000 to begin to recommend the first steps that should be taken to correct the problems.

Contact: Carole Beal, Monroe County Department of Health, Water Quality Planning Bureau, (716) 292-3935 or cbeal@mcls.rochester.lib.ny.us

Northrup Creek /Long Pond

Greece Citizens for a Clean Environment (GCCE) is assisting the Health Department and the municipalities in the watershed with a watershed management plan for Northrup Creek/Long Pond, with a principal focus on phosphorus reduction. GCCE has served as a catalyst group to increase governmental attention to this watershed. GCCE is also conducting water quality monitoring.

Contact: Greg Kesel, Greece Citizens for a Clean Environment, 57 Long Pond Rd. Rochester, NY 14612

16. Oatka Creek

The Oatka Creek Watershed Committee formed as a result of work of the Town of LeRoy Conservation Advisory Council and the 1998 Caring for Creeks Symposium. The goal of the committee is to develop a watershed management plan for Oatka Creek. The Committee is facilitated by the Rochester Area Community Foundation, sponsor of the Caring for Creeks symposia and an umbrella organization. Participants include agencies from Monroe, Genesee, and Wyoming counties, municipalities in the watershed, agricultural producers, DEC, Genesee Land Trust and citizen organizations. The Committee has also been involved in water quality monitoring with assistance from University of Rochester and Rochester Area Community Foundation. More recently, work is underway to develop a framework for municipal participation in the development of a comprehensive plan.

Contact: Jack Bradbury, Chair of Oatka Creek Watershed Committee, (716) 768-4908
Andy Olenick, Oatka Creek Watershed Committee, (716) 454-4743

17. Wayne County Watersheds

In 1999 the Wayne County Water Quality Coordinating Committee published *Comprehensive Watershed Management in Wayne County* which serves as an educational guide and planning tool for citizens and local decision-makers. The document was initiated by the WQCC and is a cross-breed between Lake Books, citizens' guides to water quality protection that have been published for several individual Finger Lakes, and a management plan with specific recommendations. In the Wayne County document, recommendations are discussed topically in areas such as Best Management Practices, wellhead protection, and model local ordinances. The scope of the plan is county-wide, including Sodus, Port, East and Blind Sodus Bays on Lake Ontario and several creek watersheds rated as priorities.

Contact: Robert K. Williams, Wayne County Soil and Water Conservation District, (315) 946-4136

18. Creek Committees

The last five years have witnessed residents along stream corridors banding together into creek committees with an interest in protecting water quality, property, wildlife habitat and other values. Creek committees can bring up and downstream neighbors, local elected officials, and governmental agencies together to address specific problems and educate the residents of stream corridors in watershed protection practices. A good example of the development of creek committees in the absence of a nearby lake or primary water body is Chemung County in the Southern Tier.

Contact: Mark Watts, Chemung County Soil and Water Conservation District, (607) 739-2009

Watershed Restoration Projects

1. Irondequoit Bay

Irondequoit Bay, a 6.7 km long and 1 km wide embayment of Lake Ontario separated from the lake by a sandbar, is of great importance in Western New York due to its proximity to a major urban center, the City of Rochester. Watershed planning and remediation of water quality problems related to eutrophication in Irondequoit Bay has a long history with significant public investment.

Stakeholder Involvement

Citizens and municipalities around the bay have demonstrated an interest in improving the water quality of the bay. The *Irondequoit Bay Plan* of 1974 focused on water quality as a major problem. The Monroe County Department of Health conducted a study of onsite sewer systems around Irondequoit Bay in the 1960s. This study was followed in 1988 by a study that recommended limiting use of on-site disposal systems.

The *Irondequoit Basin Framework Plan*, completed in 1985, called for Irondequoit Bay to be managed in order to achieve the standards for Class B waters with the desired best use of primary contact recreation. A companion document entitled *Proposed Approach for Water Quality Management in the Irondequoit Basin* summarized conditions in the bay and recommended implementation of a number of strategies for improving water quality. Goals for the bay include watershed streams meeting state standards, use of the bay for swimming, and a consumptive fishery for cold and warm water species of fish.

In 1985, the towns around the bay joined with Monroe County in adopting the *Environmental Objectives and Management Measures for Irondequoit Bay* which incorporated as goals the National Urban Runoff Program criteria of epilimnetic (upper waters) phosphorus concentration and phosphorus loading from Irondequoit Creek.

In the 1986 NYS Priority Waterbodies List, DEC stated “Eutrophication is also a problem in two major embayments along the lake, Irondequoit Bay, and Sodus Bay. Local inputs of nutrients from point and nonpoint sources are responsible”. The 1991 NYS Priority Waterbodies List identified Irondequoit Bay as impaired with high priority for remediation.

In response to improvements in water quality, use of the Bay as a recreational resource has grown. Two actions have been taken to address the growth in public interest in the Bay. The *Irondequoit Bay Pedestrian Access Plan* identifies opportunities for public access and delineates a system of trails and roadways to link access points to increase opportunities for public enjoyment of the resource. The *Irondequoit Bay Harbor Management Plan*, still in draft, discusses scenarios for carrying capacity on the bay and indicates appropriate areas for different water-based recreational activities.

Assessment and Prioritization

Awareness of eutrophic conditions in Irondequoit Bay and the need to remedy these conditions has a long history. In a 1912 report, George C. Whipple described highly eutrophic conditions in the bay, including floating mats of algae and vegetation, and odors. In a 1939 conference on the bay, Dr. Robert T. Clausen of Cornell University said that only pollution abatement and controlled land use, an early reference to nonpoint sources of pollutants, would clean the bay. Water quality surveys conducted by various agencies up until the mid-1960s documented a continued deterioration of the Bay. Works by the Rochester Committee for Scientific Information throughout the 1960s documented nutrient and coliform pollution of the bay. A report by R. C. Bubeck and others in 1971 detailed the effects of run-off of deicing salts on the Bay. A chapter on Irondequoit Bay included in *Lakes of New York State* indicated that “ in recent years, the bay has been frequently likened to a sewage oxidation pond.” The Nationwide Urban Runoff Program undertaken by the Environmental Protection Agency in 1978 assigned a grant to the New York State Department of Environmental Conservation to address water quality issues in Irondequoit Bay. The study concluded “although some form of intervention may be necessary to accelerate the rate of improvement in bay water quality, the present external phosphorus loading of 39 kg/day must be reduced to approximately 14 kg/day to maintain the bay in a trophic state consistent with recreational usage.”

Resource-Based Solutions

Recognition of the role of sewage treatment plant effluent in the pollution of Irondequoit Creek and Bay influenced the decision to centralize wastewater treatment to divert it out of the Bay watershed. Another program virtually eliminated Combined Sewer Overflows entering the Bay. These efforts resulted in major reductions of most point source discharges of nutrients to Irondequoit Bay.

Although improvement in bay water quality occurred, epilimnetic phosphorous levels still indicated eutrophic conditions would persist without added efforts. A study conducted by researchers from the University of Rochester quantified internal and external loadings of phosphorus within the Bay. In an attempt to control internal loading of phosphorus, a pilot study on the impact of sealing bottom sediments with aluminum sulfate (alum) was conducted in Ide's Cove, a small deep cove of the Bay. Success of the pilot study led to full scale alum treatment of the deep (>6 m) basin of the bay in 1986.

In 1990, USEPA funding supported oxygenation of the metalimnion of the Bay to encourage development of a biological community capable of harvesting the spring and summer algal crop, hence reducing the amount of biomass settling to deep sediments, and to suppress transport of sediment derived phosphorus to the epilimnion. Oxygenation during summer stratification has continued through the present.

Several projects were implemented to reduce external loads to the bay, including:

- Use of extensive wetlands at the mouth of Irondequoit Creek to treat stormwater runoff. A control structure was constructed on Irondequoit Creek to attenuate stormwater runoff and provide a longer contact time over a greater area of the wetlands.
- Conversion of existing dry detention basins to created wetlands. EPA and DEC supported a project to improve the water quality of stormwater by retrofitting existing dry stormwater detention basins to encourage the development of vegetative communities.
- Reduction of Barge Canal discharges to the Irondequoit Bay watershed.
- Extension of sanitary sewers in unsewered and developed areas around the bay and in the watershed.
- Implementation of construction site erosion and stormwater runoff controls.
- Creation of a watershed based group, the Irondequoit Creek Watershed Collaborative, to pursue uniform implementation of stormwater Best Management Practices in all municipalities in the watershed.

Evaluation and Feedback

Monroe County has had a Cooperative Monitoring Program in place with the United States Geological Survey since 1980. As part of that effort, monitoring stations are maintained at the upstream and downstream ends of the Irondequoit Creek wetlands; on Allen's Creek, the largest tributary of Irondequoit Creek; on the East Branch of Allen's Creek; and upstream in the watershed at Railroad Mills Road. Atmospheric deposition collectors are maintained in the lower watershed at the Indian Landing School, and in the upper watershed at Mendon Ponds Park. Precipitation gauges are maintained at locations throughout the watershed to record amount and variability of precipitation, and groundwater monitoring is conducted on a series of wells in the lower watershed. Irondequoit Bay limnology is monitored monthly in winter, and biweekly through the rest of the year, employing in-situ monitoring for temperature, oxygen, conductivity, and light transmission through the water column. Nutrients and other chemical parameters are measured at discrete depths.

Key Result Measures for the Bay include:

- The ratio of chlorophyll *a* to potential phosphorus, which has improved consistently since the 1970s.
- The period with dissolved oxygen concentration at mid-depth less than 1.5 mg/L, which has become shorter; and
- Phosphorus loading, which has decreased since installation of the control structures diverting stormwater runoff for treatment in the wetlands.

Contacts:

Monroe County Health Department, Bureau of Water Quality Planning, Margy Peet, (716) 274-8442
Monroe County Health Department, Environmental Health Laboratory, Charles Knauf, (716) 274-6820

2. Onondaga Lake

Onondaga Lake is reputed to be the most polluted lake in the country, with about 30% of the watershed in an urban land use. As a result, this relatively small lake has been the subject of extensive characterization, and there has been much study of the sources of pollution. Because of its serious water quality problems, Onondaga Lake has been subject to federal RCRA and CERCLA regulations, as well as state environmental controls. Until recently point sources of pollution provided the focus to improve water quality. The watershed perspective has been evident throughout the lake's recent history because many water quality impairments result

from activity within this highly urbanized watershed. Comprehensive watershed planning and stakeholder involvement have been initiated only recently.

Stakeholder Involvement

In 1990 the Onondaga Lake Management Conference (OLMC) was established with the congressional approval of the Great Lakes Critical Programs Act of 1990, which provides a framework for federal, state, and local governments to cooperate in the cleanup of the lake and the revitalization of the Onondaga Lake waterfront. The OLMC had six voting members representing EPA, DEC, NYS Attorney General, ACOE, Onondaga County, and the City of Syracuse.

A Citizens Advisory Committee (CAC) was established as part of the OLMC to represent a cross-section of community interests. The committee included representatives from business, labor, and environmental groups. The CAC developed reclamation objectives for the lake that focused on aesthetics, contact recreation, wildlife habitat enhancement, water quality remediation, and restoration of fishing and fish consumption.

Between 1992 and 1993, the CAC and OLMC conducted several surveys to understand public perception of watershed protection and lake reclamation. The response was the desire to improve water quality to expand recreational uses of the lake.

The OLMC published a pamphlet entitled *The State of Onondaga Lake* (OLMC 1993) summarizing lake conditions, problems and their sources, and a characterization of pollutants. The purpose of the pamphlet was to communicate to the public technical issues about pollution to the lake. In 1993 the OLMC released a plan for the lake, which included 53 specific recommendations for lake-wide restoration. An "Onondaga Lake Land Use Plan" including both short-term and long-term recommendations was also developed.

The City of Syracuse also developed an "Action Plan for Lakefront Development" (Syracuse Office of Lakefront Development 1991) that explains the City's vision for the Inner Harbor Area. The plan includes a $126 million restoration of the Barge Canal facility, a pleasure boat marina, restaurants, retail establishments, water-oriented recreation, a cultural park, waterfront housing, hotels, and a freshwater education and research center. The Metropolitan Development Association (MDA), City of Syracuse, Onondaga County and the New York State Urban Development Corporation jointly sponsored the preparation of a "Land Use Master Plan" (Reiman Buechner Partnership 1992).

Federal funds administered by the OLMC have contributed to the support of the ongoing monitoring and remediation efforts. The members of the OLMC are currently in the process of reforming the Conference into the Onondaga Lake Partnership.

Assessment and Prioritization

Until recently, little work has been focused on the watershed or on assessments at a subwatershed scale. Most of the assessment work has been focused on in-lake water quality problems. Around 1966 Onondaga County contracted the first water quality study of Onondaga Lake, conducted by the Syracuse University Research Corporation (SURC 1966; now Syracuse Research Corporation), in which salinity and phytoplankton growth were monitored.

In the late 1960s the first comprehensive limnological and water quality study, called "The Onondaga Lake Study" (Onondaga County 1971), was conducted, which characterized the physical, chemical, and biological aspects of the lake and included comprehensive monitoring of the tributaries to the lake. Sources of pollutants were assessed, including estimation of pollutant loads from each tributary. The lake was characterized as hypereutrophic, attributed to elevated loads of external pollutants.

The findings of these and subsequent studies were summarized in the 1993 *State of Onondaga Lake Report*, prepared for the OLMC. The recent book *Limnological and Engineering Analysis of a Polluted Lake* (Effler 1996) provides a comprehensive assessment of the ecology, water quality and external loading of Onondaga Lake.

In 1991 the first systematic study of macrophytes in Onondaga Lake was undertaken (Madsen, et al. 1992). In addition, a series of laboratory studies and mesocosm studies were undertaken to examine the factors that affect macrophyte growth in the lake. In the same year a study titled *Phytoplankton, Zooplankton, Macrobenthos and Ichthyoplankton Abundance, Biomass and Species Composition in Onondaga Lake, 1994* (Makarewicz, et. al.1995) was conducted. The data established a baseline survey and were also utilized to examine the historical and seasonal relationships of the organisms studied for comparison to those observed in previous studies.

An extensive water quality and biological monitoring effort is underway as the ongoing lake monitoring program is designed to assess progress towards compliance with designated uses of swimming and fishing. Data are collected in stream segments to compare with tributary segment classification, and in-lake data are compared to ambient water quality standards.

Resource-Based Solutions

A number of solutions to the lake water quality problems have been developed and are being implemented. Many of these involve extensive modeling to further understand the water quality issues, reducing discharge of pollutants from point sources and strategies for cleaning up the contamination problems associated with past industrial use.

Evaluation and Feedback

The Onondaga County Department of Drainage and Sanitation has lead a comprehensive annual program of strategic resource-based monitoring. This monitoring program has been recently revised and expanded to focus on ecological as well as water quality conditions in the lake program.

Additional Watershed Restoration Project Descriptions

3. Beaver Lake

Beaver Lake is a small lake (206 acres) located within the Beaver Lake Nature Center, owned by Onondaga County.

Stakeholder Involvement

Goals were set in 1987 to improve lake water quality and the Beaver Lake ecosystem by Onondaga County through the former Onondaga County Water Quality Management Agency and a limited number of stakeholders.

Assessment and Prioritization

In 1987, a technical team headed by the Onondaga County Planning Department conducted an assessment concluding that the lake water quality was poor (hypereutrophic) with serious ecosystem degradation. Management objectives included reduction in alga growth and improved aquatic habitat quality. Ichthyological Associates of Ithaca, NY were retained to provide a set of possible remediation measures.

Resource-Based Integrated Solution

Selected measures have included a lakewide alum treatment (1992) and a pilot macrophyte replanting project (1995).

Evaluation and Feedback

Water quality monitoring is ongoing since 1992. A fisheries assessment was conducted in 1994. Lake level and water budget data have been collected since the late 1990s.

Contact: Onondaga County Health Department, Russ Nemecek, (315) 435-6600

4. Chittenango Creek

A watershed management approach includes Agricultural Environmental Management (particularly in the upper and middle sections) and flood control/streambank restoration within the lower section of the watershed.

Stakeholder Involvement

In 1995 Onondaga County Soil and Water Conservation District with some limited stakeholder involvement defined watershed goals for Chittenango Creek, particularly focused on agriculture.

Resource Assessment and Prioritization

The SWCD carried out an agricultural assessment equivalent to Tier 1 and Tier II farm review under New York State's Agricultural Environmental Management program. A streambank inventory was completed in 1996.

Resource-Based Solutions

Implementation measures have been defined through agricultural assessments and the streambank inventory.

Contact: Onondaga County Soil and Water Conservation District; Walt Neuhauser, (315) 677-3851

5. Kendig Creek

Stakeholder Involvement

Seneca County Soil and Water Conservation District has monitored the Kendig Creek watershed from 1989 – 1997 in collaboration with State University of New York (SUNY) at Brockport's Center for Applied Aquatic Science and Aquaculture (CAASA).

Assessment and Prioritization

Scientists gauged stream hydrology to obtain stage height and stream discharge. Weekly baseline and event water quality samples for nutrients and suspended solids were also taken between 1990 and 1994. Sources of nutrients were identified through a stressed stream analysis (Makarewicz and Lewis 1996) which included point and nonpoint sources.

Resource-Based Solutions

Recommended solutions included preparation of a remedial action plan, Best Management Practices, and additional monitoring.

Evaluation and Feedback

The plan emphasized monitoring effectiveness of BMPs.

Contact: Seneca County Soil and Water Conservation District, Philip S. Griswold, (315) 568-4366

6. Lake LeRoy Reservoir

Stakeholder Involvement

The Lake LeRoy Watershed Advisory Committee formed in the late 1980s, and included participation from the Village of LeRoy, county and federal agencies, and agricultural producers.

Assessment and Prioritization

An assessment of water quality problems was conducted and indicated impairment from nutrients and sediment which created water quality problems. Anoxic conditions at deeper lake levels during the warmer months result in releases of iron and manganese affecting water quality taste and odor. In addition, atrazine and others pesticides were detected, raising concerns.

Resource-Based Solutions

The Village of LeRoy operates an oxygen injection system and aquatic weed harvester to improve water quality conditions. Agricultural Best Management Practices and erosion control measures were implemented.

Evaluation and Feedback

Lake LeRoy continues to be monitored as a public drinking water supply.

Contacts: Genesee County Health Department, Thomas Guerin, (716) 344-8506
Genesee County Soil and Water Conservation District, George Squires, (716) 343-2362

7. Eighteenmile Creek

Stakeholder Involvement

The DEC in cooperation with the Eighteenmile Creek Remedial Action Plan Committee issued the Remedial Action Plan for Eighteenmile Creek in Niagara County in 1997. The Area of Concern extends from the mouth of the creek upstream to a point just below a dam in the hamlet of Burt.

Assessment and Prioritization

Remedial Action Plan goals were established to restore physcial, chemical, and biological integrity of the Area of Concern ecosystem. A variety of sources have been linked through assessment to resource impairments. For example, fishing is impaired by PCBs (polychlorinated biphenyls) and dredging restrictions are the result of metals contamination. Contaminants in sediments due to industrial and municipal discharges, waste disposal, and use of pesticides are identified as a primary source of water quality problems in the Area of Concern.

Resource-Based Solutions

On-going implementation activities include hazardous waste investigation of the Williams Street Island, sediment core sampling; and evaluation of the City of Lockport sewer system.

Evaluation and Feedback

A local committee called Friends of Eighteenmile Creek is evaluating nonpoint source pollution impacts; biological sampling is planned.

Contacts:

T.S. Manickam, NYS Department of Environmental Conservation, Region 9, (716) 851-7070

Cindy Long, Niagara County Soil and Water Conservation District, (716) 434-4949

8. Lake Neatahwanta

Stakeholder Involvement

Lake Neatahwanta is one of the Oswego County Water Quality Coordinating Committee's (WQCC) top priorities. The lake has been the subject over the 1990s of a concerted restoration effort among local leaders, the WQCC, county, regional, state and federal agencies and the Lake Neatahwanta Reclamation Committee (a citizen organization that sees tremendous potential in the lake as a scenic community and recreational resource). Most of the lake is surrounded by public land or wetlands, with few private lakeshore property owners.

Assessment and Prioritization

Lake Neatahwanta is a shallow (mean depth 2.5 meters), extremely productive lake with periodic excessive concentrations of algae, poor transparency, and high phosphorus concentrations. In 1991, the Lake Neatahwanta Diagnostic Feasibility Study and Management Plan was completed. Subsequent studies have included comprehensive water quality monitoring, a streambank inventory, nutrient loading assessment, GIS mapping of watershed soils, and a survey for the presence of the European aquatic moth (that feeds preferentially on invasive Eurasian watermilfoil).

Resource-Based Solutions

Implementation activities have included several agricultural Best Management Practices related to livestock in the watershed, stormwater detention and streambank stabilization, alum treatment, and multiple public education projects.

Evaluation and Feedback

In 1997 the Lake Neatahwanta Reclamation Committee commissioned the Upstate Freshwater Institute of Syracuse to conduct three synoptic studies with results confirming "extreme eutrophication" and recommending massive reductions in phosphorus levels. Remedial measures such as copper sulfate treatments to control algal blooms and aquatic vegetation harvesting were recommended to deal with the symptoms of the hypereutrophic conditions.

Based on the synoptic surveys, more realistic management goals for Lake Neatahwanta were developed in consultation with DEC Division of Water. Short-term treatment and long-range nonpoint source pollution control actions have been identified.

Contacts:

Oswego County Planning Department, Karen Noyes (315) 349-8292

Oswego County Soil and Water Conservation District, John DeHollander (315) 343-0040

Lake Neatahwanta Reclamation Committee, Joe Allerton (315) 592-5900

9. Johnson Creek

Assessment and Prioritization

Niagara County SWCD did event-based monitoring to assess conditions in the watershed between 1997 and 1998, including a stressed stream analysis between 1998 and 1999. Areas were prioritized and Agricultural Environmental Management was implemented for the watershed. In addition, Niagara County cooperated with Orleans County, NRCS and DEC in 1998 in a riparian protection program to improve the quality of fish habitat.

Resource-Based Solutions

Landowners have enrolled in a riparian buffer program.

Contacts: Niagara County Soil and Water Conservation District, Cindy Long (716) 434-4949
Orleans County Soil and Water Conservation District, Nichelle Billhardt (716) 589-5959

10. Oak Orchard Creek

Stakeholder Involvement

Orleans County SWCD initiated agricultural assessments in 1995, and assisted farmers with preparation of farm plans under the Agricultural Environmental Management program.

Assessment and Prioritization

Stressed stream and segment analysis were used to identify sources and set priorities.

Contact: Orleans County Soil and Water Conservation District, Nichelle Billhardt, (716) 589-5959

11. Oneida Creek

Stakeholder Involvement

In 1995 Oneida County SWCD with some limited stakeholder involvement defined watershed goals for Oneida Creek particularly focused on agriculture

Assessment and Prioritization

A streambank inventory and water quality monitoring helped to identify sources of sediment.

Resource-Based Solutions

Fencing, biotechnical slope protection, and riprapping were used to stabilize targeted streambank segments.

Contact: Oneida County Soil and Water Conservation District, Kevin Lewis, (315) 736-3334

12. Oswego River Remedial Action Plan

Stakeholder Involvement

DEC formed a Citizen's Advisory Committee (CAC) in 1990 as the first step of the Oswego River Remedial Action Plan. The CAC was composed of industry representatives, outdoor sports enthusiasts, environmentalists, research scientists and local government representatives.

Assessment and Prioritization

Stage I of the Oswego RAP (DEC 1990) includes assessments of existing environmental problems, causes of use impairments, and sources of pollutants responsible for impairments.

Resource-Based Solutions

Stage II of the Oswego River RAP (DEC 1991) describes a remedial strategy, recommends remedial actions with specific commitments and describes methods for monitoring progress in the Area of Concern (AOC).

Evaluation and Feedback

Evaluation of the changes resulting from remedial actions is recommended in the Stage II RAP. The Stage III RAP is designed to be the feedback mechanism, documenting the restoration of impaired uses.

Contact: DEC, Robert Townsend, (518) 457-9603

13. Rochester Embayment Remedial Action Plan

Stakeholder Involvement

Monroe County prepared the Rochester Embayment Remedial Action Plan under a contract with DEC. A technical group composed of individuals with interest and knowledge in water quality issues was established in 1988 to begin the work of the RAP.

Assessment and Prioritization

Stage I of the RAP (Monroe County Department of Planning and Development and DEC 1993) included an assessment of the existing environmental conditions, causes of use impairments, and sources of pollutants responsible for impairments.

Resource-Based Solutions

Stage II of the Rochester Embayment RAP, completed in 1997, outlines a remedial strategy, recommends remedial actions with specific commitments and describes methods for monitoring progress in the Area of Concern (AOC).

Stage III RAP is designed to be the feedback mechanism, documenting the restoration of impaired uses.

Contact: Monroe County Water Quality Planning, Margaret Peet, (716) 274-8442

14. Seneca River

Stakeholder Involvement

Watershed goals were defined and river basin problems identified in 1996.

Assessment and Prioritization

The Onondaga SWCD carried out an agricultural inventory equivalent to a Tier I and Tier II farm assessment.

Resource-Based Solutions

Actions were selected in 1997 but to date have not received funding for implementation.

Contact: Onondaga County Soil and Water Conservation District, Walt Neuhauser, (315) 677-3851

15. Tonawanda Creek

Stakeholder Involvement

Genesee County SWCD worked with farmers and the residents of the City of Batavia and in the Town of Batavia. Primary goals were to reduce sediments and nutrients associated with agriculture in the main portion of Tonawanda Creek.

Assessment and Prioritization

The Genesee SWCD carried out an agricultural assessment for the subwatersheds of the Upper Tonawanda Creek, Middle Tonawanda Creek, Murder Creek, and Ellicott Creek.

Resource-Based Solutions

The EQIP program is used to implement the education component of the plan, including public education regarding Best Management Practices. Recommended measures included nutrient management short courses for producers and agricultural consultants; calibration of manure spreaders; nitrogen testing; soil test implementation and manure sampling; and encouraging farm producers to participate in programs such as the Cornell Cooperative Extension Tactical Agriculture (TAG) teams to gain expertise in nutrient and pest management.

Contact: Genesee County Soil and Water Conservation District, George Squires, (716) 343-2362

16. Upper Black River

Stakeholder Involvement

The Lewis County SWCD assisted in defining watershed goals between 1997 and 1998.

Assessment and Prioritization

The DEC PWL was used to establish management priorities.

Resource-Based Solutions

Implementation of farm plans began in 1997.

Contact: Lewis County Soil and Water Conservation District, John Stewart (315) 376-8717.

17. Roaring Brook

Stakeholder Involvement

Goals for this resource were defined in 1997 with assistance of the Lewis County SWCD.

Assessment and Prioritization

A resource assessment was begun in 1997 and is ongoing along with the development of priorities.

Contact: Lewis County Soil and Water Conservation District, John Stewart (315) 376-8717.

MONITORING AND ASSESSMENT PROJECTS

Assessments of New York State's surface water resources are conducted at regular intervals by the DEC through the Rotating Intensive Basin Studies and Priority Waterbodies List and associated programs, as discussed in Chapters Two and Three. Local water quality assessments also occur throughout the Basin to characterize baseline conditions, monitor changes, verify/establish priorities; obtain detailed information to answer specific research questions; and monitor changes following implementation of water quality improvement measures. Some monitoring programs go further, for example, by applying stressed stream analysis to prioritize tributaries by pollutant loadings and target nonpoint sources of pollution (Lewis and Makarewicz 1999).

Local monitoring and assessment projects are typically undertaken by local government agencies, often with assistance from state or federal agencies, universities, municipalities, lake associations, consultants, citizen volunteers, schools, or other stakeholders. In some places, baseline assessments are precursors to a watershed plan. Examples of water quality assessments and monitoring projects ***that are not associated*** with a comprehensive watershed planning or restoration effort (which all incorporate monitoring and assessment) and that are funded through FL-LOWPA are listed in Table 5-1. This is not an exhaustive but rather an illustrative list of local monitoring programs.

Table 5-1 Local water quality monitoring efforts in the New York Lake Ontario Basin not integrated into a local comprehensive watershed management plan or restoration program.[1]

Waterbody	County	Lead
Catharine Creek Watershed	Chemung	SWCD
Skaneateles Lake tributaries	Cortland	SWCD
21 Hamilton County Lakes	Hamilton	SWCD
12 Herkimer County Priority Sites	Herkimer	SWCD
Jefferson County Priority Watersheds	Jefferson	SWCD
Lewis County Priority Watersheds	Lewis	SWCD
Madison County Lakes	Madison	Planning Dept.
Honeoye Creek, Black Creek, Genesee River, Lake Ontario	Monroe	Health
Johnson Creek, Twelvemile Creek, Eighteenmile Creek, & Bond Lake	Niagara	SWCD
Oneida Creek Watershed & Sconondoa Creek Watershed	Oneida	SWCD
Beaver Lake Tributaries, Jamesville Reservoir, Meadow Brook, Spafford Creek & Skaneateles Lake Tributaries	Onondaga	Health Dept.
Oak Orchard, Johnson & Sandy Creeks	Orleans	SWCD
Sandy Pond	Oswego	Planning Dept.
Lamoka, Waneta and Cayuta Lakes	Schuyler	SWCD
Waneta Lake, Lake Demmons & Lake Salubria	Steuben	SWCD
Dryden Lake	Tompkins	SWCD
Twelve priority tributaries	Wayne	SWCD

Source: FL-LOWPA Program Narratives, 1996-1999

[1]Watershed Management Planning and Restoration Projects described in Chapter 5 are not included in this table.

SITE-SPECIFIC NONPOINT SOURCE POLLUTION CONTROL PROJECTS

Site-specific nonpoint source implementation projects take place in every county of the New York State Lake Ontario Basin through local, federal or state funded programs. Site-specific implementation projects involve actions judged to be prudent in meeting an observed or measured water quality need. Seeding steep and eroding road banks, installing rip rap and biotechnologies along unstable stream banks, and using Best Management Practices to curb sources of pollution on agricultural and non-agricultural lands are examples. These actions are usually carried out by a local agency, often in cooperation with state or federal agencies, landowners, municipalities, or other local stakeholders. These actions are often identified as priorities in county water quality strategies, result from an investigation of an immediate, site-specific problem, or may be recommended in a comprehensive local watershed plan.

Site-specific implementation projects are important in areas where there is little chance or need for a comprehensive watershed management plan. In such places, there may be little community identification with a particular watercourse (e.g., relatively few people using a headwater area that feeds a major water resource downstream); or no perceived or measured problems (water quality is currently high). Resources may be allocated in these areas for preventative or remedial measures to maintain high water quality both at the site and downstream.

Site-specific implementation projects play an extremely important role in the stabilization of watersheds across the Lake Ontario Basin. Table 5-2 shows recent site specific activities in the counties of the Lake Ontario Basin associated with FL-LOWPA. This in not an exhaustive but rather an illustrative list of projects. Implementation projects are carried out in all 25 FL-LOWPA counties. Those listed in table 5-2 are recent projects not affiliated with a completed, comprehensive watershed plan or restoration program, but that met a specific, defined need.

Table 5-2. Site-specific nonpoint source implementation programs to stabilize watersheds in the Lake Ontario Basin.

County	**Watershed**	**Activity** (Ag = agricultural)	**Local Agency**
Allegany	Rushford Lake/ Upper Genesee Watershed	Ag BMPs	SWCD
Chemung	County-wide	Ag BMPs, conservation tillage, roadbank and streambank stabilization	SWCD
Cortland	County-wide	Ag BMPs, streambank and roadbank stabilization	SWCD
Genesee	Lake LeRoy and Tonawanda Creek Watersheds	Ag waste management, and streambank stabilization	SWCD
Lewis	County-wide	Streambank stabilization	SWCD
Livingston	Conesus Lake Watershed	Hydroseeding and Ag BMPs	Planning Dept.
Madison	Lake Moraine Watershed	Ag BMPs	Planning Dept.
Monroe	Irondequoit Creek	Streambank stabilization and stormwater mitigation	Health Dept.
Niagara	Lake Ontario Direct Drainage	Ag BMPs, hydroseeding	SWCD
Oneida	Oneida Creek	Ag BMPs, wetlands development and streambank stabilization	HealthDept. and SWCD
Onondaga	Seneca River Watershed and Chittenango Creek-Limestone Creek-Butternut Creek Watershed	Ag and Non-Ag BMPs	Health Dept. and SWCD
Orleans	Lake Ontario	Direct Drainage Hydroseeding	SWCD

Table 5-2. cont'd.

Oswego	Salmon River, Lake Neatahwanta	Streambank stabilization	Planning Dept. and SWCD
Schuyler	Seneca Lake, County-wide	Hydroseeding, streambank stabilization	SWCD
Seneca	Mill Creek Watershed	Ag BMPs and roadbank stabilization	SWCD
Steuben	County-wide	Hydroseeding, streambank stabilization	SWCD
Tompkins	Cayuga	Hydroseeding, streambank stabilization	SWCD
Wyoming	County-wide	Ag BMPs, hydroseeding, streambank and roadbank stabilization	SWCD

SUMMARY

There are numerous local initiatives underway across the Lake Ontario Basin that meet local objectives while complementing New York State's water quality programs. For localities in early stages of watershed planning, there are plenty of cases and lessons in the Basin from which to learn. The breadth and geographic reach of community-based programming is a positive sign that communities are developing stewardship approaches to managing their water resources. A significant amount of water quality assessment occurs at the local level. These data can play an increasingly useful role in the updating of the DEC's Priority Waterbodies List and documenting conditions and trends. There are places in the Basin where comprehensive management plans may not be an appropriate goal, but where assessment and implementation of site specific measures to control nonpoint sources of pollution are sufficient. Information exchange about water quality priorities and programs must occur. Especially important is information exchange and coordination within river basins where downstream citizens have a vested interest in the success of programs and efforts upstream.

CHAPTER SIX

RECOMMENDATIONS AND DISCUSSION

INTRODUCTION

The major purpose of this report was to examine the status of watershed planning and management in the New York State Lake Ontario Basin—FL-LOWPA's program area—and to suggest ways to advance effective practices for the overall protection and improvement of water quality. The amount of work completed to date in the Basin is impressive, and lessons for overcoming barriers have been learned that can benefit others in earlier stages of watershed management.

To have a truly sustainable Lake Ontario Basin—characterized by healthy watersheds at all scales, where upstream waters do not adversely affect downstream waters—requires that some gaps be filled. These gaps lie in the areas of communication, priority setting, program alignment, data quality and compatibility, use of quantitative, resource-based management objectives, planning incentives, and training and education. FL-LOWPA is well positioned to help close many of these gaps, and suggestions for FL-LOWPA's organizational role are included in a separate document titled *FL-LOWPA's Future: Organizational Considerations for a Sustainable Lake Ontario Basin*. It should be clear, though, that no single entity can close the gaps discussed below. The watershed partnerships that have formed over the last fifteen years as the region's collective experience has rapidly evolved need to be tapped to address continuing needs. The following recommendations should be weighed by all participating in water resources management in New York State's Lake Ontario Basin.

RECOMMENDATIONS

1. In partnership with federal, state, regional and local stakeholders, define resource goals that protect human health and the environment for watersheds nested in the Lake Ontario Basin.

2. Set regional priorities within river basins and direct drainages (Black, Genesee, and Seneca-Oneida-Oswego River basins and Lake Ontario Direct Drainage Areas).

3. Support watershed monitoring and assessment with GIS applications and sound protocols and data sharing.

4. Encourage use of quantitative, resource-based objectives tied to resource assessment in watershed and water quality plans at the local level, and establish mechanisms to measure progress toward these objectives.

5. Support development and implementation of comprehensive, community-based plans at the subwatershed level.

6. Continue local and prudent implementation of protective measures consistent with county water quality strategies in the absence of a comprehensive watershed plan.

7. Foster coordination between local programs within basins, and between local programs and broader initiatives, to ensure complementary and reinforcing agenda and efforts.

8. Foster communication and information exchange on practical process know-how, tools and techniques as well as goals and priorities.

9. Provide incentives for innovative and collaborative approaches.

10. Direct funding, process, and technical support to subwatersheds to support holistic, cooperative watershed management approaches at a scale that is conducive to comprehensive assessment, intermunicipal participation, and measurable water quality improvements.

DISCUSSION OF GAPS IN THE NEW YORK LAKE ONTARIO BASIN

Communication and Information Exchange

While communication and information exchange has certainly increased over the years, more is needed to truly integrate local water resources planning and management across the Basin and with State and Federal programs and initiatives. More integration would result in agreement on criteria, streamlined monitoring, and data and task sharing which can make individual programs more efficient. One continuing obstacle is a lack of stan-

dardization for data collection as local research questions and water quality issues vary across the region. Also, the diversity of computer systems being used (e.g., in Geographic Information Systems) continues to inhibit the ability to share and centralize data.

Data Sharing

There have been some attempts to develop data repositories to facilitate data exchange and sharing throughout the Basin (USGS 1999; G/FLRPC 1995). A long-term goal for some organizations in the Basin is development of a basin-wide digital database and central data repository for watershed analyses. Such a task will require an enormous commitment of technical and human resources. Key to success will be involvement of agencies (federal, state, and local), committees and task groups such as the NYS GIS Coordinating Body, and research institutions which share the goal and are already working to overcome hurdles to data sharing. For example, a promising initiative is the NASA-chartered Regional Application Center for the Northeast, an organization focused on making remotely sensed geographic data available to state and local governments for the northeastern United States.

Organizational Communications

The diversity of interest groups interested in water quality or having a role in its protection in the Basin calls for good organizational communications to integrate resources and efforts. Many organizations use a variety of tools, such as web sites, newsletters, exhibits, radio ads, signage, educational programs, and public meetings to communicate with others about their interests and work. Organizations in the Basin should take advantage of electronic media to make communications more efficient, but recognize that there may be important target audiences which are missed through a technology-based approach. Attention to development and evaluation of communication strategies on the part of water resource organizations in the Basin is suggested. Communication requires a significant effort to which some organizations may not have enough resources committed.

Planning and Setting Direction

The watershed planning work in the Basin to date is largely characterized by grassroots, community efforts. This is positive in that watershed programs are more likely to be implemented when developed by the communities with a stake in the resource. The question arises, “How are we doing on a broader level? How are we doing across the river basins, and the Lake Ontario Basin?” At this time, there is little direction given, other than state water quality standards and process models, for the development of local programs. River basin goals could provide a general but important level of guidance to the local level to ensure local programs are aligned and reinforcing. These general goals should be set in concert with stakeholders from the local, regional, and state levels.

Next, basin priorities should be articulated through dialogue and consensus for the major drainage areas in the Lake Ontario Basin. This process should take advantage of relevant existing work (e.g., as for the Genesee River basin through its Remedial Action Planning process). Basin goals and basin priorities must be general enough to allow for local flexibility but concrete enough that they accomplish the goal of having all parties working in a neighborly fashion.

Increased incentives for multi-year planning at the local and basin levels are needed (in addition to implementation programs).

Coordination and Priority Setting

As the watershed management framework discussed in the beginning of Section 4 is steadily tested and refined, there is a growing confidence that cooperative approaches to managing subwatersheds can be successful. At the next level of cooperation, local programs would be aligned across larger sub-basins to more efficiently reach water quality goals. Most local programs are well established and have brought local benefits to their respective constituents. In the future, more efforts can be made to check for harmony among local programs within sub-basins. This is different from systematizing local programs, which disregards the importance of local context. To move watershed management forward in the Basin, the alignment of independent local programs and projects should be checked against sub-basin priorities. This step naturally flows from steps described in the Planning and Setting Direction section above.

Education

There continues to be a need for public education about the value of water resources, the importance of watersheds, and the role of individuals and communities in protection of water resources. Also, the multi-disciplinary nature of watershed management needs to be appreciated, and water resources professionals should continually educate themselves outside their traditional disciplines to broaden the scope of problem solving.

Learning from the practical experiences of others is also important. Professional training and public education require allocations of resources, and these may not be adequate currently to meet the need.

Three additional challenges are discussed below.

Establishing a Clear Linkage between Lake Ontario and is Basin

There is a perceptual and programmatic disconnection between Lake Ontario and the Lake Ontario Basin. For example, documented critical sources of impairment to Lake Ontario itself are primarily toxicants. The Lake Ontario Lakewide Management Plan lists lakewide critical pollutants as PCBs, DDT and its metabolites, dioxins/furans, mirex, dieldrin and heptachlor/heptachlor epoxide (Lake Ontario LaMP 1997). Many of these toxicants stem from historical sources (e.g., landfills, contaminated sediments), industries and municipalities (e.g., combined sewer overflows), atmospheric deposition and inputs from other Great Lakes. Other impairments are caused by introduction of exotic species through the Great Lakes system. Tackling the lakewide impairments requires significant action at the state, provincial, and federal levels. Most of the impairment problems within the basin stem from eutrophication, erosion, acidification (in the Black River sub-basin), and nutrient inputs. While phosphorus is one of the major sources of impairment within the local waters of the basin, excepting the nearshore littoral zone, Lake Ontario itself is phosphorus poor.

New York State has several statewide nonpoint source pollution related programs in place, but the major intergovernmental emphasis for Lake Ontario is abatement of toxicants to restore the lake ecosystem. A major FLLOWPA focus is abatement of nonpoint source pollution to address local impairments in the basin and benefit the Lake Ontario ecosystem. Forging connections between the Basin and the Lake may best be accomplished by focusing on major river systems within the major Lake Ontario sub-basins. Dialogue and coordination of efforts on a sub-basin scale can highlight upstream-downstream linkages while keeping the focus narrow enough to accommodate local concerns. In these sub-basins, there may be more potential to tangibly relate programs to one another and overcome the perception that, in the outskirts of the Basin, Lake Ontario is less relevant.

There needs to be good two-way dissemination of information between state, provincial, and federal parties working on Lake Ontario ecosystem concerns and stakeholders working on local and basin concerns. As one example, to achieve success in meeting the goal of restoring beneficial uses in the Great Lakes Areas of Concern through the development and implementation of Remedial Action Plans, these plans need to be coordinated with myriad water quality programs and initiatives in the contributing creek subwatersheds and river basins.

Allocating Resources to Encourage Sustainable Watersheds

Embracing the Watershed Unit of Management

The last decade has been marked by growing acceptance among government agencies, researchers, resource managers and laypersons alike that the watershed is the most appropriate planning and management unit to effectively control nonpoint sources of pollution to our waterways. The way government agencies and resource managers do business has changed as a result. Interdisciplinary teams are needed to assess important watershed features like soils, limnology, land use patterns and demographics, etc. More emphasis is placed on community participation and education, recognizing that individual actions to protect watersheds are necessarily decentralized and often voluntary. Municipal involvement and cooperation is sought to ensure more effective and uniform approaches to water quality protection across town and village boundaries.

Concerted efforts to implement the watershed management model have given rise to a number of watershed organizations and initiatives for several lakes and tributaries in New York's Lake Ontario Basin. For example, Remedial Action Plans and their associated Citizens Advisory Committees have been active since the late 1980s for the Genesee River/Rochester Embayment and Oswego Harbor/River under an International Joint Commission initiative. Task forces or watershed umbrella groups have formed over the last decade for the majority of Finger Lakes (see case studies in Chapter Five).

Where high quality, consensus-based watershed management plans exist in the Basin, and/or where watershed organizations have a proven track record for effectively determining and implementing programs to improve or protect water quality, future public funding should increasingly be targeted on a watershed basis. This will be a gradual transition, as individual political units would become less relevant with the evolution of intermunicipal watershed institutions. Signs of the transition are already evident in the Finger Lakes region, as grant funds are secured to develop or implement elements of consensus-based strategic plans for Canandaigua and Keuka Lakes. The lesson is good, strategic planning works, and financial support follows.

There are areas within the Lake Ontario Basin where watershed institutions are less likely to form due to the absence of real or perceived problems or a water-related community focal point (like a public drinking water supply or recreational asset). Assessment and protection are warranted in these areas in the Basin because they influence water quality downstream, and because protection is far more efficient than remediation. In these areas, updated and rigorous county water quality strategies may offer the best mechanism for ensuring protection, and funding should be targeted to support their implementation.

Promoting Quantitative, Resource-Based Planning and Management

Quantifying Water Resources Management

Many local watershed management programs use measurable objectives to help define program scope, such as the number of acres to be hydroseeded; septic systems to be inspected in a given year; or landowners to be enrolled in a riparian buffer project. These types of measurable objectives help resource managers quantify their services and defend expenditure of public resources. The effectiveness of all watershed programs should be documented using quantifiable measures wherever possible.

To evaluate the real effectiveness of watershed management practices, however, a clear understanding of desired environmental outcome(s) is needed. Quantitative, resource-based objectives can offer a target against which those implementing practices can track how well they are doing. For example, research has indicated a direct linear relationship between percent imperviousness in a watershed and changes in hydrology, habitat structure, water quality, and biodiversity of aquatic systems. One study has shown stream degradation occurs at relatively low levels of imperviousness (10-20 percent), and at 10-15 percent imperviousness, habitat quality begins to sharply decline (Schueller 1994). Imperviousness is one of the few variables that can be quantified at multiple scales, from individual land parcels to watersheds, making it a unifying measure for watershed protection usable by planners, engineers, scientists and local officials (Scheuller 1994).

The common obstacle to using resource-based objectives in watershed management in the Lake Ontario Basin is that they can be difficult and costly to determine and measure. Examples would include a value for desired pounds reduction in phosphorus loading, or tons reduction in sediment loss from a watershed. Setting these objectives requires an in-depth understanding of the dynamics of a watershed problem and agreement on a desirable/attainable level of problem resolution. Resource-based objectives also require a feedback mechanism to monitor change in environmental conditions and assess progress toward the target.

Many local programs do not currently have the information, expertise, or resources in place to incorporate resource-based objectives on a broad scale (there are exceptions). Often local watershed programs rely more heavily on prudent implementation of preventative or remedial measures for high priority sites to resolve observed or measured problems. In such cases, pre and post-implementation monitoring can help measure environmental improvement.

Developing a Nonpoint Source Pollutant Loading Index

Nonpoint source pollution is costly and difficult to measure across a large geographic area, and each water quality parameter has its pros and cons. Reliance on a single parameter may be misleading. An alternative to using single parameters to assess conditions is to utilize an index. An index is a number representing an aggregate of parameters, like that used to assess trophic status. For example, a nonpoint source pollution index combining Total Nitrogen, Total Phosphorus, Sediment, and Chemical Oxygen Demand (COD) has been suggested by Yagow and Shanholtz (1996). Development and application of watershed indices has potential to make watershed assessments more efficient (and comparable) but requires scientific expertise. Laypersons involved in community-based programs may need to be educated about the use of the index as well.

To encourage the use of quantitative resource-based objectives the following are needed:

- Training for water resources planners and managers on quantifying pollutant loadings and the effectiveness of implementation measures.
- Teaching/demonstration projects to test the use of quantitative objectives and pollution indices.
- Relationships with research institutions that can provide assistance in the development of quantitative measures and indices for nonpoint source pollution.❑

APPENDIX B

Participants and Contacts[1]

Mr. Larry Albers
GIS Coordinator
NYS DEC
50 Wolf Road
Albany, New York 12231
(518) 457-3143

Mr. Joe Allerton
Lake Neatahwanta Reclamation Committee
827 Forest Avenue
Fulton, New York 13069
(315) 592-5900

Mr. Jim Balyszak
Water Resources Specialist
Yates County SWCD
110 Court Street
Penn Yan, New York 14527
(315) 536-5188
FAX (315) 536-5136
ycswcd@linkny.com

Ms. Marion Balyszak
Seneca Lake Pure Waters Assoc. Seneca Lake Area Partners
207 Franklin Square, P.O. Box 247
Geneva, New York 14456
(315) 789-3052
FAX: (315) 789-8799
slpwa@eznet.net

Ms. Amanda Barber
Manager
Cortland County SWCD
100 Grange Place, Room 204
Cortland, New York 13045
(607) 756-0851 ext. 3
FAX: (607) 756-0029
ab@nycortland.fsc.usda.gov

Mr. Paul Bauter
Keuka Watershed Improvement Cooperative (KWIC)
Suite 205
1 Keuka Business Park
Penn Yan, New York 14527
(315) 536-0917

Ms. Carole Beal
Monroe County Department of Health
Room 692, 111 Westfall Road
Box 92832
Rochester, New York 14692-8932
(716) 274-8442

Ms. Nichelle Billhardt
District Manager
Orleans County SWCD
446 West Avenue
Albion, New York 14411
(716) 589-5959
FAX: (716) 589-7709
nichelle.billhardt@nyalbion.fsc.usda.gov

Dr. Jay A. Bloomfield
NYS DEC, Division of Water
50 Wolf Road
Albany, NY 12233
(518) 457-0731

Mr. Ed Bugliosi
USGS
30 Brown Road
Ithaca, NY 14850
(607) 266-0220
FAX: (607) 266-3005
ebuglios@usgs.gov

Mr. Tom Brace
NYSSWCC
1290 Terry Hill Road
Alpine, NY 14805
(607) 594-2034

Ms. Jessica Breiten
H-OCCPP
Department of Planning
800 Park Avenue
Utica, NY 13501
(315) 798-5710
FAX: (315) 798-5852

Mr. David Miller
Director
Cayuga County Planning Department
County Office Building
5th Floor
Auburn, NY 13021
(315) 253-1276
FAX: (315) 253-1586

Mr. Steven C. Carlisle
Soils Information System Lab
7th Floor, Bradfield Hall
Cornell University
Ithaca, NY 14853
(607) 255-2644

Mr. Andy Cohen
GIS Specialist
USGS
425 Jordan Road
Troy, NY 12180
(518) 285-5638
FAX: (518) 285-5601
acohen@usgs.gov

Mr. Phil DeGaetano
NYS DEC, Division of Water
50 Wolf Road
Albany, New York 12233
(518) 457-0633

Ms. Elaine Dalrymple
Schuyler County SWCD
P.O. Box 326
Montour Falls, New York 14865
(607) 535-9650
FAX: (607) 535-3011
swcd@onlineimage.com

Mr. John DeHollander
Oswego County SWCD
185 E. Seneca Street
Oswego, New York 13126
(315) 343-0040

Ms. Tanya DeNee
Ontario County SWCD
480 N. Main Street
Canandaigua, New York 14424
(716) 396-1450
ontswcd@frontiernet.net

Mr. Joe Delvecchio
NRCS
Galleries of Syracuse
5th Floor
441 S. Salina Street
Syracuse, New York 13202
(315) 477-6502

H. Kier Dirlam
ST-WRPDB
Center for Regional Excellence
4039 Route 219, Suite 200
Salamanca, New York 14779
(716) 945-5301

Mr. Steve Eidt
Regional Water Engineer
NYS DEC–Region 7
615 Erie Blvd. West
Syracuse, New York 13204
(315) 426-7500
speidt@gw.dec.state.ny.us

Ms. Angela Ellis
Livingston County Planning Dept.
6 Court Street, Room 305
Geneseo, New York 14454
(716) 243-7550
FAX: (716) 243-7126
aellis@co.livingston.ny.us

Mr. Ron Entringer
Chief, Program Implementation
NYS DOH
Flanigan Square
547 River Street
Troy, New York 12180
(518) 402-7713
FAX: (518) 402-7599

Mr. Tony Esser
Water Quality Coordinator (GIS)
NRCS
The Galleries of Syracuse
441 S. Salina Street
Syracuse, New York 13202
(315) 477-6536

Ms. Jennifer Fais
ST-CRPDB
145 Village Square
Painted Post, New York 14870
(607) 962-5092
FAX: (607) 962-3400

Mr. Dick Ford
Lake Manager
Cazanovia Lake Association
3950 Nelson Heights Road
Cazenovia, New York 13035
(315) 655-4212
cazlake@aol.com

Ms. Marna Gadoua
NYS DEC, Great Lakes Program
50 Wolf Road, Room 302A
Albany, New York 12233
(518) 485-8980
FAX: (518) 485-7786
mmgadoua@gw.dec.state.ny.us

Ms. Diana L. Gallagher
GIS Specialist
Crop and Soils Science
Cornell University
Bradfield Hall, Room 721
Ithaca, New York 14853
(607) 255-2278

Mr. Tyrone Goddard
State Soil Scientist
NRCS–State Office
The Galleries of Syracuse
441 S. Salina Street, Suite 354
Syracuse, New York 13202
(315) 477-6526

Mr. Philip S. Griswold
District Manager
Seneca County SWCD
12 N. Park Street
Seneca Falls, New York 13148
(315) 568-4366
FAX: (315) 568-2414
psg@senecafa.fsc.usda.gov

Mr. Thomas Guerin
Genesee County Health Dept.
3837 W. Main Street Road
Batavia, New York 14020
(716) 344-8506

Mr. Robert Hartrick
Area Conservationist
NRCS
29 Liberty Street, Suite 1
Batavia, New York 14020
(716) 343-3664
FAX: (716) 343-5538

Ms. Janet Hawkes
Cayuga Lake Watershed Network
1554 Taughannock Blvd.
Ithaca, New York 14850
(607) 273-6260
FAX: (607) 273-1719

Mr. Lynn B. Herzig
President
Finger Lakes Association
309 Lake Street
Penn Yan, New York 14527
(315) 536-7488
FAX: (315) 536-1237

Mr. James B. Hyde
Research Scientist
NYS DOH
Flanigan Square, Room 400
547 River Street
Troy, New York 12180
(518) 402-7713
FAX: (518) 402-7599

Mr. Steven S. Indrick
Assistant State Soil Scientist
NRCS - State Office
The Galleries of Syracuse
441 S. Salina Street, Suite 354
Syracuse, New York 13202
(315) 477-6521

Mr. Michael Johnston
District Manager
Madison County SWCD
P.O. Box 189
Morrisville, New York 13408
(315) 684-3181
FAX: (315) 684-9386

Mr. William M. Kappel
Hydrogeologist
USGS-Water Resources Division
30 Brown Road
Ithaca, New York 14850
(607) 266-0217 ext. 301
FAX: (607) 266-0217

Mr. Greg Kesel
Greece Citizens for a Clean Environment
57 Long Pond Road
Rochester, New York 14612

Ms. Shohrem Karimipour
GIS Specialist
NYS DEC
50 Wolf Road
Albany, New York 12233
(518) 457-9871

Mr. N.G. Kaul
NYS DEC
50 Wolf Road
Albany, New York 12233
(518) 457-7939
FAX: (518) 457-0625

Mr. Jim Kersting
Honeoye Valley Association
6057 Lawrence Hill Road
Springwater, New York 14560
(716) 367-2301

Mr. John W. Kick
GIS Coordinator
NRCS–State Office
The Galleries of Syracuse
441 S. Salina Street, Suite 354
Syracuse, New York 13202
(315) 477-6525

Mr. Steve Komor
GIS–Soils
USGS
30 Brown Road
Ithaca, New York 14850
(607) 266-0217
FAX: (607) 266-0217

Mr. Charlie Knauf
Monroe County Environmental Health Lab
740 E. Henrietta Road
Rochester, New York 14620
(716) 274-6819
FAX: (716) 274-8098
cknauf@mcls.rochester.lib.ny.us

Mr. Walter Kretser
Adirondack Lake Survey Corp.
P.O. Box 296
Ray Brook, New York 12977
(518) 897-1354

Ms. Betsy Landre
Program Coordinator
Water Resources Board
FL-LOWPA
309 Lake Street
Penn Yan, New York 14527
(315) 536-7488
FAX: (315) 536-1237
wrb@eznet.net

Mr. Peter Landre
Executive Director
CCE - Yates County
110 Court Street
Penn Yan, New York 14527
(315) 536-5123

Mr. Bill Legg
Centers for Nature Education
3805 Jordan Road
Skaneateles, New York 13152
(315) 685-5624
leggbill@dreamscape.com

Mr. Stephen Lewandowski
Cayuga Lake Watershed Steward
109 East Seneca Street
Ithaca, New York 14850
(607) 272-3700

Mr. Rich Lewis
NYS SWCC
1 Winners Circle
Albany, New York 12235
(518) 457-3738

Mr. Kevin L. Lewis
District Manager
Oneida County SWCD
9025 State Route 49, Room 204
Marcy, New York 13403
(315) 736-3334
FAX: (315) 736-9547
kev61464@aol.com

Ms. Cynthia Long
District Manager
Niagara County SWCD
4487 Lake Avenue
Lockport, New York 14094
(716) 434-4949
FAX: (716) 434-4985
ncswcd@pcom.net

Mr. Russ Lura
Madison County Planning Dept.
County Office Bldg.
Box 606
Wampsville, New York 13163
(315) 366-2378
FAX: (315) 366-2742

Mr. Jim Luz
Regional Water Engineer
NYS DEC-Region 6
State Office Building
317 Washington Street
Watertown, New York 13601
(315) 785-2236

Ms. Lee Macbeth
City of Syracuse–Water Dept.
101 N. Beech Street
Syracuse, New York 13210
(315) 473-2634

Mr. Jim Malyj
Seneca County SWCD
12 N. Park Street
Seneca Falls, New York 13148
(315) 568-4366
FAX: (315) 568-2414
jcm@senecafa.fsc.usda.gov

Mr. T.S. Manickam
NYS DEC Region 9
270 Michigan Ave.
Buffalo, NY 14203-2999
(716) 851-7070

Ms. Elizabeth Mangle
District Manager
Hamilton County SWCD
P.O. Box 166
Lake Pleasant, New York 12108
(518) 548-3991
FAX: (518) 548-7803
hcswcd@teletnet.net

Mr. Jay Matteson
District Manager
Jefferson County SWCD
21168 NYS Route 232
Watertown, New York 13601
(315) 782-2749
FAX: (315) 782-3054
omatj@mailrelay.suny.jefferson.edu

Mr. Jim McCardell
NYS SWCC
1 Winners Circle
Albany, New York 12235
(518) 457-3738

Mr. Greg McKurth
District Manager
Wyoming County SWCD
31 Duncan Street
Warsaw, New York 14569
(716) 786-5070
FAX: (716) 786-0381
wcswcd@wycol.com

Mr. John McMahon
Regional Water Engineer
NYS DEC Region 9
270 Michigan Avenue
Buffalo, New York 14203
(716) 851-7070

Mr. Mike Mercincavage
ST-ERPDB
375 State Street
Binghamton, New York 13901
(607) 724-1327
FAX: (607) 724-1194

Mr. Jeff Myers
NYS DEC Division of Water
Room 392, 50 Wolf Road
Albany, New York 12233-3502
(518) 457-7130
jamyers@gw.dec.state.ny.us

Ms. Sheila Myers
Extension Agent
Cornell Cooperative Extension
Onondaga County
220 Herald Place, 2nd Floor
Syracuse, New York 13202
(315) 424-9485
FAX: (315) 424-7056

Mr. Kevin Millington
Coastal Resources Specialist
NYS DOS
41 State Street, 8th Floor
Albany, New York 12231
(518) 473-2479
FAX: (518) 473-2464
kmilling@dos.state.ny.us

Mr. Les Monostory
Onondaga County Health Department
P.O. Box 15190
Syracuse, New York 13215
(315) 435-6600

Ms. Ann Moore
Cayuga County Water Quality Management Agency
7413 County House Road
Auburn, New York 13021
(315) 252-7011
annmoore@yahoo.com

Mr. Bill Morton
NYS DEC
50 Wolf Road, Room 398
Albany, New York 12233
(518) 457-9872

Mr. Mark Negri
USGS
12202 Sunrise Valley Drive, MS
Reston, Virginia 20191
(703) 648-5613

Mr. Russell Nemecek, Ph.D.
Onondaga County Dept. of Health
P.O. Box 15190
4894 Onondaga Road
Syracuse, New York 13215
(315) 435-6600
FAX: (315) 435-6606

Mr. Walt Neuhauser
Onondaga County SWCD
2571 Route 11
Lafayette, New York 13084
(315) 677-3851

Ms. Lois New
NYS DEC Division of Water
Room 310C, 50 Wolf Road
Albany, New York 12233-3500
(518) 485-7748

Ms. Karen Noyes
Oswego County Planning Dept.
46 E. Bridge Street
Oswego, New York 13126
(315) 349-8292
FAX: (315) 349-8279
knoyes@co.oswego.ny.us

Mr. Andrew Olenik
Oatka Creek Watershed
70 Cascade Drive
Rochester, New York 14614
(716) 454-4743

Ms. Pam O'Malley
CNYRPDB
100 Clinton Square, Suite 200
126 N. Salina Street
Syracuse, New York 13202
(315) 422-8276
pomalley@cnyrpdb.org

Mr. Bruce Oswald
Project Director
NYS Office for Technology
State Capitol
Albany, New York 12224
(518) 474-0876
FAX: (518) 473-3389

Mr. Kevin Olvany
Manager
Canandaigua Lake Watershed
P.O. Box 653
Canandaigua, New York 14424
(716) 393-2990
kevin.olvany@co.ontario.ny.us

Mr. Ryan Palmer
Jefferson County SWCD
P.O. Box 838
21168 NYS Route 232
Watertown, New York 13601
(315) 782-2749
FAX: (315) 782-3054
omatj@mailrelay.suny.jefferson

Mr. Jeffrey Parker
District Manager
Steuben County SWCD
415 W. Morris Street
Bath, New York 14810
(607) 776-7398 ext. 3
FAX: (607) 776-7487
jeffrey-parker@ny.nacdnet.org

Mr. Tom Pearson
Regional Water Engineer
NYS DEC - Region 8
6274 East Avon-Lima Road
Avon, New York 14414
(716) 226-2466

Ms. Margy Peet
Monroe County Health Dept.
P.O. Box 92832, Room 962
Rochester, New York 14620
(716) 274-8442
FAX: (716) 274-6094
mpeet@mcls.rochester.lib.ny.us

Mr. Jim Petreszyn
Madison County Planning Dept.
Box 606
Wampsville, New York 13163
(315) 366-2376

Mr. Tim Pezzolesi
CCE-Ontario County
480 North Main Street
Canandaigua, New York 14424
(716) 396-3478
tpp4@cce.cornell.edu

Mr. Robert Pierce
Ontario County Planning Dept.
20 Ontario Street
Canandaigua, New York 14424
(716) 396-4489
FAX: (716) 296-2950
robert.pierce@co.ontario.ny.us

Mr. Howard Pike
Chief, Floodplain Management
NYS DEC
50 Wolf Road, Room 388
Albany, New York 12233
(518) 457-1617
FAX: (518) 485-7786

Mr. Jerry Rasmusen
GIS Coordinator, US Fish & Wildlife
NYS DEC
50 Wolf Road
Albany, New York 12233
(518) 783-5733

Mr. Dave Reckahn
Wyoming County SWCD
31 Duncan Street Extension
Warsaw, New York 14569
(716) 786-5070
FAX: (716) 786-0381
wcswcd@wycol.com

Mr. Patrick Reidy
Cortland County SWCD
100 Grange Place, Room 202
Cortland, New York 13045
(607) 756-0851 ext. 3
FAX: (607) 756-0029
pr@nycortland.fsc.usda.gov

Ms. Wendy Rosenbach
NYS DEC
50 Wolf Road, Room 308
Albany, New York 12233
(518) 485-8738

Ms. Anne Saltman
CNYRPDB
100 Clinton Square, Suite 200
126 North Salina Street
Syracuse, New York 13202
(315) 422-8276
asaltman@cnyrpdb.org

Mr. Craig R. Schutt
District Manager
Tompkins County SWCD
903 Hanshaw Road
Ithaca, New York 14850
(607) 257-2340 ext. 115
FAX: (607) 257-7896
craigschutt@hotmail.com

Mr. Fred Sinclair
District Manager
Allegany County SWCD
5425 County Road 48
Belmont, New York 14813
(716) 268-7831 ext. 3
FAX: (716) 268-7224

Mr. James Skaley
940 Dryden Road
Ithaca, New York 14850
(607) 256-1617
JESkaley@aol.com

Ms. Sharye Skinner
President
Cazenovia Lake Association
P.O. Box 51
4522 Syracuse Road
Cazenovia, New York 13035
(315) 655-4371
sharyeskinner@usdatanet.net

Ms. Barbara Spinweber
USEPA Region 2
290 Broadway, 24th Floor
New York, New York 10007
(212) 637-3848
FAX: (212) 637-3889

Mr. George Squires
District Manager
Genesee County SWCD
29 Liberty Street, Suite 3
Batavia, New York 14020
(716) 343-2362
FAX: (716) 345-1815
george-squires@ny.nacdnet.org

Mr. Jack Starke
Honeoye Lake Watershed Task Force
32 Towpath Trail
Rochester, New York 14450
(716) 223-4425

Mr. John Stewart
District Manager
Lewis County SWCD
P.O. Box 9
Lowville, New York 13367
(315) 376-6122
FAX: (315) 376-8717
lcswcd@northnet.org

Mr. Curt Swartle
NYS DEC - Division of State Lands
50 Wolf Road
Albany, New York 12233

Mr. Ted Teletnick
District Manager
Herkimer County SWCD
5653 State Route 5
Herkimer, New York 13350
(315) 866-2520 ext. 3
FAX: (315) 866-8870
ted.teletnick@ny.usda.gov

Mr. Robert Townsend
NYS DEC
50 Wolf Road, Room 302A
Albany, New York 12233
(518) 457-9603

Mr. Colby Tucker
NYS DEC - Western Watershed Section
50 Wolf Road, Room 398
Albany, New York 12233
(518) 457-0634
FAX: (518) 485-7786
catucker@gw.dec.state.ny.us

Ms. Linda P. Wagenet
Cornell Center for the Environment
Rice Hall
Cornell University
Ithaca, New York 14853
(607) 255-6518
FAX: (607) 254-2896
lpw2@cornell.edu

Mr. Al Wahlig
Keuka Lake Association
538 West Lake Road
Hammondsport, New York 14840
(607) 868-3218

Ms. Lisa Warnecke
GeoManagement Associates
256 Greenwood Avenue
Syracuse, New York 13210
(315) 478-6024

Mr. Robin Warrender
Environmental Engineer III
NYS DEC
50 Wolf Road, Room 388
Albany, New York 12233
(518) 457-0635
FAX: (518) 485-7786
rl1@gw.dec.state.ny.us

Mr. William Wasilauski
Regional Water Engineer
NYS DEC - Region 5
Route 86, P.O. Box 296
Ray Brook, New York 12977
(518) 897-1200

Mr. Mark Watts
District Manager
Chemung County SWCD
851 Chemung Street
Horseheads, New York 14845
(607) 739-2009
FAX: (607) 739-4392
chemswcd@servtech.com

Mr. Lloyd Wetherbee
Schuyler County SWCD
P.O. Box 326
Montour Falls, New York 14865
(607) 535-9650
FAX: (607) 535-3011
swcd@onlineimage.com

Mr. Mike Welchko
Madison County SWCD
P.O. Box 189
Morrisville, New York 13408
(315) 684-3181
FAX: (315) 684-9386

Mr. John Wildeman
Director
NYS Ag & Markets
1 Winners Circle
Albany, New York 12235
(518) 457-3738

Mr. Robert K. Williams
District Manager
Wayne County SWCD
10 Leach Road
Lyons, New York 14489
(315) 946-4136
FAX: (315) 946-4136
robert-williams@ny.nacdnet.org

Mr. Phillip Zarriello
Hydrologist
USGS
30 Brown Road
Ithaca, New York 14850
(607) 266-0217
FAX: (607) 266-0521

Mr. John Zmarthie
NYS Canal Corporation
P.O. Box 308
E. Syracuse, New York 13057
(315) 437-2741

Mr. David Zorn
G-FLRPC
1427 Monroe Avenue
Rochester, New York 14618
(716) 442-3770
dzorn@frontiernet.net

Individuals included were either personally interviewed by EcoLogic, LLC for the project, coordinated local focus groups at the county level, provided input on specific sections of the report or were identified as the primary contact(s) for local case studies in Chapter 5. This is not intended to be an exhaustive list of water resources contacts for the Lake Ontario Basin.

APPENDIX C

ACRONYMS

ACOE	(United States) Army Corps of Engineers
AEM	Agricultural Environmental Management
AOC	Area of Concern
APA	Adirondack Park Agency
AVCP	Aquatic Vegetation Control Program
BMP	Best Management Practice
CAASA	Center for Applied Aquatic Science and Aquaculture
CAC	Citizen Advisory Committee
CCE	Cornell Cooperative Extension
CLWMP	Canandaigua Lake Watershed Management Plan or Conesus Lake Watershed Management Plan
COD	Chemical Oxygen Demand
CSLAP	Citizens Statewide Lake Assessment Program
CRP	Conservation Reserve Program
CSO	Combined Sewer Overflow
CTA	Conservation Technical Assistance
DEC	(New York State) Department of Environmental Conservation
DOH	(New York State) Department of Health
DOS	(New York State) Department of State
DOT	(New York State) Department of Transportation
EMC	Environmental Management Council
EPA	(U.S.) Environmental Protection Agency
EQIP	Environmental Quality Incentives Program
FL-LOWPA	Finger Lakes–Lake Ontario Watershed Protection Alliance
FSA	Farm Service Agency
GCFCE	Greece Citizens for a Clean Environment
G/FLRPC	Genesee-Finger Lakes Regional Planning Council
GIS	Geographic Information Systems
GLWQA	Great Lakes Water Quality Agreement
GWLF	Generalized Watershed Loading Functions
H-OCCPP	Herkimer-Oneida Counties Comprehensive Planning Program
IJC	International Joint Commission
IO	Intermunicipal Organization
KLA	Keuka Lake Association
KWIC	Keuka Watershed Improvement Cooperative
LaMP	(Lake Ontario) Lakewide Management Plan
MDA	Metropolitan Development Association
NRCS	Natural Resources Conservation Service

NYSARC	New York State Association of Regional Councils
OCWA	Onondaga County Water Authority
OLMC	Onondaga Lake Management Conference
OWL	Owasco Watershed Lake Association
PWL	Priority Waterbodies List
RAP	Remedial Action Plan
RAWS	Remedial Action Worksheets
RIBS	Rotating Intensive Basin Surveys
SLAP-5	Seneca Lake Area Partners in Five Counties
SLPWA	Seneca Lake Pure Waters Association
SLWAP	Skaneateles Lake Watershed Agricultural Program
SPDES	State Pollutant Discharge Elimination System
ST-CRPDB	Southern Tier-Central Regional Planning & Development Board
ST-ERPDB	Southern Tier-East Regional Planning & Development Board
ST-WRPDB	Southern Tier-West Regional Planning & Development Board
SUNY	State University of New York
SURC	Syracuse University Research Corporation
SWAP	Source Water Assessment Program
SWCD	Soil & Water Conservation District
TMDL	Total Maximum Daily Load
TWAC	Town Watershed Advisory Committee
USDA	United States Department of Agriculture
USFWS	United States Fish & Wildlife Service
USFS	United States Forest Service
USGS	United States Geological Survey
USEPA	United States Environmental Protection Agency
UWA	Unified Watershed Assessment
WHIP	Wildlife Habitat Incentives Program
WQCC	Water Quality Coordinating Committee
WRP	Wetlands Reserve Program
WRB	Water Resources Board

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FL-LOWPA

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