Watershed Management Plan

2014

Otisco Lake

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LITERATURE CITED

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Others

Photographs: Vince Legnetto, William Ayling, Derek Conant, and Onondaga County Soil & Water Conservation District

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EXECUTIVE SUMMARY

Otisco Lake
Watershed Management Plan

The Otisco Lake Watershed Management Plan provides a comprehensive review of the state of Otisco Lake and its watershed. The purpose of the plan is to identify issues affecting the water quality and ecology of Otisco Lake and to provide specific recommendations to protect the lake's future.

Otisco Lake is located in southwestern Onondaga County and is one of New York State's Finger Lakes. Slightly over 6 miles long with a maximum width of .8 miles, Otisco Lake is bordered by three townships (Marcellus, Otisco and Spafford) with small portions of four other towns (Onondaga and Tully in Onondaga County; Preble and Scott in Cortland County) comprising the rest of the watershed.

As a major drinking water supply source for Onondaga County, Otisco Lake is protected by the Otisco Lake Watershed Rules and Regulations implemented by the Onondaga County Water Authority (OCWA). The lake also serves as an important recreational and environmental resource. The Otisco Lake outlet dam is operated by OCWA, but water levels are largely weather dependent since OCWA has limited abilities to control lake elevations. Except for a narrow connection, Otisco Lake is divided by a causeway separating the smaller and much shallower southern end from the rest of the lake. The two sections are effectively distinct lakes.

There are two private boat launching access points at Otisco Lake with shoreline access located along the extreme northeastern portion of the lake, the southwestern corner near the lake causeway, and at the Onondaga County Otisco Lake Park near Turtle Bay on the east shore which operates as a "carry in / carry out" facility. Otisco Lake does not have a public boat launch.

The OCWA monitoring program is focused on treatment needs for water supply purposes and provides a comprehensive long-term water quality database for Otisco Lake. Data collection with a more lake water quality focus was done remotely from 2002 to 2007 by the Upstate Freshwater Institute (UFI) under a grant program known as Our Lake. Since 2008, Hobart William Smith College-Finger Lakes Institute has also sampled Otisco Lake as a part of its current Finger Lakes monitoring program.

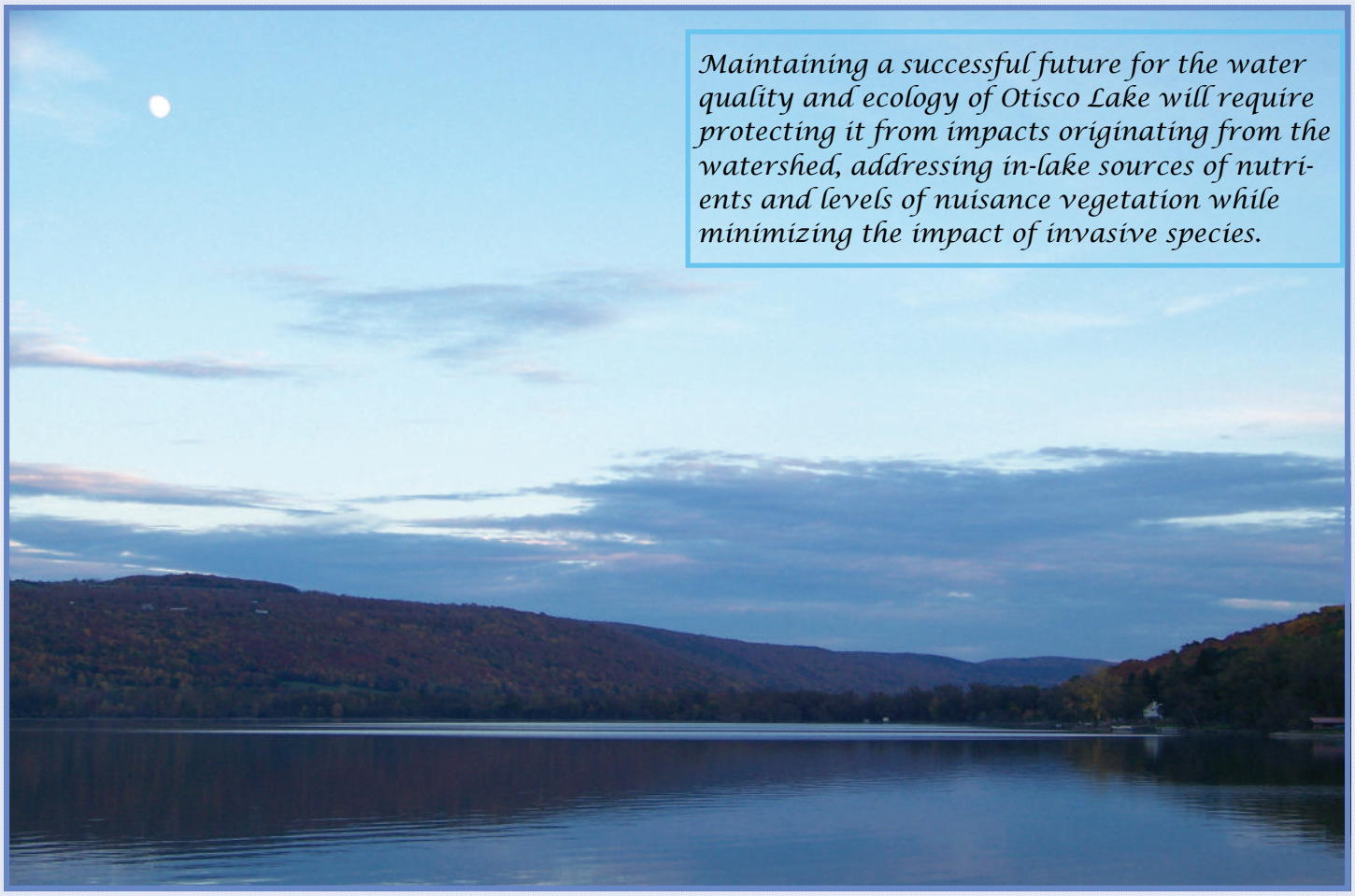
Otisco Lake does not meet dissolved oxygen standards, but there is no conclusive evidence that conditions (such as nutrient levels and oxygen depletion) have changed appreciably over the period of record which dates back to the early 1900s.

Otisco Lake has a diverse aquatic plant community with native coontail and the non-native Eurasian watermilfoil predominant. There is evidence that the area of the lake showing the greatest amount of aquatic vegetation expansion has been at the north end of the lake immediately south of the Narrows. Extensive areas of shallow water throughout the lake are impacted by an abundance of Eurasian watermilfoil and by nuisance levels of other species. Mechanical harvesting, benthic barrier placement and suction removal control efforts have provided a minimal measure of relief. Early detection and hand-pulling control efforts by the Otisco Lake Preservation Association (OLPA) have nearly eradicated the invasive water chestnut.

Diverse populations of game fish including walleye, tiger muskellunge, smallmouth bass, largemouth bass, white perch, yellow perch, and brown trout are found in Otisco Lake

The Otisco Lake watershed is 38.7 mi^2 (24,777 acres) and is large enough relative to the lake's size and volume to flush fairly rapidly. The watershed is approximately 42% agricultural, 33% forested lands and 9% shrub/scrub. Wetlands and open water comprise almost 13% of the watershed. Approximately 50% of the occupied dwellings in the watershed are lakefront residences with the majority of residential development along the east shore and northern third of the western shoreline.

Otisco Lake faces challenges in maintaining and improving its water quality in the coming years. These include the control of internal sources of nutrients (primarily phosphorus) as well as stormwater runoff containing nutrients, sediments, pesticides, and other pollutants from agricultural and non-agricultural watershed sources. Sediment inputs from three major tributaries were shown to have increases from 100 to 400 percent over an approximate 25-year period (1981-83 compared to 2005-08).



Maintaining a successful future for the water quality and ecology of Otisco Lake will require protecting it from impacts originating from the watershed, addressing in-lake sources of nutrients and levels of nuisance vegetation while minimizing the impact of invasive species.

This plan evaluated and identified changes needed in priority area Tier V Agricultural Environmental Management (AEM) plans. Recommendations were made to implement these changes and to inventory and remediate other sources of contamination.

A review of land use regulations and policies in the primary watershed towns indicate they provide an adequate level of resource protection.

Rural communities often struggle to evaluate the potential impacts of development. This management plan recommends an evaluation of ecosystem services to better understand the value of the services provided by forested and agricultural environments to facilitate better decision-making.

Watershed resident and stakeholder surveys were conducted to better understand public perception of Otisco Lake and the problems it faces. The resident survey with 177 responses identified dense aquatic weed growth interfering with boating and public access to the lake as a major concern.

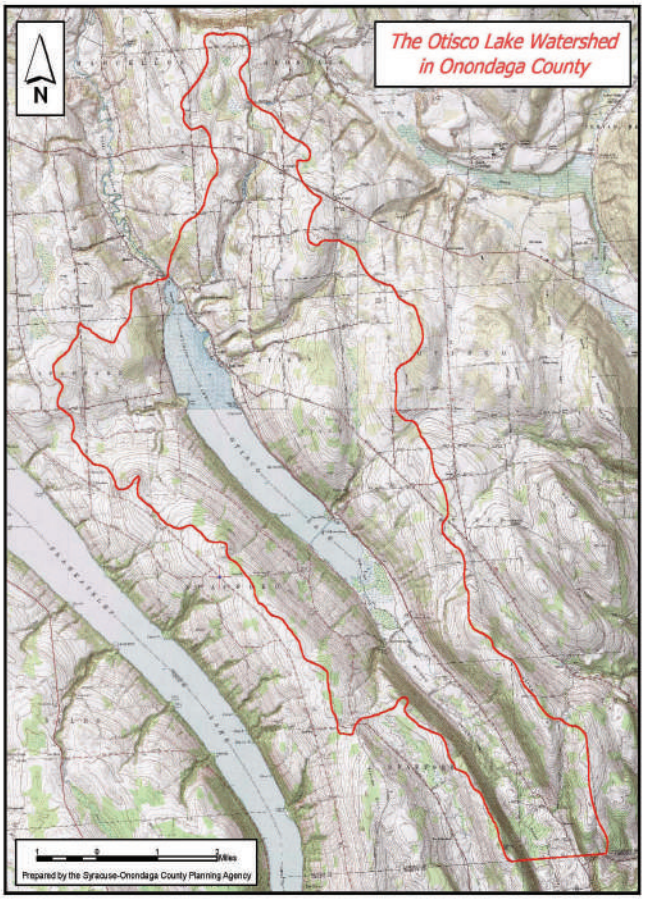
A stakeholder opinion survey identified invasive species prevention/education, high nutrient levels, septic effluent, and fishing as high priority issues of concern to lake quality. Watershed issues identified as of highest priority included: hydrofracking, chemical fertilizer application, affects of runoff, hazardous household waste disposal, and watershed inspection and maintenance of onsite septic systems.

Maintaining a successful future for the water quality and ecology of Otisco Lake will require protecting it from impacts originating from the watershed, addressing in-lake sources of nutrients and levels of nuisance vegetation while minimizing the impact of invasive species. The recommendations outlined in the management plan provide a first step in this direction. Long-term success can be achieved through continued and expanding cooperative working relationships among municipalities, public entities, the lake and other private resource oriented associations, and local landowners. Otisco Lake and watershed issues and concerns are summarized below:

Summary of
Otisco Lake and Watershed Issues and Concerns

Area	Category	Issues
Lake	Monitoring	Need to assess on-going lake water quality.
	Aquatic vegetation	Excessive growth and effective methods of control.
	Invasive species	Control of current species, prevention of future introductions**,** on-going education of lake users.
	Water quality	Elevated levels of nutrients and near-shore sedimentation.
Watershed	Monitoring	Need to assess on-going tributary inputs.
	Fishing	No public boat launching facility available.
	Agriculture	Sediment, nutrient, pesticide and pathogen runoff.
	Commercial and industrial influences	Surface and groundwater pollution.
	Shoreline residences	Household hazardous waste disposal; onsite septic maintenance.

OTISCO LAKE



- Lake Length: 6 miles
- Maximum Width: .8 miles
- Lake Surface Elevation: 787 feet
- Lake Surface Area: 2048 acres
- Average Depth: 33 feet
- Maximum Depth: 66 feet
- Volume: 21 billion gallons
- Hydraulic Retention Time: 1.7 years
- DEC Water Quality Classification: AA
- Water Level Control: Some – Otisco Lake Outlet Dam
- Shoreline Length: 15.5 miles
- Watershed Area: 24,777 acres
- Primary Watershed Land Use: Agriculture (42%)
- Highest Point in Watershed: 1986 ft (Ripley Hill)
- Number of Towns in Watershed: 7
- Lake Associations: Otisco Lake Preservation Association (www. otiscolakepreservation.org)

CHAPTER 1

INTRODUCTION

1.1 Project Introduction and Background

Otisco Lake is the easternmost of New York State's Finger Lakes. It serves as a public drinking water supply source for Onondaga County residents and provides an important recreational and environmental resource for permanent and seasonal residents as well as visitors from other parts of central New York and beyond. Being such a valuable resource, it is incumbent upon residents, lake users, and stakeholders to protect and manage Otisco Lake to the best of their ability.

Since a watershed can be defined as the total area that eventually drains into a lake, all surface and groundwater generated from precipitation and snowmelt in the area defined as the "Otisco Lake watershed" will makes its way into Otisco Lake. Thus, it is imperative that a plan for Otisco Lake includes its watershed since decisions regarding land use within the watershed have a direct influence on the water quality, aquatic biology, and recreational opportunities in the lake.

As a public drinking water supply source, Otisco Lake is provided a level of enhanced protection thorough the Otisco Lake Watershed Rules and Regulations. However, while applicable to lake resource management, these rules and regulation focus on drinking water quality needs. There is some state and federal agency authority over lake resource management and land use, but it is limited. As a result, actions and activities having the greatest impact upon land use and ultimately the lake are conducted at the local level. Therefore, municipal decisions play a much larger role in how well a lake is protected from development activities.

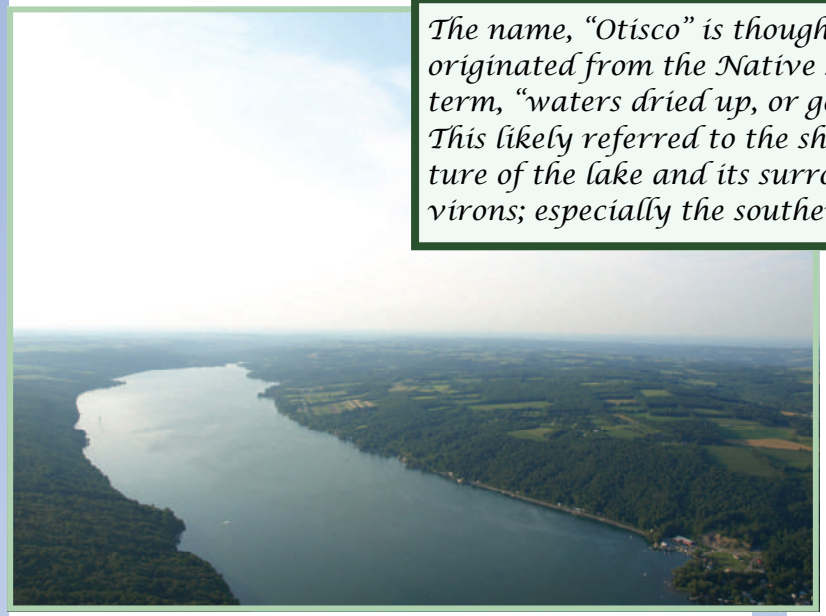
There is a long history of lake and watershed stewardship conducted cooperatively by OCWA as the drinking water supply purveyor, Onondaga County agencies, and a number of federal and state agencies. A more recent addition has been OLPA, a local non-profit lake association, as a primary impetus for lake management activities (e.g., aquatic vegetation management, invasive species control, land use policy) and public outreach activities.

A view of Otisco Lake north of the Narrows. Primary roadways adjacent to the lake are Otisco Valley Road (left) and Route 174 (right). Otisco Lake outlet dam is also visible (center left)

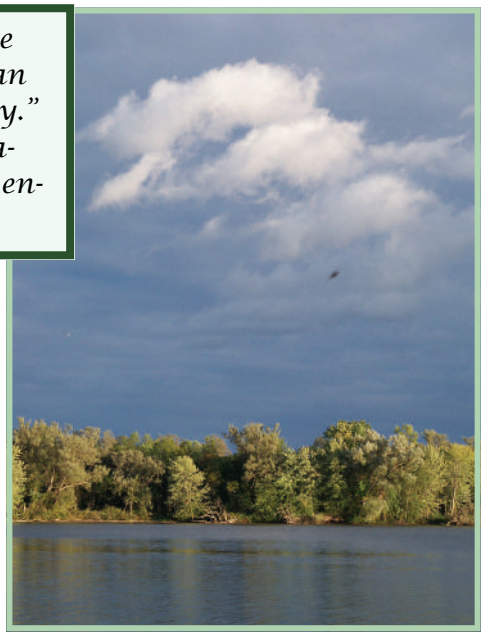
Otisco Lake is provided a level of enhanced protection through the Otisco Lake Watershed Rules and Regulations.

1.2 Cultural History of the Otisco Lake Region

The Finger Lakes region has been occupied by Native Americans for about 9,000 years since the retreat of the Pleistocene glaciers. The Iroquois were one of the first tribes to permanently inhabit the area and thought to have arrived during the thirteenth or fourteenth century. Three of the five Iroquois Nation tribes (the Onondagas, the Senecas, and the Cayugas) lived in the Finger Lakes region. They held dominion over the area until the 1700s when Europeans arrived.



The name, "Otisco" is thought to have originated from the Native American term, "waters dried up, or gone away." This likely referred to the shallow nature of the lake and its surrounding environs; especially the southern end.



Although it is known that the Onondagas had a trail leading to Otisco and other lakes in the area for fishing and hunting, there are no recorded permanent Native American settlements in the Otisco Lake watershed. However, there are stories and signs indicating their camps were near the lake.

Permanent European settlement began after the Revolutionary War when lands were given by the United States Government to soldiers as payment for their services. In 1804, the first house by a white settler (Oliver Tuttle) was erected at the head of the lake in the present day Town of Otisco, which was formed two years later in 1806.

The name, "Otisco" is thought to have originated from the Native American term, "waters dried up, or gone away." This likely referred to the shallow nature of the lake and its surrounding environs; especially the southern end. The watershed landscape changed permanently with the construction in 1869 of a dam at the north end to impound water for use in maintaining water levels in the Erie Canal. The dam raised the lake's water level by approximately 9 feet. It also submerged a road that existed at the southern end linking residents in the towns of Otisco and Spafford. In addition to expanding the lake's surface, the wetlands at the southern end were submerged. The road was rebuilt with hemlock logs in 1908. A storm in 1929 washed out portions of the causeway and the structure continued to deteriorate until it was reconstructed in 1983 (Deyle 1985).

In the early part of the last century, Syracuse residents would come to the lake by way of the Marcellus-Otisco Railway for boat excursions. Heath's Grove contained a pavilion that was used for parties and town picnics. Rental cottages were available. Over the ensuing decades, most of the lake's shoreline (except for areas with steep slopes along the western shore) was developed.

In 1908 the Suburban Water Company obtained the right to use Otisco Lake for a public water supply. The Company raised the dam in 1909 which increased the water level another 4 feet. In 1926, the Federal Water Company bought Syracuse Suburban and changed its name to the Onondaga Water Service. From the 1920s on, demand for Otisco Lake water grew with the expanding economy and housing boom. After a series of changes and ownership, the Water Service became known in 1955 under its present name, the Onondaga County Water Authority.

CHAPTER 2

STATE OF OTISCO LAKE

2.1 Overview and Summary

Otisco Lake is a valued water body serving as a major source of drinking water for approximately 340,000 customers in Onondaga County and provides recreational, aesthetic and ecologically benefits to residents and visitors alike. These uses are intrinsically bound by the quality of the lake.

In order to protect, preserve or enhance a resource, it is important to understand how it functions. To that end, monitoring and investigations over several decades have helped determine whether conditions in Otisco Lake have changed, what factors are responsible for the lake's present condition, and what are the threats to its future well-being.

The existing database provides no conclusive evidence lake conditions, including nutrient levels and oxygen depletion, have changed appreciably.

Long-term management is dependent upon the physical characteristics of the lake and its watershed, water quality data, information on biological communities living in the lake, and how people use both the lake and surrounding watershed. Obtaining such information can be time-consuming, costly, and at times inconclusive. Nevertheless, these steps are necessary to make sound decisions and commitments for the future of Otisco Lake. Fortunately, the existing data base provides more than an adequate amount of information to help formulate a number of management decisions.

Focused on drinking water supply treatment needs, the OCWA lake monitoring program provides the lake's longest-standing water quality data set. Lake and tributary data has been collected during the last decade through the Central New York's Near-Real-Time Surface Water Quality Network (Our Lake), Hobart-William Smith College-Finger Lakes Institute, and the United States Geological Survey (USGS). There is also an historical data base of special studies and investigations.

Otisco Lake is usually described as mesotrophic or moderately nutrient - enriched. While the watershed contributes phosphorus, nitrogen, sediment and other contaminants, the lake bottom sediments are a major source of phosphorus which is the nutrient most responsible for algal growth.

However, the "open water" or mid-lake area normally exhibits very good water clarity which is thought to have increased since zebra mussels established themselves in the late 1990s. Aquatic vegetation expansion in parts of the lake, most notably the area immediately south of the Narrows, may also be a result of the increased water clarity.

Oxygen loss from the deeper waters and warm temperatures in the water column limit Otisco Lake's ability to support trout thorough late summer. Nevertheless, Otisco Lake supports a healthy aquatic system providing a diversity of game fish including walleye, tiger muskellunge, smallmouth bass, largemouth bass, white perch, yellow perch, and brown trout. While walleye are the most sought after game species, Otisco Lake has developed a region wide reputation for tiger muskie.

The existing database provides no conclusive evidence lake conditions, including nutrient levels and oxygen depletion, have changed appreciably over the period of record which dates back to limited data collection and narrative accounts from the early decades of the 1900s.

Data indicate overall water quality condition in Otisco Lake is similar to Honeoye, Cayuga, and Owasco lakes rather than its more pristine neighbors such as Skaneateles and Canandaigua lakes.

2.2Lake Characteristics and Hydrology

Otisco Lake is the most easterly of the eleven Finger Lakes. It is 6.01 miles long and contains 15.53 miles of shoreline. The average width is .59 miles with a maximum width of .80 miles. It is a shallow lake compared to most of the other Finger Lakes with an average depth of 33 feet and a maximum depth of 66 feet. Thirty-five percent of the lake's volume is found at depths greater than 33 feet.

With a surface area of 3.2 mi^2 and a volume of 21 billion gallons, Otisco Lake has the fourth smallest surface area and third smallest volume of the Finger Lakes. Net flow direction is south to north. On average, Otisco Lake flushes approximately once every two years which is the third fastest rate of all the Finger Lakes.

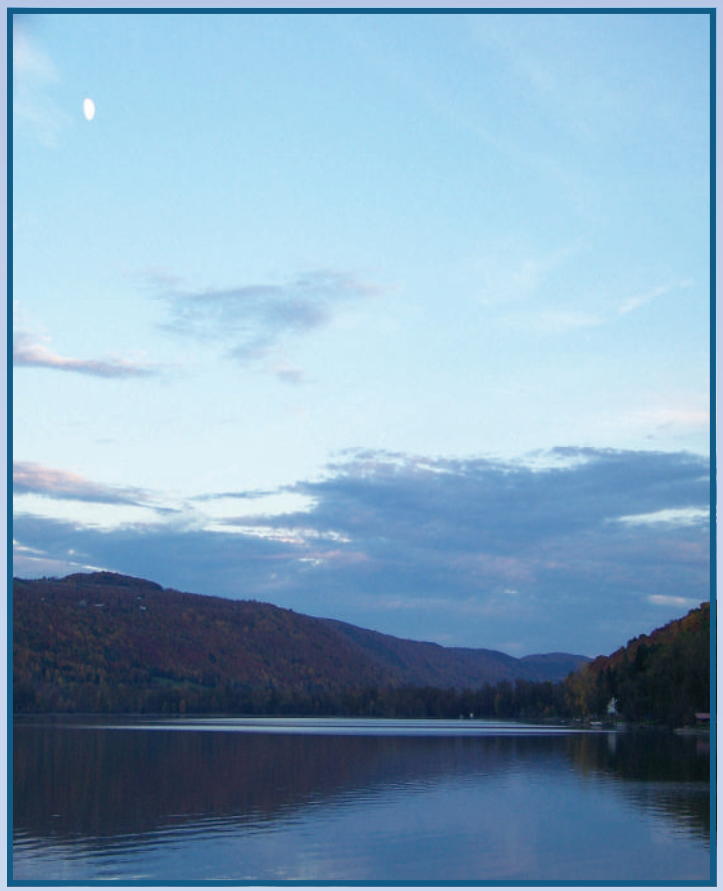
A notable feature of Otisco Lake is its division by a causeway separating the smaller and much shallower southern end from the rest of the lake. Average depth in the southern section of the lake is about 3 feet and the maximum depth around 9 feet. A narrow channel through the causeway serves as the only connection and means for water exchange between the two lake sections.

The southern basin normally has a brown, turbid appearance attributed to sediment resuspension. While there is deposition from Spafford Creek, bottom sediments in the southern basin are organic soils derived from the former wetland area flooded when the elevation of Otisco Lake was first raised in 1869 for use in maintaining water levels in the Erie Canal, as discussed previously.

Winkley (1989) included Otisco Lake in the hydrogeological setting known as the northward-draining troughs. The glacial troughs of Onondaga County are unusually deep valleys and oriented in the same direction (parallel) to the regional topographical trend. Groundwater from the east and west sides of the lake generally flows toward the lake. Longitudinal flows move along the axes of the valley which is generally in a northward direction.

Otisco Lake has the fourth smallest surface area and third smallest volume of the Finger Lakes.

Turbid conditions characterize Otisco Lake south of the Causeway (upper right of photo).



2.3 Water Quality and Clarity

Chemical Characteristics

Otisco Lake is classified as mesotrophic meaning it supports a moderate level of biological productivity. Lakes of this trophic status are generally described as being moderately clear with an increasing probability of the hypolimnion (bottom waters) becoming depleted of dissolved oxygen (i.e., anoxic) during the summer. In a mesotrophic system, numerical ranges for average summer values for the following parameters include: total phosphorus: 12-24 ppb, secchi disc transparencies: 16.6 ft-13.1 ft (2-4m) and chlorophyll a: 2.6- 7.3 ppb. This also translates into a Carlson Trophic State Index (TSI) value of 30-50 (Carlson and Simpson 1996).

Mean values for secchi disc transparencies, total phosphate (TP), and chlorophyll-a for the 2008-2011 data set are indicative of a mesotrophic lake.

Otisco Lake Mean Values 2008-2011 for Trophic Indicators

Secchi Disc	Total Phosphorus (TP)	Chlorophyll-a
10.5 ft (3.2m)	18.4 ppb	2.0 ppb

Likewise, TSI values computed over the past two decades **Table 1, (Appendix A)** exhibit some variability, but also are in the mesotrophic range.

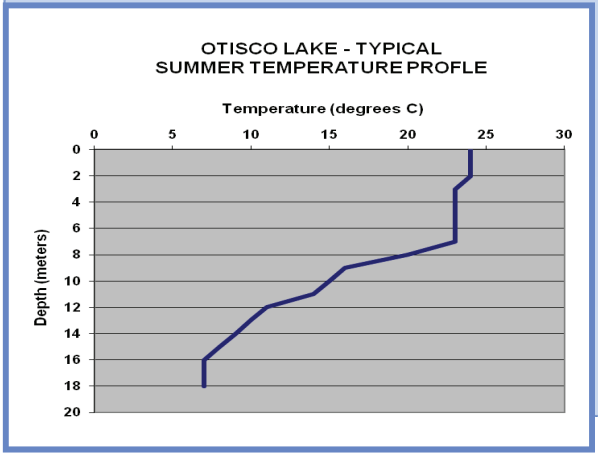
Otisco Lake was one of several local waterbodies where water quality data was collected from 2002 to 2007 by the UFI thorough a multi-organizational effort (www.ourlake.org 2009).

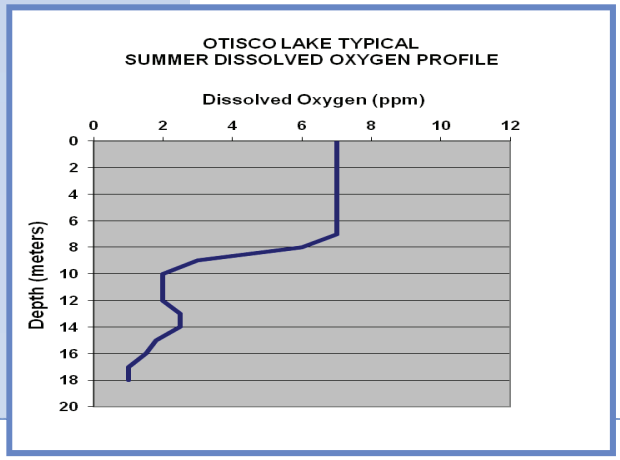
Hobart William Smith College-Finger Lakes Institute has been sampling Otisco Lake as a part of its Finger Lakes monitoring program since 2008. Surface and lake bottom values for several parameters in 2008, 2009, 2010, and 2011 are summarized in **Table 2, (Appendix A).**

An interesting anomaly is seen in the high mean total phosphate and large standard deviation reported for the 2009 data in **Table 2.** Both the high mean value and large standard deviation reflect a single sample taken on July 22, 2009 showing an elevation spike in a surface water sample: TP >150 ppb. Explanations include: i) the sample being taken soon after a strong precipitation or wind event, ii) an event induced by carnivorous zooplankton predation upon herbaceous zooplankton, or iii) bottom water mixing due to wind events inducing blue green algae blooms. The latter phenomenon has been reported to occur in Honeoye Lake (J. Halfman pers. comm. 2010). This explanation is also an indication of the role bottom sediments likely play in supplying phosphorus (called internal cycling) for phytoplankton (algae) growth.

Otisco Lake shows strong temperature stratification during the summer months. Average depth of the thermocline in the July through August time period is typically around 26-33 feet www.ourlake.org 2009, Halfman, pers. comm 2012). At the same time, dissolved oxygen is depleted rapidly from the lower waters resulting in close to or the complete loss of oxygen from virtually the entire hypolimnion.

The widespread depletion of dissolved oxygen, has lead some investigators to consider Otisco Lake as being eutrophic (Halfman and O'Neill 2009).
The precipitation of calcium carbonate known as "whiting" is another interesting, recurring phenomenon in Otisco Lake that varies with respect to timing and magnitude. It is a distinct component of lake turbidity in the upper waters





and arises abruptly. Whiting events can easily be mistaken for phytoplankton blooms due to the green, turbid appearance of the lake water.
From a limnological standpoint, Otisco Lake south of the causeway can be considered a separate lake. Total phosphorus, phytoplankton biomass, and turbidity levels are much greater than those found in the main lake while transparencies are much lower (Callinan, 2001).

The release of phosphorus from bottom sediments due to anoxia in the hypolimnion has long been thought to play a role in Otisco Lake nutrient dynamics.

Chemical Characteristics- Historical

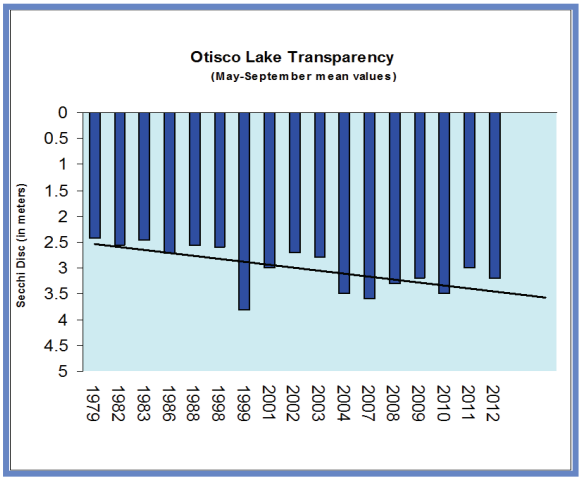
Not unexpectedly, secchi disc transparencies, which are a measure of visibility or water clarity, show seasonal and annual variability. A general increase in mean values for May-September is seen since zebera mussels became established in the lake in 1997.

Of historical interest is a single August secchi disc reading of 9.8 feet from Birge and Juday (1910) and a mean of two readings in 1973 of 10.8 feet reported by Oglesby(1974), and included in Appendix A.

Further indication of the lake's historic low levels of dissolved oxygen in the deeper lower waters is seen in an assessment of the lake fishery by Eaton (1928) who described Otisco as the shallowest, warmest, and weediest of the lakes he surveyed. The author added the deeper waters were not suited for fish during the summer due to low dissolved oxygen levels.
Internal cycling or the release of phosphorus from bottom sediments due to anoxia in the hypolimnion has long been thought to play a role in Otisco Lake's nutrient dynamics. Concentrations up to 80 mg/l of total phosphorus were reported from the hypolimnion by Effler et al. (1989).

The pattern of seasonal dissolved oxygen loss has shown no substantive change.. There are indications this pattern was present in the early 1900s...

Major ion trends over several past decades indicate declines in calcium, magnesium and alkalinity, but increases in sodium, chloride, and sulfate. Sediment accumulation rates of 0.3 in/year have been calculated for Otisco Lake; one of the highest rates measured for the Finger Lakes (Callinan, 2001).



Water Quality Classification

Otisco Lake is classified as AA (best usage classification-drinking water) and serves as a public and private drinking water supply source. It also provides multi-recreational uses including fishing, boating and swimming.

Otisco Lake is on the New York State Department of Environmental Conservation (NYSDEC) Waterbody Inventory/Priority Waterbodies List (WI/PWL) with the following use impairments, causes and sources:

Aquatic life:	Known to be stressed
Recreation:	Known to be stressed
Water Supply:	Possibly threatened
Causes:	DO/Oxygen Demand
Sources:	Agricultural, streambank erosion

Otisco Lake does not meet current dissolved oxygen standards due to undetermined natural or unnatural causes. As a result, Otisco Lake is on the Federal Clean Water Act Section 303 (d) list as a "Listed Waterbody Not Meeting Dissolved Oxygen Standards, Pending Verification of Impairments/Pollutants/Sources." The NYSDEC is conducting an evaluation of 45 lakes identified by the USEPA, including Otisco Lake, to determine whether these waters are impaired in any significant manner by pollutant loadings from other than natural conditions.

2.4 Lake Water Level

OCWA is responsible for the operation and maintenance of the Otisco Lake dam. There is an on-going program of monitoring and inspection of the dam to meet NYSDEC regulations as well as a schedule for future needs of the dam (Anthony Geiss, pers. comm. 2013). OCWA is required to maintain a minimum flow release into Nine Mile Creek of 1 million gallons per day or 1.5 cubic feet per second. As a target level, OCWA tries to maintain a daily lake level average computed from a 50 year record. The lake level is based upon the spillway crest elevation of 786.60 feet (Mark Murphy, pers. comm. 2013). However, lake levels throughout the year are largely weather dependent since OCWA has limited ability to control lake elevations. The average minimum level over the past 52 years has been 28.5 inches below the spillway crest and the average maximum 4.4 inches above it (Mark Murphy, pers. comm. 2013).

Map showing historical lake water levels.

Lake levels throughout the year are largely weather dependent since OCWA has limited ability to control lake elevations.

Otisco Lake outlet dam

Phytoplankton and Zooplankton

There are no known recent studies of phytoplankton and zooplankton population dynamics for Otisco Lake. The most comprehensive phytoplankton data set comes from OCWA's weekly analyses on water samples drawn from their water supply intake (depth 20 feet) and samples historically taken at several locations and depths in the lake. Identification is done to the genus level. In recent years, *Fragilaria* sp., have typically been dominant during bloom periods. The cyanobacteria (blue-green algae), *Anacystis sp.* is dominant through most of the growing season (OCWA 2011).

Studies of diatom species presence in bottom sediment cores have been used to infer historical changes in total phosphorus concentrations in lakes. Such an investigation has included a number of New York lakes, including Otisco Lake. Findings indicated *Fragellaria crotonensis*, a well known eutrophic and a mesotrophic indicator, increased significantly in top sections of core samples (the more recently deposited) when compared to the bottom sections (older deposition) which are estimated to be from approximately 1940.

Some mesotrophic species were also found in the lower sections (older) of the Otisco Lake core suggesting moderate nutrient concentrations have been present for some time or that the core sample was not deep enough to represent conditions prior to the lake's human-induced nutrient enrichment (Enache et al. 2012).

Fisheries

Otisco Lake provides a diversity of game fish and has developed a reputation for tiger muskie. Ice fishing for this species is especially popular.

Otisco Lake provides a diversity of game fish including walleye, tiger muskellunge, smallmouth bass, largemouth bass, white perch, yellow perch, and brown trout. White perch are the most abundant sport fish caught. Stocking includes walleye, tiger muskellunge, and brown trout.

While walleye are the most sought after game species, Otisco Lake has developed a reputation for tiger muskie and ice fishing for this species is especially popular. An ice fishing world record fish was caught in February 2009. Otisco Lake provides an excellent environment for tiger muskie growth (NYSDEC, 2009).

Otisco Lake has a limited ability to support trout through late summer because the water tempera-

tures throughout much of the water column are too warm (>20 degrees C or 68 F) and not oxygenated sufficiently (>5 mg/l). This more than likely affects the number of stocked brown trout surviving into the fall (NYSDEC, 2009).

In July 2008, the NYSDEC conducted its first comprehensive fisheries survey in Otisco Lake since the 1990s. White perch were by far the most abundant species caught which was also the case in the previous survey. Smallmouth bass were more abundant than in past surveys with walleye more abundant than in previous sampling, but below what was considered peak populations levels in the 1998-2001 time period.

Walleye are the most sought after game species.

Alewife were common as were bluegill and pumpkinseed. Similar to past surveys, relatively few yellow perch were caught. Infrequent or incidental collections were made of brown trout, rock bass, carp, white sucker, black crappie, brown bullhead, and spottail shiner (D. Lemon, pers. comm. 2010).

Fish Advisories

There are no special advisories for eating sport fish in Otisco Lake. Only the general health advisory for freshwater systems applies which is eating no more than one meal (one-half pound) per week of fish from the state's freshwaters.

Wildlife

No site-specific investigations on water-dependent wildlife were identified, but anecdotal evidence provides some information on reptile and amphibian abundance. In the 1960s, Turtle Bay, as the name implies, was the home to large number of turtles, but since then the populations have been decimated and turtles are no longer observed in the bay. Based on local conversations, turtle harvesting during the 1990s resulted in the loss of the turtles. Likewise, incidental reconnaissance of tributaries to the lake indicate amphibians may be absent from some of these streams.

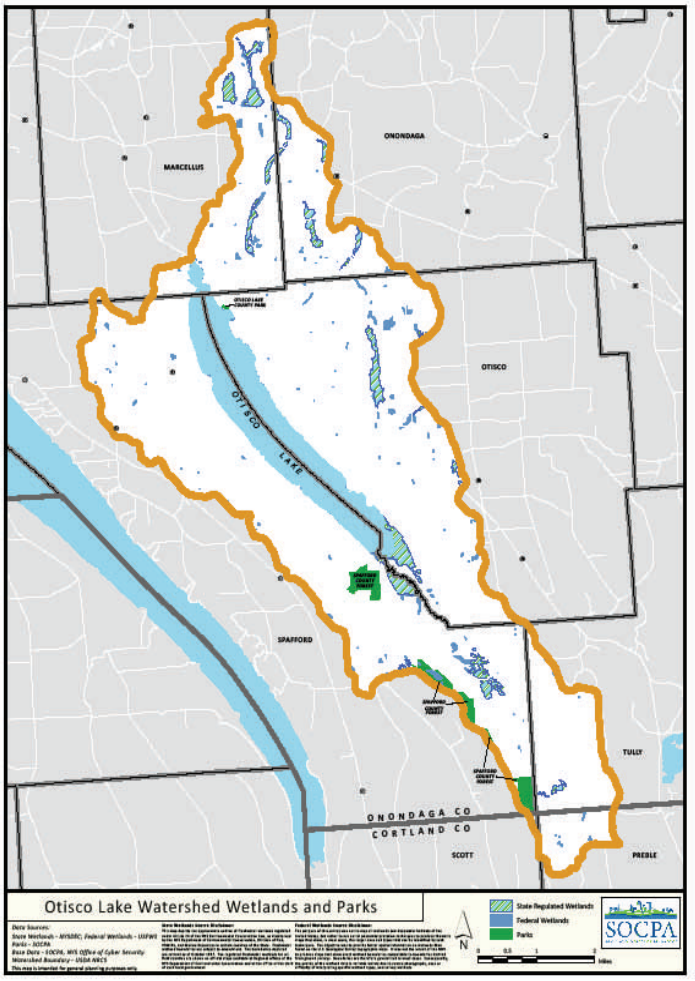
Over the past decade, Canada geese have begun to inhabit areas of the lake throughout the summer months. The extended presence of Canada geese provides a new source of nutrients to the lake.

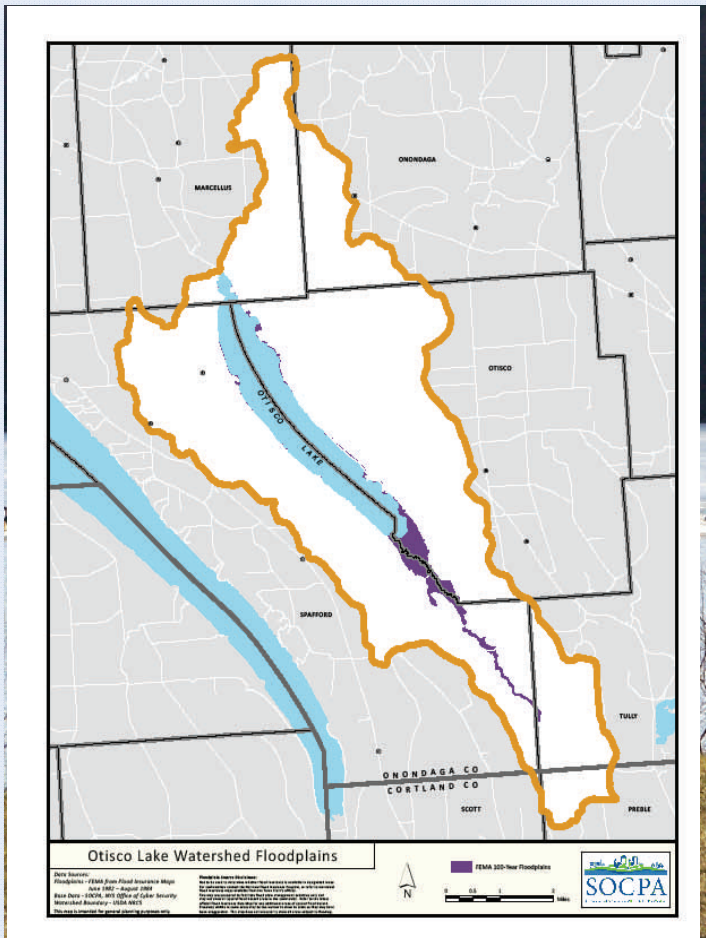
Many wildlife species inhabit Otisco Lake and the surrounding area.

2.6 Floodplains and Important Habitats

Along the lake, the current 100-year floodplain is restricted to the extreme southeast corner adjacent to and just north of the Causeway. The areas adjacent to the lower and middle reaches of Spafford Creek are the primary flood plain areas in the watershed (Federal Emergency Management Agency 2012).

Regulated wetlands are found in the upper reaches of Van Benthuysen Brook, Amber Brook, Rice Brook, and in areas adjacent to Spafford Creek. Portions of the Spafford County Forest are located within the extreme southern and southwestern portions of the watershed. Spafford Forest contains 701 acres of wilderness available for hiking and outdoor exploration. The 3-acre Onondaga County Otisco Lake Park on the lake's eastern shore provides shoreline fishing access and leisure opportunities.





2.7 Aquatic Plants

Present Conditions

The most recent comprehensive work on submerged aquatic vegetation was conducted in 2003-2004 by Hairston, Johnson and Lord (2005) as part of an investigation to assess the use of biological control for Eurasian watermilfoil in Otisco Lake. In this investigation the littoral zone or area where rooted or attached plants grow was defined as 18.4 feet or less.

Twenty aquatic plant species were identified from Otisco Lake with native coontail (*Ceratophyllum demersum*) and the non-native Eurasian watermilfoil (*Myriophyllum spicatum*) as codominants. Other abundant species included: water stargrass (*Zosterella dubia*), water celery (*Vallisneria americana*). elodea *(Elodea canadensis*), southern naiad (*Najas guadalupensis*) and curly leaf pondweed (*Potamogeton crispus*).

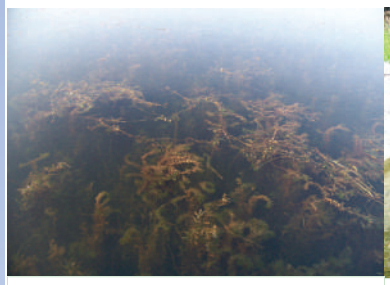
Greatest macrophyte abundance was found in the extreme northern end of the lake to roughly one mile south of the Narrows. Densities were greater in the eastern half of the lake than on the western side. On the western side of the lake, the Lader Point area had the highest densities of aquatic vegetation while the rest of the western shore had densities characterized as sparse or non-existent. This is largely due to the steep drop-off in water depth which provides a very narrow littoral zone. The only area along the Causeway where medium to dense vegetation densities were found was in the extreme southeast corner. Most of the eastern near shore was found to have moderate or high densities. Little vegetation was present south of the Causeway, Hairston, Johnson and Lord 2005). Locations of dense vegetation from the study are shown in (**Figure 1, Appendix A)**.

Historical Conditions

A less comprehensive study using a different methodology was conducted in 1987 (Auer and Effler 1987). The objective was to assess areas where mechanical harvesting would be beneficial. *Myriophyllum* species (likely all or predominately *M. spicatum* - Eurasian watermilfoil) and *Potamogeton crispus* dominated in heavily vegetated areas.

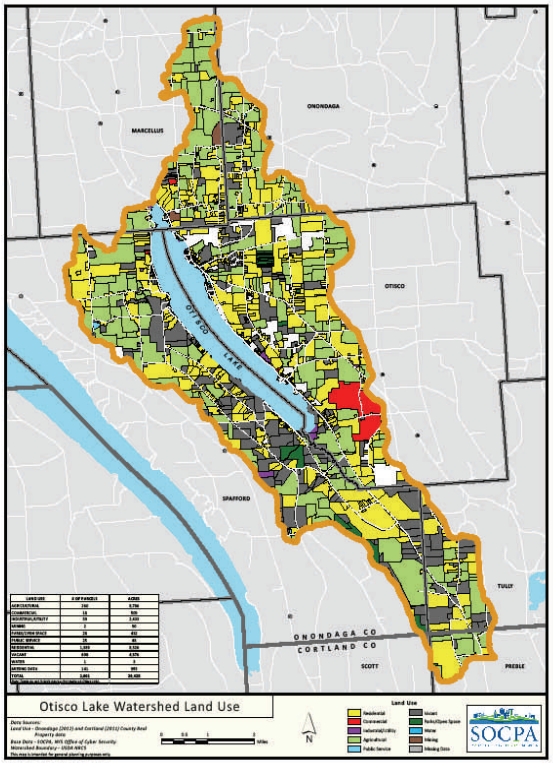
As with the most recent survey, much of the area north of the Narrows was found to have dense vegetation growth as was the Lader Point area and near shore areas north of where Amber Brook enters the lake (eastern shoreline).

However, several changes in conditions can be inferred. With the exception of a few inshore areas of medium or moderate growth, the area immediately south of the Narrows had generally sparse growth. This contrasts greatly with the dense growth reported by Hairston et al. (2005). Auer and Effler (1987) also identified much of the near shore area south of the Causeway as having moderate to dense aquatic vegetation growth while this area was found to be generally void of rooted vegetation by Hairston et al. (2005)



Dense areas of aquatic vegetation include the invasive Eurasian watermilfoil.

Algae growth and shoreline buildup of aquatic vegetation.



Otisco Lake Watershed Land Use

Along with other lake parameters, Shaffner and Ogelsby (1979) reviewed macrophyte conditions. Perhaps of greatest interest was reference to the general absence of rooted aquatic plants reported in the lake by Baston and Ross (1975) in the mid-1970s and the possible role played by low lake levels due to a drought in 1965. Water levels did not return to normal until 1967.

2.8 Invasive Species

Several non-native or invasive species are of particular concern for Otisco Lake and the watershed. Both the zebra mussel (*Dreissena polymorpha*) and rooted aquatic Eurasian watermilfoil (*Myriophyllum spicatum*) are well-established in Otisco Lake. Zebra mussels were first sighted in Otisco Lake in 1997. While the closely related quagga mussel (*Dreissena bugensis*) has not been reported in the lake, this may be due more to the absence of any concerted effort to identify it from Otisco Lake as opposed to its true absence. Water chestnut (*Trapa natans)* has been present in the northeastern section of the lake north of Turtle Bay since at least 2006.

Asian clams (*Corbicula fluminea*) were found in the southwest corner of the lake by the Causeway and off the County Park near Turtle Bay in September 2012. Based upon size, it is estimated Asian clams have been in Otisco Lake since about 2010.

A mat of the highly invasive species, Hydrilla verticillata. (Photo by David J. Moorhead, University of Georgia, Bugwood.org and taken from the Cornell Cooperative Extension Invasive Species Program and the New York Invasive Species Clearinghouse publication: Hydrilla verticillata: What Marinas Need to Know-March 2012.)

The 2011 discovery of Hydrilla (Hydrilla verticillata) in the Cayuga Lake outlet raises the threat of this highly aggressive macrophyte spreading to Otisco Lake and other nearby water bodies.

Volunteers hand-pulling water chestnut from Otisco Lake.

Buildup of Eurasian watermilfoil.

The Asian clam is found in Otisco Lake.

2.9 Invasive Species Management

Invasive species management in Otisco Lake has focused on the aquatic plants, Eurasian watermilfoil and water chestnut. Mechanical harvesting and limited "suction dredging" have been used to help control an overabundance of Eurasian watermilfoil and other aquatic plants. These efforts have been funded privately and through New York State Finger-Lake-Lake Ontario Watershed Protection Alliance (FLLOWPA) funds made available to Onondaga County. A pilot one-acre benthic matting project was conducted in 2012. In 2013, matting was made available for seasonal use by lake residents through the OLPA. This popular program was expected to continue in 2014.

An approximate one-acre area of water chestnut has been the target of hand-pulling efforts for successive years with the plant nearly eradicated from Otisco Lake. Public education and awareness efforts have been used separately and in conjunction with the Watercraft Steward Program thorough the Finger Lakes Institute to inform lake users about invasive invertebrate and plant species of concern or of imminent threat to Otisco Lake. Over the past several years, Cornell Cooperative Extension of Onondaga County (CCE) has conducted workshops and other information sessions on invasive species for lake and watershed residents.

Three methods of aquatic plant management (clockwise from top); suction removal, mechanical harvesting and benthic matting.