2 Lake Montauk to Lake Erie: 7,850 New York State Lakes

Introduction

Famous Lake George, Queen of American Lakes, and beautiful Skaneateles Lake stand in contrast to infamous Onondaga Lake, referred to as the nation's most polluted lake. These extremes exemplify the wide range of lakes within New York State. Lakes can be found in the middle of large metropolitan areas where they are seen daily by millions and in secluded forests accessible only by bumpy dirt roads or narrow hiking trails. Our lakes also come in a wide variety of sizes, shapes, and even colors. This chapter explores the similarities and great variety of lakes in New York State, and provides insights into regional characteristics to help develop informed lake management programs.

Water, water, everywhere

No standard definitions of what constitutes a lake or pond exist in New York State. By the most commonly accepted definitions, however, New York State has about 7,850 lakes and ponds, including its reservoirs. Until the state adopts standard definitions, the unofficial estimate remains at 7,850. That places New York State sixth on the national Most Lakes List, behind Wisconsin, Maine, Michigan, and Minnesota. Alaska leads the list with a nearly unbelievable one million lakes. The lakes of New York State occupy a surface area of nearly 4 million acres, or more than 10 percent of the state. About 80 percent of this watery area is dominated by Lake Ontario and Lake Erie, the two Great Lakes that New York State shares with Canada and other states. Due to their enormous size, these two lakes are usually excluded from standard water resources statistics for New York State, such as volume of water, surface area, and number of shorefront residents. Even without Lake Ontario and Lake Erie, however, other New York State lakes still occupy a substantial part of the surface area of the state, and lakes are an important part of the lifeblood of New Yorkers.

What's in a name?

The names of New York lakes are as idyllic as Journeys End Lake, as peaceful as Whippoorwill Lake, as simple as G Lake, as ominous as Big Bad Luck Pond, and as evocative as Teakettle Spout Lake. The name of a lake may give clues to its character, as with the 34 round, oval and oblong lakes that are named Round and the large number aptly named Green Lake. The colors of the rainbow are well represented. There are lakes named Red, Yellow, Blue, Green, Orange, Brown, Black, White, and even Clear. There is no Purple Lake; one can only speculate whether this was due to its infrequency in nature or in verse. There are at least 23 Silver Lakes or Ponds, some of which are often quite green. One Silver Lake, an acidic Adirondack Lake, may be the clearest lake in the state. About 3,050 lakes, ponds and reservoirs have been officially assigned names and are listed in the *Gazetteer of New York State Lakes, Ponds, and Reservoirs* (NYSDEC, 1987). That list contains the vast majority of New York State lakes considered "significant." Another 500 or so unnamed larger ponds, and 4,300 unofficially named and unnamed smaller lakes and ponds, are often known only by the name of a present or historical landowner.

Lake classifications and characteristics

Best intentions

All waterbodies in New York State are classified by New York State Department of Environmental Conservation (DEC) for their best intended use, such as drinking water, recreation or wastewater disposal. In this system, lakes used for drinking water are considered Class AA or Class A lakes, the distinction corresponding to the amount of treatment required to render the water safe for drinking. As an added distinction, some lakes in the Lake George area are Class

AA-S (S=special), which means that no wastewater, whether treated or untreated, can be discharged directly into them. Consequently, their waters can be used as a drinking water source with only minimal treatment. Similar rules apply to lakes Erie and Ontario, which are also designated as Class A-S.

Lakes used primarily for contact recreation, such as swimming, are designated as Class B. These lakes are not classified for drinking water, have somewhat less stringent water-quality standards, and can accept discharge of treated wastewater, although direct discharges to small lakes are not common in New York State. Class C lakes are used primarily for non-contact recreation, such as fishing and boating.

While Class D lakes were originally designated to accept wastewater, this designation has been phased out. All lakes must now meet the federal goal of "swimmable, fishable" conditions, so Class D lakes have been reclassified to reflect more appropriate uses. Class N lakes are found within the New York State Forest Preserve, and are not classified for human uses, although they do serve many ecological functions within the forest ecosystems. The classification system is described in detail in the Appendix B, "New York State water quality classifications." (6 NYCRR Part 701)

The assignment of lakes into these categories reflects the convergence of several factors:

- historical precedent (how it was used);
- water quality information, is it adequate to support a particular use; and
- caution, without sufficient information, a "lesser" use is assumed.

Water-quality parameters

There are general correlations between best intended use and water-quality conditions, as seen in the Table 2–1 (NYSDEC, 2004a), but there are also some odd results. Heavy recreational use has degraded some lakes classified for drinking water and they may not fully support the best-intended use of the lake. At the other end of the spectrum, many lakes classified for non-contact recreation (Class C) have long been adequate to support contact recreation or even potability. However, because they have seen

(Continued on page 24)

A tale of two lakes

To paraphrase Garrison Keillor, most lakes in New York State, like the men of Lake Wobegon, are above average, at least compared to most United States lakes. That said, there are also too many lakes that don't quite approach average. New York State has a legitimate claim to have both the "best" and "worst" lakes in the country. Fortunately, there are many contenders for the title of best lake, with Lake George, Lake Placid, and countless smaller and obscure lakes and ponds vying for the crown. Skaneateles Lake, the jewel of the Finger Lakes and one of the most pristine lakes in the country, is almost visible from the tallest waste beds along the shoreline of the worst lake in New York State. Onondaga Lake holds the dubious distinction of "most polluted" lake, with its shoreline wastebeds, and contaminated water and sediments. These two opposites, only a few miles from each other, are really oceans apart.

Troubled waters

Onondaga Lake is a 3,000-acre lake in the city of Syracuse and its adjacent urban communities. It is one of the largest urban lakes in the country, enjoys a rich history, and is considered hallowed ground as the site of the founding of the Iroquois Confederacy. In the 19th century, the lake supported a thriving resort industry; a coldwater fishery comprised of Atlantic salmon, lake sturgeon, and whitefish; and served as an important recreational and commercial way station for many residents and visitors. For most of the 19th century, the lake was also a leading domestic source of salt in the United States, and was a large factor in the development and success of the Erie Canal.

Unfortunately, the lake has also been the recipient of a century of industrial contamination and municipal wastewater, byproducts of an age in which urban development was often insensitive to the degrading effects on spectacular natural resources. The resulting ruination prompted Daniel Patrick Moynihan, then a New York State Senator, to give Onondaga Lake the title of "the most polluted lake in the world."

The downward spiral began in the late 19th century. The Solvay Process Company established a factory on Onondaga Lake that produced nearly 80,000 tons of soda ash in 1890. This output grew to nearly 1 million tons annually by the mid 1960s, which

resulted in about 2 million tons of calcium chloride and sodium chloride waste. This waste was discharged directly into the lake, or pumped to wastebeds along the lake shore. In-lake waste deposits measured up to 45 feet deep and wastebeds along the shore rose to 65 feet tall along a third of the shoreline. The company became Allied Chemical and eventually Honeywell International. From the middle of the 1910s until the late 1980s, the various companies discharged to the lake a brew of organic compounds, including benzene, toluene, hydrochloric acid, mercury, polychlorinated biphenol (PCB), and other carcinogens.

In addition, undertreated wastewater and untreated stormwater also flowed into the lake. Starting in the 1920's, municipal wastewater from the Metropolitan Syracuse Wastewater Treatment Plant discharged directly in the lake at the south shore. The effluent comprised roughly 20 percent of the water entering the lake, perhaps the largest percentage for any lake in the country. Advanced wastewater treatment was not utilized until the late 1970's, similar to most other wastewater treatment plants in the country. All of this led to the U.S. Environmental Protection Agency (EPA) declaring Onondaga Lake as a hazardous waste site in 1994.

This steady attack of pollutants took its toll. The coldwater fisheries disappeared in the 1920's. Swimming was prohibited by the 1940's. Fishing was banned in 1972, although a catch-and-release program was allowed by 1986, and limited consumption of some fish species was restored in 1999. A significant lake restoration plan has been proposed for the lake, highlighted by a $451 million-dollar settlement with Honeywell International in 2006. Remediation methods include capping, dredging and barrier walls sited along much of the lake bottom, shoreline and within the groundwater zone. Advanced wastewater treatment improvements, and a significant reduction of combined stormwater-wastewater sewer overflows will require a similar expenditure. (Landers, 2006). There is some evidence of recent improvements in nutrient levels in the lake.

Beautiful waters

Skaneateles Lake's rich, blue water is as clean as Onondaga's is dirty. William Henry Seward, world traveler and the Secretary of State under Abraham Lincoln, called Skaneateles Lake "the most beautiful body of water in the world." This Finger Lake is a primary water supply for the city of Syracuse. It spans a length of 17 miles, is 300 feet deep and covers 8,700 acres. It is among the clearest lakes in the country, with water transparency readings occasionally exceeding 50 feet (15 meters), rivaling the water clarity normally found only in sterile, highly acidic lakes. The nutrient and algae levels are very low, while oxygen levels remain high from top to bottom. The lake supports healthy warmwater and coldwater fisheries, including perch, smallmouth bass, lake trout, rainbow trout and landlocked salmon. It has a long history of boating, with the first steamboats using the lake in the 1830's, and it hosts a number of national and international sailing events. These attributes add to the tourism appeal of the quaint village that inherited the name of the lake.

Added credence was bestowed on the purity of Skaneateles Lake when the EPA affirmed that the city of Syracuse could distribute the water from Skaneateles Lake to its users without filtration. This Filtration Avoidance Determination is rare. While awarded to the New York City reservoirs (see "Snapshot of the New York City Reservoirs" case study in the Downstate lakes section of this chapter), this designation has not been granted to Lake Superior and most other pristine lakes. This designation came with a high level of responsibility to keep pollutants out of the lake, which created a number of innovative programs. The Skaneateles Lake Watershed Agriculture Program (SLWAP) involved partnerships between Cornell Cooperative Extension offices, several government agencies, the City of Syracuse, and farmers. Twenty-six farms in the watershed adopted whole-farm plans devised to reduce contaminants exiting the farms. SLWAP resulted in agricultural pollutant management of more than 90 percent of the farmland in the watershed. This reduced soil erosion by more than 2,700 tons per year, and annually saves farmers more than $1,000 in fertilizer costs.

The Skaneateles Lake Watershed Land Protection Program (SLWLPP) is a pollution prevention initiative with extensive educational and outreach programs. It is a partnership between the City of Syracuse and Skaneateles Lake watershed residents. Information is available throughout the watershed on septic management, water-testing and treatment, well management, erosion control and conservation easements for landowners. Municipal regulations have zoning, wastewater and chemical disposal and agricultural activities. In addition, Article 17-1709 of state Environmental Conservation Law (ECL) prohibits point-source discharges within the Skaneateles Lake watershed.

little organized use historically, particularly in remote and inaccessible regions such as the Adirondacks, they have been classified C to fit their best intended use. The aggregate of Class C lakes has lower water clarity than their phosphorus levels might predict because the water in so many of these lakes has a natural brown color that limits light transparency.

Even though similar amounts of pollution often enter both shallow and deep lakes, deep lakes generally have greater water volume and, therefore, a better chance for diluting the pollution. Although the maxim "dilution is the solution to pollution" mostly reflects the use of streams and rivers to dilute wastewater, it also applies to lakes. Table 2–2 shows the relationship between water depth and water quality. (NYSDEC, 2004a)

Water Quality Classification	% of NYS Lakes	Typical Water Clarity (meters)	Typical Phosphorus Levels (ppb)	Typical Water Color*	Typical pH Classification+
Class AAspecial	1%	4–5	10	Faint	Slightly basic
Class AA	7%	3–4	10	Faint	Slightly basic
Class A	10%	3	10–15	Faint	Slightly basic
Class B	23%	2–3	15–20	Not visible	Basic
Class C	46%	2–3	10–15	Moderate	Slightly acidic
Class N	13%	2–3	10–15	Moderate	Acidic

Table 2–1. Correlation between water-quality classification (best intended use) and actual water quality.
**Refers to "natural" brown color. +Neutral pH = 6.8 to 7.2; Slightly basic = 7.2 to 7.5; Basic = greater than 7.5; Slighty acidic = 6.5 to 6.8; Acidic = less than 6.5.*

Lake Type	Typical Water Clarity (meters)	Typical Phosphorus Levels (ppb)	Typical Water Color*	Typical pH Classification+
Very Deep Lakes (>100 feet deep)	4–5	5–10	Faint	Slightly basic
Stratified Lakes (> 20 feet deep)	3–4	10–15	Faint	Basic
Shallow Lakes (< 20 feet deep)	2–3	20	Moderate	Slightly acidic

Table 2–2. Correlation between lake depth and water-quality parameters.
**Refers to "natural" brown color. +Neutral pH = 6.8 to 7.2; Slightly basic = 7.2 to 7.5; Basic = greater than 7.5; Slighty acidic = 6.5 to 6.8; Acidic = less than 6.5.*

There is often a water-quality distinction between deep and shallow lakes in New York State that is not coincidental. The amount of pollutants entering lakes is controlled by a number of factors associated with the perimeter of the lake, including the:

- extent of shoreline development;
- age and viability of septic systems, and frequency of pumping; and
- greenness of surrounding lawns, which indicates how many lawn-care chemicals may be washing into the lake.

What's the dirt on New York State lakes?

Geography and geology influenced when and how land was colonized, and they also dictated the number and kind of lakes that formed. The lands of New York State can be characterized by more than 70 unique categories of soil types, and a similarly large number of categories of near-surface soils and bedrock

soil types. Some of these geologic features leave a significant imprint on the type and quality of lakes within the state. For example, the thin soils and lack of limestone within areas of the Adirondacks leaves many lakes sorely lacking in alkalinity or **buffering capacity**, which renders them susceptible to acidic deposition, commonly called acid rain. The same geologic fingerprint results in many lakes becoming naturally acidified. They have amber-brown coloration and **soft water**, both of which significantly affect their flora and fauna.

Bureaucratic tags

Both DEC and EPA identify ecological regions where common soil and geological features, land use patterns, and other shared factors result in common ecology and lake conditions.

Ecozones and ecoregions

Ecozone is defined as a large area that contains a geographically distinct assemblage of natural communities sharing a large majority of their environmental conditions, species and ecological dynamics. Some ecozones are named for their governing geographic feature, such as the Mohawk Valley, Hudson Valley, Appalachian Plateau, and Manhattan Hills. Other names, such as the Coastal Lowlands (referring to Long Island) are not as descriptive. To add to the confusion, lakes in some of ecozones exhibit few differences from those in others. The ecozone concept, therefore, has limitations for classifying New York State lakes.

EPA has promoted the development of **ecoregions,** dividing the nation into 14 distinct areas based on the "natural" nutrient conditions of an area and not limited by state or local political boundaries. EPA nutrient ecoregions within New York State are shown in Figure 2–1 (EPA, 2007). Water-quality conditions vary within each of these ecoregions, based on surface and bedrock geology, soil types, land uses, and the extent and duration of human usage of these lakes as shown in Table 2–3. (NYSDEC, 1987; 2004a)

These classifications ultimately may be useful for developing regionally based water-quality standards.

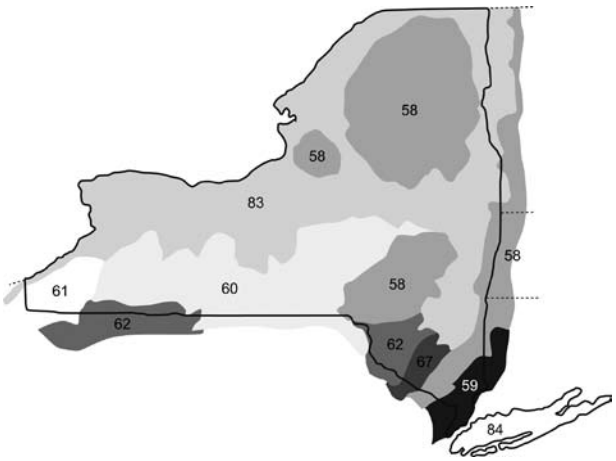

Fig. 2–1. EPA Level III ecoregions in New York State. Areas defined by EPA based on existing nutrient conditions.

USEPA Ecoregions in NYS	Name	% of NYS Lakes	Typical Water Clarity (meters)	Typical Phosphorus Readings (ppb)	Typical Algae Levels (ppb)*
58	Northeastern Highlands	45	2–3	15	1–5
59	Northeastern Coastal Zone	7	3	15–20	5
60	Northern Appalachian Plateau and Uplands	14	3	10–15	5
61	Erie Drift Plain	2	1–2	30–35	20–25
62	North Central Appalachians	7	3–4	10	1–5
83	Eastern Great Lakes and Hudson Lowlands	25	2–3	15–20	5–10
84	Atlantic Coast Plain Barrens	1	1–2	1–20	5–10

*Table 2–3. Water-quality conditions in EPA ecoregions in New York State. Variations are based on surface and bedrock geology, soil types, land uses and extent and duration of human usage. *Measured as chlorophyll a.*

These nutrient-based delineations may have important ramifications for both local and regional lake management. Much of what constitutes lake management in New York State revolves around nutrient control, and is discussed in Chapter four, "Problem diagnosis" and Chapter five, "Fisheries management.

Hydrologic Unit Codes

As if the terms ecozone and ecoregion weren't confusing enough, the state has also been divided into large and small drainage basins. These nested watersheds have been given even more confusing designations called **Hydrologic Unit Codes** (HUC). For New York State lakes, the most significant designations are the "HUC 6" codes, which essentially divide the state into the 14 major drainage basins as pictured in Figure 2–2. (NYSDEC, 2007). HUC

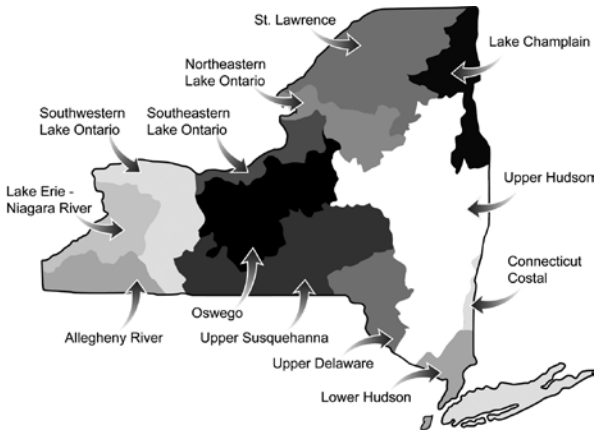

Fig. 2–2. New York State major drainage basins.
The major watersheds designated as Hydrologic Unit Codes 6.

numbers are required on some grant proposals, and these designations serve a number of government purposes. A variety of EPA and state government sources provide information on the HUC codes for specific waterbodies and more information on this nested system.

These delineations of ecozones, ecoregions, and HUC drainage areas can be very useful. They are related to lake geography, topography, hydrology, and geology, and other -ographies and -ologies," but they are not really intuitive. For example, the Adirondacks are part of the "Nutrient Poor Largely Glaciated Upper Midwest and Northeast" ecoregion. This ecoregional title does not elicit strong images of a lonely loon call on a peaceful summer morn. Most people would think of "Manhattan Hills" as a New York City address rather than an ecozone. While these geographical fractions of the state are close to valid and easily understood, an even simpler system is possible.

Location, location, location

As in real estate, the most important factors that affect the "value" of a lake are location, location and location. A more intuitive separation of the state uses broad geographic areas that correlate to broad lake characteristics. Although the broad geographical regions used below may share some characteristics with nearby neighbors, each region is unique enough to warrant a separate category, despite the long-standing impression of many New York City and Long Island residents that anything north of Westchester County can be generically called "Upstate." The character of each region is described as it relates to the lakes within its confines. Tables in this section use either metric or standard units in keeping with the original data source.

Long Island and New York City lakes

Fig. 2–3 Location of Long Island and New York City lakes.

This region of the state is characterized by very high population density, and by geology that is unique among New York State regions, which dramatically influences the type of lakes present. The densest population occurs in the western areas including New York City, decreasing to moderate and sparse population densities further east on Long Island. Since this region has the highest population density and smallest percentage of landscape covered by lakes (see Table 2–4), human pressure and its effect on lakes in this region is great. (NYSDEC, 1987; U.S. Census Bureau, 2000)

Region*	Population Density	% of Region Occupied by Lakes
Long Island/NYC	> 6000 /sq. mile	<1%
Downstate	350 /sq. mile	1%
Central NY	100 /sq. mile	1%
Adirondacks	20 /sq. mile	4%
Finger Lakes Region	200 /sq. mile	3%
Western NY	240 /sq. mile	1%

*Table 2–4. Population density of each New York State region and the percentage covered by lakes in each region. *Figures do not include area encompassed by Lake Ontario and Lake Erie.*

The surface geology is primarily gravel with some sand, underlain by thick deposits of unconsolidated sediments. Coarser grained soils dominate the primarily flat or low-elevation terrain, heavily occupied by both fresh and tidal wetlands and plains.

There are not a large number of lakes in this region. A typical lake in Long Island and New York City tends to be small, shallow, and kettle in origin. The lakes are highly productive**,** with relatively low water clarity and high levels of nutrients and algae. Less than 10 percent of the lakes are larger than 100 acres. The largest is the 500-acre Lake Montauk. More than 30 percent of the named lakes are between 6 and 10 acres.

The western, urbanized portion of this area has small numbers of waterfowl inhabiting "pocket" ponds that fill slight depressions in a dense network of buildings, roads and pavements. The eastern section of this region is characterized by a landscape of oak/pine bush and agriculture, proximity to tidal influences, and the temperature-moderating influences of the Atlantic Ocean and Long Island Sound. There are many small, shallow, moderately colored, fresh to moderately saline, sandy bottomed ponds that are either very weedy or highly turbid. Many of these lakes are classified for shell fishing. Due to the mix of fresh and saline waters, the fisheries communities can be dominated by both freshwater and saltwater fish.

Long Island and New York City lakes are used for aesthetic enjoyment, fishing, and boating that is limited to non-power craft. Unlike other parts of the state, most of these lakes do not suffer the user conflicts among residents, swimmers, anglers, power boaters and canoeists, although birds and humans often compete for the same close spaces.

Fanwort *(Cabomba caroliniana)* is the most significant invasive aquatic plant in this region. The exotic weed is rare in most other parts of the state. Relatively new invaders such as variable watermilfoil *(Myriophyllum heterophyllum)* and Brazilian elodea *(Egeria densa)* are also clogging Long Island waterways. In contrast, Eurasian watermilfoil *(Myriophyllum spicatum)* and water chestnut *(Trapa natans)*, the exotic plants most common to the rest of the state, have only recently been found in this region. Hydrilla *(Hydrilla verticillatum)* was also first found in Long Island in 2008. This region is highly susceptible to invasions from exotic plants and animals due to climate and the proximity to domestic and international shipping routes. Long Island and New York City may be a major gateway through which many exotic organisms enter the waterways of New York State. These lakes and ponds, however, also contain many rare and threatened plant species, some of which are unique to the Pine Barrens on eastern Long Island.

Lake management issues tend to focus on the invasive aquatic plants that are common in many of the shallow lakes in this region. There are algal blooms triggered by nutrients from urban runoff and groundwater, waterfowl contributions, and lake users, and an increasing number of lakes and ponds with blue-green algae producing toxins. There is fish contamination due to pesticides, organic compounds, and heavy metal. As a result, an inordinately high percentage of lakes in this region are on the federal

Region	% of NYS Lakes	% of 303d Lakes Listed for Fish Consumption Advisories
Long Island/NYC	5	20
Downstate	18	10
Central NY	12	15
Adirondacks	58	40
Finger Lakes Region	5	10
Western NY	2	5

Table 2–5. Percentage of lakes in each New York State region, and the percentage of lakes by region that are on the Federal 303d list for fish consumption advisory.

303d list of impaired waters (see Table 2–5) (NYSDEC, 1987; 2004b). The federal 303d list and other state and federal lake assessments are described in greater detail in chapter four, "Problem Diagnosis."

Most lakes in this region are found within a city or county park. Lake management is frequently the responsibility of:

- municipalities including the New York City Department of Environmental Protection and Parks Department;
- county government agencies include parks departments, Environmental Management Councils, and Soil and Water Conservation Districts; and
- larger government including the DEC regions 1 and 2 Division of Fish and Wildlife offices, and the Department of State through their Coastal Zone Program.

An unusual exception to this standard management pattern is the lakes within the town of Southampton. Under many circumstances, they are governed by the original charter granted to the town, superseding the jurisdiction of state or county government in regulatory authority (subject to legal interpretation).

Downstate lakes

Fig. 2–4. Location of Downstate lakes.

This region encompasses the area on both sides of the Hudson River north of the Long Island and New York City region and south of the Catskills. The influence of "The City" is heavily felt by these lakes in this area. The region's large concentration of waterbodies, both natural and constructed, serves the immense thirst of New York City for potable water and recreational opportunities. The region contains a relatively large number of lakes classified for use as a drinking water supply, especially in the northwest and southeast portions of the region. Twenty-two of the twenty-five largest lakes in the region are used for drinking water, the waterbodies within the New York City reservoir system. An even larger number of lakes are classified for contact recreation as shown in Table 2–6 (NYSDEC, 1987).

Region	% of Lakes in Region Classified for Drinking Water	% of Lakes in Region Classified for Bathing
Long Island/NYC	10%	35%
Downstate	25%	60%
Central NY	20%	30%
Adirondacks	20%	10%
Finger Lakes Region	15%	25%
Western NY	25%	30%

Table 2–6. Percentage of New York State lakes classified by intended use.

In colonial times, this region was the first in New York State to experience rapid development. Lakes here have some of the longest history of documented uses. As an apparent result, this region has about half of the New York State lakes named "Lake ___," probably mirroring the European convention of "Loch___."

Currently, population density in this region is high, but lower than in the western Long Island/New York City area. The densest population occurs in the southern areas of the region, where the suburbs of New York City are located, decreasing to moderate and sparse population densities further north, east and west. The primary land uses in the southern areas are urban and suburban residential and commercial development, with limited industrial activity. The northern area is dominated by forested land. The western portion of the region contains agricultural land.

The surface geology is dominated by silt and some bedrock. The underlying bedrock geology includes limestone, shale, sandstone, and siltstone, particularly along the northwestern edge of the region. There is some granitic terrain near the Catskills, which geologically and limnologically resembles the Adirondacks more than the lowland downstate areas. Mountainous terrain and "ancient" hills, including the Catskills and the Shawangunks, dominate the northern portions of the region.

The southeastern and southwestern portions of the region, on both sides of the Hudson River, have a high density of ponded waters, but otherwise the downstate region is not particularly rich in lakes. The lakes tend to be small, soft water kettle lakes of various depths.

About 10 percent of the lakes are greater than 100 acres. The larger lakes generally are less productive with greater water clarity and lower nutrient and algae levels than the smaller lakes. A large number of sizeable, power-generating reservoirs were created along the western side of this region, primarily in the southern portion of the Delaware River basin. Other large reservoirs provide drinking water for New York City and suburban communities, and are not used for recreation. Waterbodies not used for potable water have a variety of other activities, including swimming, boating and fishing. User conflicts are common, largely due to the high population densities.

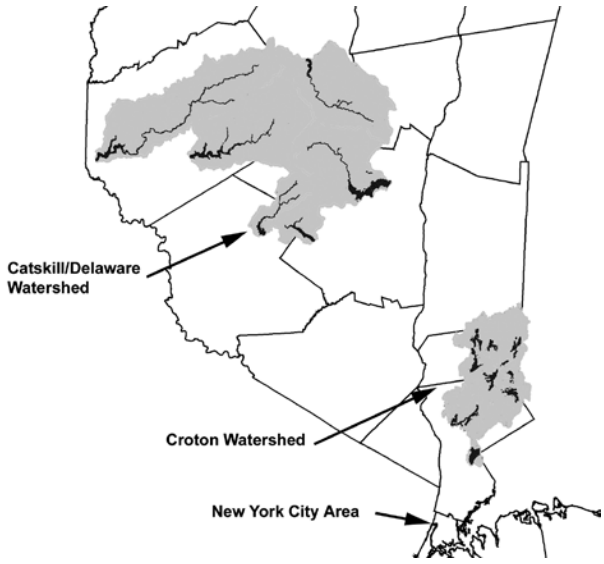

Fig. 2–5. New York City reservoir watershed map.

Snapshot of the New York City Reservoirs

By the early 1800's, the thirst of a growing city, soon to be the largest and most famous in the world, was only partially quenched by an inadequate source of uncontaminated water controlled by the city. Through the foresight of city planners and engineers, and the sweat of thousands of workers, one of the largest public works projects in history began with the construction of the Croton Aqueduct and Reservoir in 1837. Over many years, New York City gradually built a network of reservoirs, constructing dams, conduits, connecting roadways, and underground pressure tunnels criss-crossing tremendous tracts of land occupied by downstate farms, local businesses, and small housing communities. Much of this land was consumed by the city through eminent domain, uprooting thousands of neighbors and scores of neighborhoods, although the huge numbers of workers formed their own temporary communities, and these relocations resulted in some of the first planned communities in the country. By the late 1800s, much of the Croton system of reservoirs had been developed, but it was still not enough as the needs of the city and its expanding suburbs grew. In the early 1900s, the state legislature approved the expansion of the reservoir network into the Catskills, starting with the Ashokan Reservoir, linked to the Kensico Reservoir on the eastern side of the Hudson River through the Catskill Aqueduct. The latter runs between mountain ranges and anywhere from several feet to more than a thousand feet beneath the Hudson River. This system expanded into the Delaware River region in the 1930s, and by 1967 had 18 collecting reservoirs, 6 balancing and distributing reservoirs, 3 lakes, 3 underground aqueducts, and 8 connecting tunnels. This enormous collecting, storage, and delivery system carries more than 1 billion gallons of water as far as 120 miles by gravity. This water is fed into more than 6,000 miles of water distribution lines underneath the city, serving more than 9 million residents of New York City and its northern suburbs, not to mention countless more visitors (See Fig. 2–5) (Galusha, 2002; NYCDEP).

The fisheries communities are dominated by **warm-water fish** that prefer water at or exceeding 50ºF and tend to be tolerant of fluctuations in temperature and oxygen content. This category includes bass, perch, walleye, northern pike, pickerel, muskellunge, sunfish, bluegill and carp.

Many lakes in this region suffer from excessive algae growth and invasive exotic plants, particularly in the more developed southern portion of the region. Eurasian watermilfoil *(Myriophyllum spicatum)* is a problem, although most other exotic plants including water chestnut *(Trapa natans*) have migrated from upstate and Brazilian elodea *(Egeria densa)* and fanwort *(Cabomba caroliniana)* have probably travelled from warmer regions. Like Long Island and New York City, the downstate area is highly susceptible to invasions from exotic plants and animals due to the proximity to multi-state and international boat traffic and to its relatively mild climate. The first New York state finding of Hydrilla *(hydrilla verticillatum)* was in this region, either due to migration from a neighboring state or as an aquaria introduction. At present, the region appears to have less invasive problems than anticipated, although the number of "hot spots" noted on statewide inventories may be artificially low because survey work has been less comprehensive in the southern portions of New York State (see Table 2–7) (NYSDEC, 1987; Eichler, 2004).

Region	% of NYS Lakes	% of NYS Lakes with One or More Species of Exotic Submergent Weeds
Long Island/NYC	5	5
Downstate	18	15
Central NY	12	40
Adirondacks	53	20
Finger Lakes Region	5	10
Western NY	2	10

Table 2–7. Percentage of lakes in each region of New York State compared to the percentage of lakes in that region with exotic, submergent weeds.

**As of 2004, list includes Myriophyllum spicatum, Trapa natans, Potamogeton crispus, Cabomba caroliniana.*

Lake management issues tend to focus on the invasive aquatic plants common in many of the shallow lakes in this region; algal blooms triggered by urban and suburban runoff, lawn fertilization and waterfowl; failing septic systems; water-supply issues; and user conflicts. The high percentage of lakes suffering from exotic weed growth has resulted in a large number of aquatic herbicide treatments and grass carp stockings in this area, perhaps also due to fewer permitting issues associated with the use of these plant management tools. Algae control through the use of copper products (**algacides**) has also been much more common in this part of the state.

Lake management is conducted by:

- residents as individual citizens, or through lake associations and property-owner groups;
- municipalities, including the New York City Department of Environmental Protection, and towns through park districts;
- county governments, primarily Soil and Water Conservation Districts; and
- state agencies, including DEC regions 3 and 4, Division of Water and Division of Fish and Wildlife.

Central New York lakes

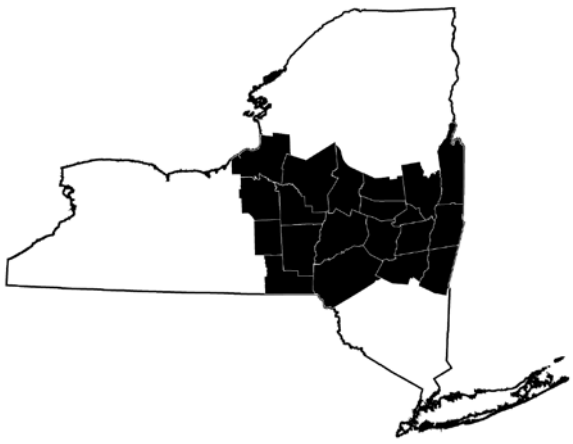

Fig. 2–6. Location of Central New York lakes.

Central New York is a region originally defined by a vast, ancient inland sea that served as the progenitor of the Great Lakes system. It is probably the most disparate of the regions identified here. It encompasses areas known as the Capital District and the Leatherstocking Region. This region stretches from

Downstate to the Adirondacks, from the eastern edge of the Finger Lakes to the Massachusetts and Connecticut borders. It can also be thought of as the eastern Susquehanna River basin, the northern Delaware River basin, and the southern Mohawk River basin. For more than 150 years, the region has been affected by the Erie-Barge Canal system. In short, this potpourri of geographical benchmarks is perhaps the most difficult region to characterize.

The surface geology is dominated by silt, with some bedrock, particularly along the eastern edge of this region. The bedrock geology includes shale, sandstone, siltstone, and some limestone. The terrain is rolling and somewhat irregular.

This region is neither lake-rich nor people-rich. It has the lowest population density of all the regions except the Adirondack region. The primary land uses are suburban or agricultural, with limited commercial and industrial development. The majority of the human activity and densest population is concentrated along the eastern and western edges. The agricultural land is found in interior portions of this region.

The density of lakes is similar to other regions of the state, with the western portion having the highest density. There is great variety in the size of Central New York lakes. Nearly 20 percent of the named lakes are between 6 and 10 acres. More than 20 percent of the lakes are greater than 100 acres. Having so many lakes at each size extreme makes this region unique.

The primary uses for the lakes include fishing, swimming and other forms of contact recreation, and some potable water use. Although many of the lakes have formal boat launch areas to support multiple uses, public access is generally low on the eastern portion of this area, particularly in the Capital Region. The percentage of lakes used for potable water (Class A) or for contact recreation (Class B) is neither high nor low compared to the other lake regions. Only 10 of the largest 25 lakes in the region are used for potable water. Most of the large drinking water reservoirs have use restrictions.

There are also a large number of waterbodies between Syracuse and Utica that are feeder lakes to the Erie-Barge Canal system. These are used to control water level and optimize navigability of the canal. The canal system includes about 40 percent of the freshwater resources in New York State, not including the Great Lakes, although much of it is in the Finger Lakes region.

The Central New York region has many small kettle lakes of various depths. Comparison of all the lakes sampled from each region shows that Central New York lakes have the highest water clarity and lowest nutrient (phosphorus) levels (see Tables 2–8 and 2–9) (NYSDEC, 2004a). The lake water is moderately soft with low to moderate levels of productivity. There is little variation in water transparency and nutrients readings between small and large lakes in the Central New York. (µmho = a measurement of electrical conductivity)

Excessive algae growth is found in some lakes in the more urbanized and agricultural areas of the region. More lakes, however, have plant problems due to invasive exotic plants such as Eurasian watermilfoil *(Myriophyllum spicatum)*. Excessive growth of water chestnut *(Trapa natans)* is locally problematic in the major river systems of the eastern Mohawk and Hudson Rivers and in peripheral small lakes.

Region	Typical Water Clarity (meters)	Typical Phosphorus Levels (ppm)	Typical Water Color	Typical pH	Typical Hardness
Long Island/NYC	1–2	30–35	Faint	Basic	Hardwater
Downstate	2–3	20–25	Faint	Slightly basic	Intermediate
Central NY	3	10–15	Faint	Neutral	Softwater
Adirondacks	2–3	10–15	Moderate	Acidic	Softwater
Finger Lakes Region	2–3	10–15	Not visible	Basic	Hardwater
Western NY	2	30–35	Not visible	Basic	Intermediate

Table 2–8. Comparison of phosphorus (productivity) in all sizes of lakes.

Hardness definitions: Soft water = Conductivitiy < 100 µmho/cm; Hard water = Conductivity > 250 µmho/cm; Intermediate = 100-250.

Region	Lakes Greater Than 250 acres			Lakes Less Than 250 acres		
	Typical Water Clarity (meters)	Typical Phosphorus Levels (ppm)	Typical Water Color	Typical Water Clarity (meters)	Typical Phosphorus Levels (ppm)	Typical Water Color
Central NY	2–3	10–15	Not visible	3	10–15	Faint
Adirondacks	3–4	5–10	Faint	2–3	15	Moderate
Finger Lakes Region	3–4	10–15	Not visible	2	15–20	Not visible

Table 2–9. Comparison of phosphorus (productivity) if lakes are subdivided by size.

Zebra mussels *(Dreissena polymorpha)* have also been found in some of the waterbodies in this region, although their densities are much higher in western regions of the state (see also Chapter three, "Lake problems"). The fisheries communities in the lakes are dominated by warmwater fish. Some of the deeper waterbodies, and the headwaters of larger stream and lake systems, however, do support **coldwater fish**. Coldwater fish require water that is 60°F or colder with oxygen content exceeding 5 parts-per-million (ppm). Coldwater supports salmonids, including trout and salmon.

Lake management issues tend to focus on user conflicts; invasive aquatic plants common in both shallow and deeper lakes; algal blooms associated with failing septic systems, lawn and agricultural land fertilization, and waterfowl; and development pressures, including an increasing percentage of cottage conversions to full-time residences.

The lake management permitting process is neither significantly more nor less restrictive than in other regions of the state. Lake associations in this region are actively involved in the formal development of lake management plans, perhaps reflecting the increasing use of these lakes. Lake management is conducted by:

- residents as individual citizens, and through lake associations, property-owner groups, and fish and game clubs;
- municipalities and county governments, including planning departments; and Soil and Water Conservation Districts; and
- state agencies, including DEC regions 3, 4 and 7; Division of Water and Division of Fish and Wildlife

Adirondack lakes

Fig. 2–7. Location of Adirondack lakes.

The Adirondack Region is broadly defined here as the large area bounded by the St. Lawrence River, Lake Champlain, and the Mohawk River. It is actually a slightly smaller area, defined by "The Blue Line" that officially designates the Adirondack Park, encompassing more than 6 million acres. In 1892, the New York State Legislature created the Adirondack Park and designated it "forever wild". Scattered parcels of private lands within the park make up more than 60 percent of its area, a situation more common in Europe than in the United States. The park covers more than 20 percent of the state, is nearly three times the area of Yellowstone National Park, and is the largest state park in the nation.

The Adirondacks are highly regarded by the people of New York State, and has the largest number of pristine lakes in the state. Many of the lakes are surrounded by craggy mountains and have conditions inhospitable to all but the most hardy swimmers—steep slopes, rocky bottoms, and COLD water.

The entire park is comprised of a mix of rugged peaks, rolling hills, expansive wetlands, and deep and

extensive valleys. The terrain along the eastern side consists of ancient, weathered mountain peaks. Although nowhere near their original size, more than 40 mountain peaks still exceed 4,000 feet. The northern portions of this region consist of flatter plains.

The surface geology is dominated by gravel and sand, with many bedrock exposures. The bedrock geology is metamorphic sedimentary and igneous rocks. It is largely devoid of limestone (calcium carbonate), which severely limits the buffering capacity of the lakes embedded within it.

This region includes the largest assemblage of old-growth forests east of the Mississippi River. Primary land uses are those associated with forested land (silviculture, wildlife habitat and outdoor recreation), with limited residential and commercial uses. Population centers are small and far between. They are found on the edges of large lakes such as Lake George, Lake Placid, Saranac Lake, and along the Fulton Chain of Lakes. This is by far the least populated region of the state. Hamilton County in the interior Adirondacks is among the least populated counties east of the Mississippi River.

Regardless of the depth and breadth of the topographic relief, this is consistently a very water-rich and lake-rich terrain. The diversity of lake types is breathtaking, from mirror-like alpine blue lakes to wide wetlands to tea-colored ponds perpetually bathed in fog and calm. As such, the lakes are perhaps the most difficult to definitively characterize.

There is no "typical" lake in the Adirondacks. Landscapes in nearly all areas have small kettle lakes of various depths, mostly hard water, and mostly with low to moderate levels of productivity. Within the northwestern portion of the park many of these lakes are naturally tea-colored. In contrast, most of the larger lakes tend to be clearwater (low natural color). Most of the large, deeper lakes are among the clearest in New York State.

Lakes at lower elevation that are large and deep tend to have moderate to poor buffering capacity, while many of the smaller and higher elevation lakes have little or no buffering capacity remaining. As a result, many of these lakes have become acidified (Table 2–10) (NYSDEC, 1987; 2004b). Some acidification occurs naturally through weak organic acids inherent in the soils and vegetation indigenous to the region. More often, the culprit is inorganic acids emitted from power plants outside of the region and state. While "acid lakes" are perhaps the most prominent label attached to Adirondack lakes, it is but one of many that could accurately characterize literally thousands of lakes within the park.

Region	% of NYS Lakes	Number of Lakes on the Federal 303d List	% of 303d Listings Due to Acid Rain
Long Island/NYC	5	21	0
Downstate	18	14	0
Central NY	12	10	0
Adirondacks	58	412	95
Finger Lakes Region	5	8	0
Western NY	2	3	0

Table 2–10. Percentage of lakes in each New York State region compared to the number of lakes in each region on the 303d list and the percentage of those affected by acid rain.

With nearly 3,000 lakes, the lake density is very high even though there are 6 million acres of land in this region. All areas support a wide density of lake sizes and depths, although lake densities are lowest in the northeast and western edges of the area.

Compared to the other lake regions, the percentage of lakes used for potable water (Class A) is relatively high, but the percentage classified for contact recreation (Class B) is quite low. This is largely due to two factors. It reflects historically low uses of these lakes for recreation due to much smaller population bases, and limited access to many interior regions of the park prior to the construction of the Adirondack Northway in 1967. There is also little available water-quality information needed to identify the best use of these lakes. Bathing and other forms of contact recreation, however, are usually well supported throughout the park, or at least would be if the water weren't so cold for much of the summer! The primary lake uses are fishing, bathing and contact recreation, and potable water use. In the southern and western portions of the region, some lakes are also used for power generation.

Many lakes within the Adirondack Park are relatively inaccessible, due to the small number of paved roads. In addition, many lakes are found within the Forest Preserve or other highly restrictive land use categories, which limits public access and use. Many of the larger lakes are accessible by major roadways, no doubt originally built to gain access to these valuable resources.

Few lakes in this region have excessive algae growth, although this problem is steadily growing as more housing developments and the humans they hold raise nutrient levels. Sewage effluent can exacerbate algae problems if conversion of lakefront properties from seasonal cottages into year-round residences fails to include septic system upgrades. Increased recreational usage can lead to more nutrient enrichment for algae and can hasten the spread of invasive species, such as Eurasian watermilfoil *(Myriophyllum spicatum)*, and zebra mussels *(Dreissena polymorpha)*. The fisheries communities in the lakes are dominated by a mix of warmwater fish in the open and wooded lowlands, and coldwater salmonids in the mountain districts and wilderness areas

As public access and lake usage increases, conflicts among user groups increasingly dominate local management efforts. Lake management issues tend to focus on user conflicts associated with:

- motor versus non-motor boat uses, including no-wake zone, speed limits and use of personal watercraft;
- introduction and control of exotic plants and animals;
- water level; and on a national level,
- lake acidification.

The regulatory process is significantly more complex in this region than in other parts of the state due to overlapping regulatory authorities. It is also due to more fundamental disagreements over the role of some management options such as aquatic herbicides in a "forever wild" area. These factors have led to a substantially lower rate of lake-wide management activities in the lakes in this region. It is likely, however, that lakeshore property owners manage weed problems along their own shoreline as often here as in other parts of the state.

The lake management permitting process is neither more nor less restrictive than in other regions of the state. Lake associations in this region are actively involved in the formal development of lake management plans, perhaps reflecting the increasing use of these lakes. Lake management is conducted by:

- residents as individual citizens, lake associations and property-owner groups, and members of public advocacy groups, such as the Adirondack Council and the Residents Committee to Protect the Adirondacks;
- academic institutions, such as Rensselaer Polytechnic Institute and Paul Smiths College, among others;
- quasi-governmental agencies, such as Cornell Cooperative Extension and the Finger Lakes-Lake Ontario Watershed Protection Alliance (FL-LOWPA) in the western portion of the Adirondacks;
- municipal and county governments, primarily Soil and Water Conservation Districts;
- local or regional government entities like the Adirondack Park Agency, the Black River-Hudson River Regulating Authority; the Lake George Park Commission and others; and
- state agencies, including DEC regions 5 and 6, Division of Water and Division of Fish and Wildlife.

Finger Lakes region lakes

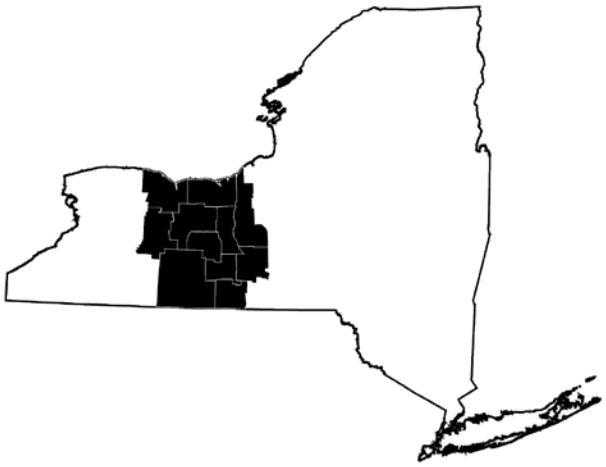

Fig. 2–8. Location of Finger Lakes region lakes.

After Long Island, the Finger Lakes Region can perhaps be more clearly defined, both geographically and in common vernacular, than any of the other lake regions. The Finger Lakes are 11 north-south oriented, mostly very deep glacial lakes found in mid-western New York. The region is generally just south of a line running between Rochester and Syracuse. These long lakes both define the region and are the underpinnings of its cultural, economic and commercial makeup. While there are other lakes in this region, some of which are locally or ecologically important, the Finger Lakes are the most dominant feature.

The surface geology is dominated by silt. The bedrock geology is primarily shale, although limestone outcrops occur in some areas. The terrain is rolling and is controlled by the valleys that were initially formed by rivers and streams and later modified and enlarged by glacial erosion. There is some overlap with the Great Lakes plains on the northern part of the region, and the Appalachian plateau along the southern part.

The population density is smaller than in most other regions. Many of the largest cities, such as Syracuse, Watkins Glen, Ithaca, Geneva and Skaneateles are located at the major inlet or outlet of their lakes. The primary land uses are residential; agricultural with local emphasis on fruits and viticulture; commerce with light industry; and limited heavy industry in the larger cities. Tourism is economically important.

Compared to other lake regions, the percentage of lakes used for potable water (Class A) is fairly low, although nearly all of the Finger Lakes are multi-use drinking water sources. The primary lake uses are fishing, swimming and other forms of contact recreation, and some potable water use. Most of the lake shorelines are occupied by houses that range from small cabins to large mansions, farms, some marinas, and some city or state parks. Use of lake water for irrigation is higher in this region than in most others.

The density of lakes is much smaller than in most other regions of the state, with the combination of rolling hills and deep valleys resulting in most water draining into the very large, deep Finger Lakes. Although the number of lakes is small, the surface area occupied by lakes is the largest outside of the Adirondacks.

Typical lakes in this region are in large, deep, glacial troughs. The largest of the Finger Lakes are among the deepest lakes in the state as shown in Table 2–11. (NYSDEC, 1982; 1987) Due to the underlying limestone, most of the lakes in the region are clear and hard water, with low to moderate levels of productivity.

Region	% of NYS Lakes	% NYS Lakes > 100ft Deep	% NYS Lakes > 1000 Acres
Long Island/NYC	5	0	1
Downstate	18	35	14
Central NY	12	10	12
Adirondacks	58	30	44
Finger Lakes Region	5	20	26
Western NY	2	5	4

Table 2–11. Percentage of lakes in each New York State region compared to the percentage of deep lakes and the percentage of large lakes in each region.

The deeper lakes in this region do not generally suffer from excessive algae growth. Algal blooms are more common in shallower lakes, as in most regions of the state, with the number of blooms steadily growing as increasing developmental pressure causes excess nutrient loading. Evidence points to the Finger Lakes as the threshold through which Eurasian watermilfoil *(Myriophyllum spicatum)* first colonized New York State lakes. Zebra mussels *(Dreissena polymorpha)* first entered this region from the Great Lakes. Most of the largest lakes in this region suffer from one or both of these invasive exotics, due at least in part to the extensive public access available. Successful examples of natural or induced biological controls have occurred in the Finger Lakes regions, however, due to its long history of exotics infestation. The fisheries communities in the lakes are dominated by a mix of warmwater and coldwater fish.

Lake management issues tend to focus on invasive species, water level, fish consumption advisories, pesticides and heavy metals, drinking (source) water

protection, and user conflicts. Management plans have been developed for most of the Finger Lakes through the cooperative efforts of local government, environmental organizations, and lake associations. The primary aquatic plant management strategies in this region have been water-level drawdown and mechanical harvesting, with the latter largely funded by the Finger Lakes-Lake Ontario Watershed Protection Alliance (FL-LOWPA). This region has also seen a variety of pioneering and innovative research and experimental projects developed to address a variety of local lake problems.

Lake management is conducted by:

- residents as individual citizens, lake and watershed associations and property-owner groups;
- international research institutions and academic institutions, such as state universities, Cornell University, the Finger Lakes Institute at Hobart-William Smith Colleges, and community colleges, among others;
- quasi-governmental agencies, such as Cornell Cooperative Extension and
- FL-LOWPA;
- municipalities and county governments; and
- state agencies, including DEC regions 7 and 8, Division of Water and Division of Fish and Wildlife, and the State Canal Corporation, which influences lake levels.

Western New York lakes

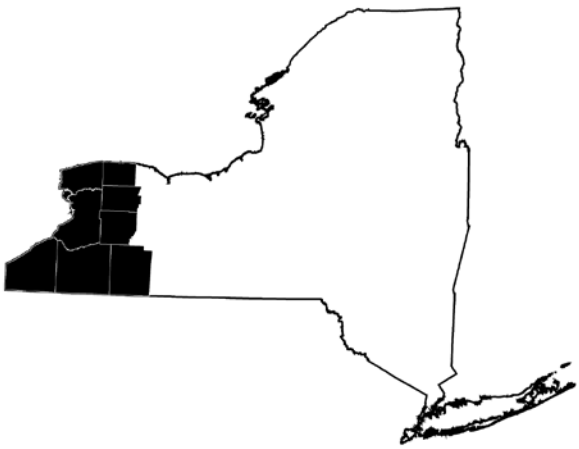

Fig. 2–9. Location of Western New York lakes.

Western New York is the portion of the state west of the Finger Lakes region, bounded by Pennsylvania on the west and south, and by Great Lakes Ontario and Erie to the north and northwest. Lakes of the western region share many characteristics with those in the Finger Lakes region. The majority of the water in this region drains northward to the Great Lakes either directly or through tributaries. A minority of waters drain southwest to the Allegheny River, or due west via the Erie Canal. The construction of the Erie Canal in 1825 drastically altered the interior portions of this region. There is a paucity of other ponded waters, and the density of lakes is smaller than in most other regions of the state.

The surface geology is dominated by silt, with some clay in the western portions of this region. The bedrock geology is dominated by shale, siltstone and sandstone, with some limestone in the north. The terrain is a mix of flat plains and rolling hills.

The primary land uses are agricultural, residential and commercial, with some heavy industry in the larger, older cities such as Buffalo. The population density is larger than in most other regions, and is concentrated in the Buffalo and Rochester metropolitan areas

With the exception of the two Great Lakes, most of the lakes in the region are relatively small and shallow, due to both drainage patterns and lack of significant relief in the terrain. Some lakes fall within watershed divides associated with wetlands, resulting in occasionally variable flow patterns. Most of the small lakes in this region are highly productive with high nutrient and algae levels and low water clarity. By nature, most of these lakes tend to be clearwater. Their intermediate hardness results in sufficient alkalinity or buffering capacity to keep pH levels relatively high, although acid rain falls in this region as in all other regions of the state.

Compared to other regions, the percentage of lakes used for potable water (Class A) is fairly high. Many small reservoirs, built in the center of this region, are used exclusively for drinking water, and public access is generally scarce. The percentage of lakes classified for contact recreation (Class B) is typical of most other regions, supporting fishing, swimming and other forms of recreation. Although

the western New York State regions comprises only a small portion of the state's lakes, Lake Ontario, Lake Erie, and Chautauqua Lake provide a relatively large percentage of the lake shoreline in the state, as shown in Table 2–12, and have multiple public access points. (NYSDEC, 1987)

Region	% of NYS Lakes	% of NYS Lake Shoreline
Long Island/NYC	5	2
Downstate	18	11
Central NY	12	16
Adirondacks	58	53
Finger Lakes Area	5	7
Western NY	2	11

Table 2–12. Percentage of lakes in each New York State region compared to the percentage of lake shoreline in that region. Although the western region has very few lakes, it has a significant amount of the New York State lake shoreline.

A large number of western region lakes have excessive algal growth, especially in the agricultural areas. An increasing number of lakes are showing growth of invasive exotic plants such as Eurasian watermilfoil *(Myriophyllum spicatum)* and curly-leafed pondweed *(Potamogeton crispus)*. Recent surveys have found Eurasian watermilfoil is widespread throughout the region. To date, water chestnut *(Trapa natans)* and fanwort *(Camomba caroliniana)* have not been found in this region, although starry stonewort *(Nitellopsis obtusa)*, an exotic macroalga, was first found here. The future colonization of water chestnut is probable since this floating pest is spreading within the state canal system. Some waterbodies have escaped the scourge of zebra mussels *(Dreissena polymorpha)*, although inventories of invasive species in this region are not always up-to-date due to a lack of monitoring programs. The fisheries communities in the small lakes are dominated by warmwater fish. The cool lakes and large rivers support some of the state's best muskellunge populations.

Lake management issues tend to focus on fisheries management, algal blooms, and conflicts between the agricultural community and other lake users. The lake-management permitting process is neither significantly more nor less restrictive than in other regions of the state

Lake management is conducted by:

- residents as individual citizens, and through lake and watershed associations, and property-owner groups;
- FL-LOWPA;
- municipal and county governments, especially the planning departments; and
- state agencies, including DEC regions 8 and 9, and Division of Fish and Wildlife.

Summing It Up

It is very important to consider the setting of a lake when pondering the conditions and problems of that lake. All waterbodies in a northern temperate climate have obvious similarities; most lakes are wet in the summer and hard in the winter. Despite this, many lake characteristics are less homogenous. The geology, topography and use differences help answer why Adirondack lakes look and behave quite differently from the Finger Lakes, or the lakes on Long Island. The savvy lake resident or manager blends knowledge of the natural conditions with the differing expectations of users and local politics in order to determine the possibilities and limitations for a particular lake. Keep the regional differences in mind when reading the next chapter that discusses the problems facing New York State lakes, and later chapters that discuss how these problems can be managed.