CAYUGA LAKE WATERSHED
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INSIDE...

The Role of Phosphorus in Cayuga Lake

By Roxy Johnston

Most water bodies in the eastern United States are phosphorus limited. This means that the nutrient in shortest supply, and therefore controlling growth of organisms, is phosphorus. In New York, total phosphorus (TP) is used as an indicator of water quality based on the idea that increases in phosphorus correspond to poor water quality by encouraging excessive algae growth, or algal blooms. It is important to remember that phosphorus is necessary for life, but it becomes a problem only when there is too much, which creates an imbalance in a natural system.

Phosphorus exists in several forms and only a portion is available for use by organisms. Unfortunately, the forms of phosphorus that algae use for growth, Soluble Reactive (SRP) and Total Dissolved Phosphorus (TDP), are also the most difficult to measure. Although measuring total phosphorus is easier than the more important forms of biologically available phosphorus, it is the least useful way to track problems related to excessive phosphorus.

Forms of Phosphorus and Relative Availability for Growth

TP = PP + TDP	TDP = SUP + SRP
Total Phosphorus (TP)	Represents all forms of phosphorus
Particulate Phosphorus (PP)	Bound to sediment and largely not available
Total Dissolved Phosphorus (TDP)	Mostly available, can bind to and release from sediment (dissolved and soluble terms are interchangeable. Most literature uses dissolved for TDP and soluble for following fractions of TDP.)
Soluble Unreactive Phosphorus (SUP)	Portion of TDP not available
Soluble Reactive Phosphorus (SRP)	Portion of TDP available

On average, studies have shown that two-thirds of total phosphorus is biologically available for algal growth, which makes the use of TP as an indicator seem reasonable. Unfortunately, the proportions of biologically available phosphorus in Cayuga Lake are opposite – meaning that two-thirds of total phosphorus is not available for algal growth. Most of

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Interpreting the Health of Our Lake: A Report Card

By Jill Cohen, Cornell University Graduate student

The Cornell class visits the Cayuga-Seneca Canal.

Members of the Cayuga Lake Watershed Network have been working with a group of graduate students at Cornell University to generate a template for a report card for the Cayuga Lake watershed. The goal of the document is to show current trends in the environmental and social health of the Cayuga Lake watershed. Led by Drs. Ed Mills and Richard Stedman of the Department of Natural Resources, as well as Sharon Anderson and Keith Tidball of the CLWN, the students represent a broad spectrum of academic interests, from engineering and ecology to development sociology and natural resources management.

With the help of the CLWN the students met with an array of key stakeholders in the watershed, including Roxy Johnston and Jose Lazono of the Ithaca Area Wastewater Treatment Plant, Steve Pennigroth of the Community Science Institute, Bill Foster from the Floating Classroom program, and members of the Tompkins County Water Resources Council. Based on these meetings, the students generated a list of indicators to include on the report card. These indicators range from "the quality of media information on water quality" to "the percentage of impervious surfaces in the watershed" to "the percent of the population that reside permanently in the watershed." Over the past four months, the students have compiled data on these indicators and will submit a draft of the proposed report card to the CLWN in January.

As opposed to assigning 'grades' to each indicator, as is traditionally done in environmental report cards, the students elected to construct a 'dashboard' of indicators. Similar to the dashboard found in cars, it will show the status of each indicator in relation to a critical level, and will convey whether the indicator has improved or declined compared to previous years. The rationale behind this design is to encourage readers to view the watershed as an interconnected system, with multiple environmental and social factors acting on the overall health of the lake and its watershed. Ideally, the status of the indicators will be updated on a regular basis, so that community members can better understand the state of the watershed.

Cayuga Lake Watershed Network

170 Main St., PO Box 348
Aurora, NY 13026
www.cayugalake.org

PHONE NUMBERS:
Office 315-364-2992
Fax 315-364-2991

OFFICE HOURS:
Wednesday - Friday, 9am - 3 pm
Other Hours by Appointment

STAFF:
Daniel Carrión, *Program Assistant*
manager@cayugalake.org

Do We Have the Right Mission?

By John Mawdsley, Watershed Network Board of Directors Chair

This is the question a group of us considered earlier this year. On entering our second decade with a successful first decade behind us, it still seemed appropriate to see if we could do even better. We had some concerns that we had spread ourselves too thin with such a comprehensive mission statement. In recent years our membership had remained steady at between 400-500, but we think it should be higher. If we could make it clearer what a difference we made in the watershed then perhaps we could get the increased membership we are looking for. Perhaps paradoxically, we thought that defining more tightly our mission would make our impact greater.

Five of the Board of Directors and the Watershed Steward had some lengthy meetings to talk through the pros and cons of making a change. The result was a revised mission statement which now states that *"The mission of the Cayuga Lake Watershed Network is to identify key threats to Cayuga Lake and its watershed and advocate for solutions that support a healthy environment and vibrant communities."*

We also identified key activities which reflect the new mission:

- Monitoring the quality and ecology of the watershed to pick up problems;
- Identifying land use changes that have the potential to impact detrimentally the water-based ecology and hence are threats;
- Advocating for solutions that preserve a healthy environment and vibrant communities;
- Being a source or repository for relevant watershed data, or working closely with other organizations that can better serve this role.

So what do we see as the main difference from the original Mission statement? Principally that we will work much harder to identify key threats and try to be proactive so that we can deal with them before they become serious problems. We are also willing to take a stance on what we think is the best solution. We will, however, consult widely before taking this position. And finally, we still see education as an important process in encouraging others to help us make the changes that will be necessary to remove the threats.

We would really like to hear what you, our members and readers of our Network News, think of these changes, especially if you don't like them. But let us know why and what you would prefer. Please send them to steward@cayugalake.org with the subject "Decade 2."

Permission to Pollute?

By Darby Kiley, Town of Ithaca Planner

NPDES is the national permitting program

U.S. Environmental Protection Agency

When the Clean Water Act was enacted in 1972, the US Environmental Protection Agency (EPA) developed the National Pollutant Discharge Elimination System (NPDES) program and authorized states to administer permit programs for point discharges to surface and ground water. In New York State, the Department of Environmental Conservation (NYSDEC) is authorized under Environmental Conservation Law (Article 17) to permit discharges through State Pollutant Discharge Elimination System (SPDES).

NYSDEC approves permit applications by developing the limits for types and quantities of pollutants in the effluent, or discharge. NYSDEC reviews applications for general and individual permits, depending on the type and amount of discharge associated with the application. General permits include Phase II stormwater, Confined Animal Feeding Operations (CAFO), construction, and small, private, commercial and institutional facilities. Individual permits are required for projects including industrial, municipal, power plants, and large private, commercial and institutional facilities.

The Cayuga Lake Watershed has a number of individual facilities with permitted discharges. Discharges directly to Cayuga Lake include the following: AES Cayuga Power Plant (Lansing), Cargill Cayuga Rock Salt Mine (Lansing), Cornell University Lake Source Cooling, and Waste Water Treatment Facilities for the Ithaca Area, Village of Cayuga Heights, Village of Aurora, and Village of Union Springs.

Other SPDES-permitted discharges in the watershed include the following: Agway Ithaca Bulk Plant (Ithaca), Emerson Power Transmission (Ithaca), Therm, Inc. (Ithaca), Cornell University Power Plant, NYS Office of Children and Families Facility (Lansing), Columbia Natural Resources, Inc. (Aurelius), ITT Fluid Tech Corp (Seneca Falls), Hampshire Chemical Corp (Waterloo), Tompkins County Airport (Lansing), and Waste Water Treatment Facilities/Sanitary Services for the Village of Freeville, Village of Dryden, Village of Interlaken, Town of Newfield, Village of Trumansburg, Village of Cayuga, Village of Seneca Falls, Village of Waterloo, and the Southern Cayuga Central Schools.

Additional permitted discharges fall under the "general permits" category. Applicants apply for coverage under a general category for certain types of activities as listed above. One relatively new permit system is for the NYS Phase II Stormwater program, which includes construction activities and municipalities in urbanized areas. Applicants with certain construction activities disturbing more than one acre of land are required to submit a Notice of Intent to NYSDEC. A number of municipalities in Tompkins County around the Ithaca urbanized area are required to develop and implement a Stormwater Management Program that includes public education, guidelines for municipal operations, and adopting local laws related to construction activities and the illegal discharging of pollutants. The Stormwater Coalition of Tompkins County meets monthly and is available to provide information to other municipalities interested in learning more about NYSDEC's program.

The Role of Phosphorus in Cayuga Lake *continued from cover*

the phosphorus is bound to sediment and settles to the bottom of the lake rather than causing excessive algal growth. Is Cayuga Lake really that unusual? The short answer is no – the lake chemistry results in decreased availability of phosphorus by binding much of it. Also, much of the inputs of phosphorus fall more in the category of natural rather than traditional 'pollutant' sources associated with human activities.

In Cayuga Lake, total phosphorus is a flawed indicator of water quality, but where does the phosphorus come from? The general origins of phosphorus are natural (as a mineral or in soil) or linked to human activities. A study of Fall Creek published in 1976 estimated that 45% of the phosphorus was from natural sources, 20% from agriculture, and 35% from point sources. It's quite likely that improvements in wastewater treatment and agricultural practices over the past three decades have decreased phosphorus inputs from both of those sources. In the case of Six Mile Creek, much of the sediment is from natural glacial deposits and historical land use practices that increased stream bank erosion. Today, much of Six Mile Creek is moving towards a stabilized condition, so letting it continue that process is probably the most cost effective way to reduced sediment, and the associated phosphorus loading to the lake. Regardless of the origin, most phosphorus entering the south end of Cayuga Lake is bound to sediment as it is delivered by streams.

To a much lesser degree, dissolved phosphorus enters the lake from the two wastewater treatment plants. Cornell University's Lake Source Cooling Facility (LSC) does not actually bring phosphorus into the lake, but circulates deep lake water to shallower areas. Levels of TDP in deep lake water have risen and fallen over the last 15 years for reasons that are not yet clear.

The general presumption of scientists is still that the lake is phosphorus limited with respect to nutrients – but other factors such as water clarity and flushing rates of the shallow southern

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More Information:

- Total phosphorus is used as an indicator of water quality, with the assumption that high concentrations of phosphorus result in excessive growth (commonly algae).
- Growth of rooted aquatic plants is also often attributed to phosphorus inputs - but this is misleading. Rooted plants are using phosphorus already in the lake sediment. While new inputs of phosphorus are finding their way to the lake sediment - there is already enough phosphorus in storage to meet the plants needs for years, so it is not the growth limiting factor.
- Total phosphorus exceeded the New York State guidance value of 20 parts per billion in the main lake only twice in eighteen years of monitoring.
- Total phosphorus exceeded the guidance value on the southern shelf eight of thirteen years of monitoring, which resulted in listing that part of the lake as impaired.
- Sediment and phosphorus inputs to the lake are dominated by inputs from the streams.
- Sediment and phosphorus inputs from streams occur mostly during storm events with the largest events carrying the largest quantities of sediment and phosphorus into the lake.
- Two thirds of the total phosphorus entering the lake is bound to sediment and relatively unavailable for algal growth.
- Wastewater treatment plants (WWTP) discharge dissolved phosphorus that is available for growth.
- Recent treatment upgrades at the Ithaca Area WWTP resulted in a 50 percent decrease in phosphorus outputs.
- The Cayuga Heights WWTP is slated for the same kind of upgrade which will reduce P considerably.
- Chlorophyll, a measure of algae, has decreased since the 1990's. This decrease is likely linked to the ban on phosphorus rich detergents, improved wastewater treatment, and the impact from the invasion of zebra and quagga mussels.
- Research indicates that chlorophyll levels do not vary with total phosphorus inputs in Cayuga, which leads researchers to think that total phosphorus is a flawed indicator of water quality for this lake because most of that phosphorus is not biologically available.
- Lack of clarity in the southern end of the lake is predominantly caused by clay and silt, not algal blooms.
- Sediment and phosphorus inputs from Six Mile Creek (probably the most 'turbid' of the streams) are from erosion of streamside glacial deposits. Impacts to streams during the settlement period likely increased erosion of these deposits. Studies indicate that 76% of the sediment in Six Mile Creek is from stream banks, not agricultural erosion.
- Unlike other streams feeding the southern end of Cayuga Lake, Fall Creek has elevated phosphorus during low flow periods – the source is unknown.
- The concentration of SRP in the deep lake water is increasing – this is a regional phenomenon that may be related to the invasion of zebra mussels. There is not enough data now to know for certain.
- The southern end of Cayuga Lake mixes with the deep water every 1-10 days.

A Brief Geologic History of the Finger Lakes

By Rachel Singley, Watershed Network Intern

Now that winter has settled on our watershed, I look around and see nature's cycles at rest- recuperating in preparation for a vibrant return in the spring. There are few natural cycles that continue through winter: the blue spruces, hemlocks, and other evergreens that maintain their slow but steady pace of life, and a natural system that knows no season: geologic movement. The geological history of our watershed is generally well known, but mostly in vague, indistinct terms that include something about the last ice age, and something about glaciers. But the details such as how the lakes themselves were formed are usually left out. Here is a summary that can be supplemented by a trip to your local library.

About 22,000 years ago the entire northeast United States was under a thick covering of ice in the form of a huge glacier called an ice sheet. The ice sheet formed on the Laurentide Mountain in northeast Canada. The sheet began as an ice cap, but under the weight of several tons of snow and ice layers that collected on top of it, the sheet spread out laterally. But just how much ice are we talking about here? A lot. To give you an idea of much ice was on top of Northeast America during the last ice age, let's see how much was *not* in the ocean, since the earth's water cycles through oceans, briefly in the atmosphere, terrestrial areas, and back to the ocean.

It has been estimated that during the height of the last glaciation of northeast America, sea levels were about 120 meters lower than they are at present. This means that a little under 1/3 of the ocean's water evaporated, traveled as precipitation in the atmosphere, and fell to earth as snow that turned to ice. Each layer of snow compacted the last, making the sheet spread laterally, advancing from its source in all directions. The ice sheet itself was estimated to be around 1- 2 km thick.

Before the ice sheet descended on this area, the paths of streams and rivers had already been cut through the landscape. The beds of the Finger Lakes were originally the beds of rivers that had eroded deep valleys, and the gorges we know today were streams that flowed down the slope of the V- shaped valley to the river below. As the ice sheet spread over New York, it filled these river valleys. The weight of the ice compacted the sides of the hills, widening the valley, transforming the V- shaped valleys into deepened U- shapes. When the glaciers finally melted, the huge volume of water left behind filled the newly widened and deepened valleys.

NASA: Visible Earth collection

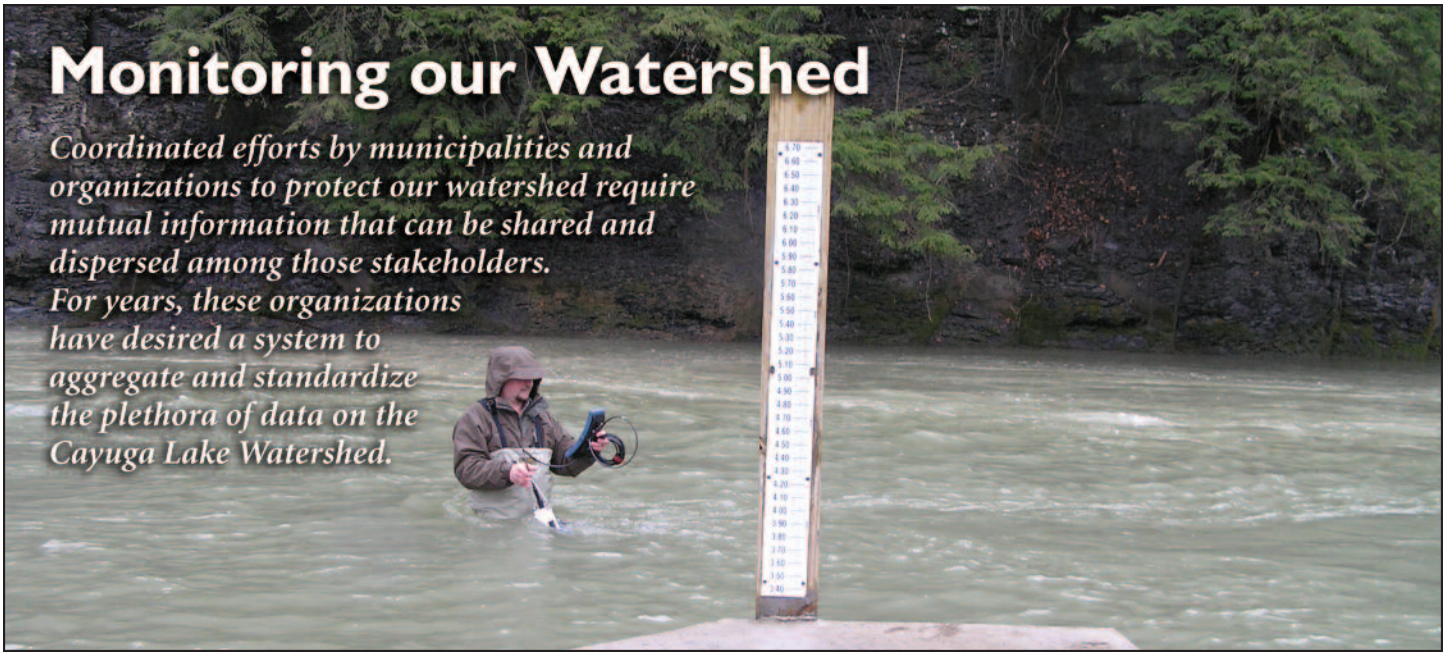
A consequence of changing the shape of these valleys was that the smaller streams and river tributaries that once flowed down the hillsides to the top of the glacier now flowed to the edge of the U- shaped valley and, since the glacier had since melted, these streams were now waterfalls at the edge of the lake. Soon the streams began to erode the ground over which they flowed, and after a while (about 21,000 years!), the streams had cut a path backwards from the cliff edge of the lake, leaving cavernous gorges in their wake. The erosion cut through the ground to the bed rock underneath, and far back into the hillside, making the deep and winding gorges we see today. Taughannock Falls in Ithaca, New York is a good example of a stream having cut right down to the bed rock because a large section of the streambed is exposed limestone bedrock. As geologic processes continue, the falls will continue to erode the ground beneath them. The path of the steams will continue to recede, and the rock structures will continue to change, as they did in the mid-1800's when the extruding shelf under the mouth of Taughannock Falls fell into the pool below.

When I look around the Finger Lakes, I not only think about the cycles of the seasons but also the extensiveness of the geologic process that carved the beautiful features of this region. Even though the gorges and lakes around us seem complete in their formation, the processes that created them are in constant motion and change. Although these changes are subtle and almost immeasurably slow, the process is never-ending!

The Role of Phosphorus in Cayuga Lake *continued from page 4*

end of the lake may be more important in controlling growth of algae.

A lot of what is understood about phosphorus in Cayuga Lake can be attributed to the total phosphorus regulations. The increased focus on phosphorus via permits and heightened public concern encouraged research projects and monitoring efforts, ultimately finding that some generalities about phosphorus do not necessarily apply to Cayuga Lake. For more information on the current science, check out the articles and websites listed below. Continued monitoring and research will improve our understanding of the lake and ultimately lead to appropriate strategies to protect the resource. The information presented above is just the beginning– stay tuned!



Monitoring our Watershed

Coordinated efforts by municipalities and organizations to protect our watershed require mutual information that can be shared and dispersed among those stakeholders. For years, these organizations have desired a system to aggregate and standardize the plethora of data on the Cayuga Lake Watershed.

There is no shortage of data on the lake and its watershed, but in order to develop a comprehensive assessment of water quality, emerging threats, and a clear understanding of the aquatic ecosystems, we need a system to monitor all factors that affect these things. However, we do not live in a perfect world, and creating such a coordinated system will take a very long time. Therefore, the Watershed Network and the Intermunicipal Organization paired up to create a "Guide to Surface Water Quality Monitoring in the Cayuga Lake Watershed."

"'There is a whole lot of monitoring being done that is of diminished value because it was not designed to fulfill any specific objectives.'" US EPA Nonpoint Source Information Exchange

Although there is a great deal of information and data being collected on the watershed, in order to be useful it needs to match certain criteria. Therefore, the monitoring document sets forth five objectives for data-collection and research to guide study designs.

1 Characterize the water quality of Cayuga Lake in order to identify status and trends – Lake Sampling.
Past documents have identified sediment, phosphorus, pesticides, volatile organic compounds, heavy metals, pathogens, and exotic/invasive species to be the long-term challenges/threats to Cayuga Lake and its watershed – so these things should be monitored through lake sampling to identify their trends.

2 Determine loading of water contaminants entering the lake via streams, creeks, brooks, and other tributaries – Tributary Mass Load Sampling
Water pollution in the lake is largely carried in by the tributaries that enter the lake – especially excess phosphorus and sediment. Little sampling of this kind has been done in the watershed.

3 Determine status and trends of water quality of tributaries – Tributary Water-quality Sampling
Tributaries could be threatened by contaminants that affect their health but do not pose as much of a threat to the lake. Therefore, since tributaries are used for drinking water, irrigation, and recreation, they should be monitored.

4 Determine long-term ecological health of the lake and tributaries – Biological Integrity Sampling
Knowing the chemicals inside of the lake only tells us so much; we also need to know how the ecosystem is doing, the living organisms, to have a broader look at the health of the watershed.

5 Encourage citizen participation – Citizen Monitoring
The more people interact with the lake, the more they will care about its health and protect it for future generations. And citizens can help us achieve objectives 1-4.

In order for the information to be useful, it also needs to be centrally accessible. Therefore, the Watershed Network is developing a "Data Clearinghouse". This clearinghouse is accessible and open to the public on Cornell University's eCommons Digital Repository. This will serve as a central location where the Watershed Network can place data and its metadata (information about the data) for the use of individual and organization watershed stewards. Metadata like how, when, and where data was collected is important because it informs the results.

It will be a slow process to create a comprehensive monitoring system, but it will be ultimately fruitful. Accurate and useful data is priceless to policy-makers, organizations, and stewards like you.

Adapted from the Guide to Surface Water Quality Monitoring in the Cayuga Lake Watershed

Long Point State Park

By Tony Ingraham

In Cayuga County, the Cayuga Lake Scenic Byway follows Route 90, which is an official state scenic byway in its own right. South of Aurora, Route 90 and the Byway swing up over Pumpkin Hill and away from one of the best public lake access points along the eastern shore—Long Point State Park. At the south end of the village, you must take Lake Road for 2 ½ miles to the park entrance. Lake Road rejoins Route 90 south of the park at Long Point Vineyard.

The National Weather Service operates a small weather station on the tip of Long Point in a little lighthouse owned by the NYS Canal Corporation.

Long Point itself is a nine-acre spit of land at the midpoint of a huge bulge in Cayuga Lake's eastern shore. Nearby Rocky Point is on the northern flank of the bulge and is visible from Aurora. Like so many such sites along the lake, Long Point is an alluvial fan made of material carried to the lake during freshets gushing from a nearby ravine. Currents and waves have shaped the sand and gravel into the point's nose-like profile.

People on the Point

There are no archeological records of Cayuga people living on Long Point, though its location on the lakeshore makes it highly likely that it was used by them. Following European settlement, the point and the nearby uplands were farmed. There was a farm and a large house on the point a century ago. The Lehigh Valley Railroad line formerly passed through the back of the point. Dairy farming is still done in the neighborhood, though less than in years past.

From Farm to Park

In the 1960s, New York State acknowledged the scarcity of public access to many of the state's large lakes, particularly near urban areas. The Conservation Department bought 102 acres at Long Point in 1963, which was turned over to the State Parks in 1967. The big house on the point was torn down in 1968.

Not long after, more acreage was acquired, including four acres on the point owned by the Binghamton Boat Club, which operated a small boat launch on the south shore of the point and a small campground on the uphill side of Lake Road. The state park operated the campground until 1990, when fiscal restraints and sub-standard restroom facilities at the site led to its closure.

Gradually, the state has expanded and improved facilities and services at the park. There is a modern restroom and bathhouse and a bathing beach with lifeguards. More land has been acquired, and now the park's 271 acres stretch all the way to Route 90, allowing the possibility of a future park entrance from the Byway and further development of the park someday (maybe camping again?). In the mid-1990's, the state rebuilt the boat launch area, including a boat basin that now protects vessels from the waves generated by winds on the long stretch of open water to the south.

One cottage survives on the northern shore from pre-park days. For years it was a park caretaker's cottage, and now it is available to the public for vacation rentals. A new playground was installed this past summer, but with the state's dire fiscal condition, we can't expect many new improvements soon.

Peaceful Surroundings

Long Point State Park is distinctive for being a gorgeous piece of

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Long Point State Park *continued from page 7*

lakeshore that generally is not heavily used except on occasional hot summer weekends. Lake Road cottage people probably use it more than anyone else. You can see way up and down the lake. Just north of Long Point, the lake spreads out to its greatest width—3 ½ miles. You can see far south past Sheldrake Point on the west shore and the AES Cayuga power station at Milliken Point on the east. It is a peaceful place for a quiet picnic while absorbing the gentle pulse of the waves and breezes along the sunny shore. And it is a good location to spot migrating waterfowl that rest and feed there in the spring and fall. Or launch your boat and rock on the swells while trying to catch some of Cayuga Lake's trout, bass, or pike.

Google Earth

In this visualization from Google Earth, Long Point is in the lower right, Rocky Point is farther along the shore at left of center, and the Village of Aurora is in the big bay above that.

Changes in the Land

Before the park, there were more trees on the point, mostly American elms which fell to the Dutch elm disease. The last farming on what now is parkland ceased in the 1940's and the land east of the road has been growing up in old fields, shrub land, and successional forestland dominated by red cedars and pines. White-tailed deer are plentiful, and the DEC manages a hunting area there with a check station in King Ferry. Small game hunting is permitted, and there is waterfowl hunting along the shore.

At the very tip of Long Point is a cute little lighthouse. It was installed by the New York State Canal Corporation. Inside, there are instruments operated by the National Weather Service. It's no wonder that Long Point, which juts way out into windy Cayuga Lake, is a good place for meteorologists to keep track of our changeable weather!

The Mission

The Cayuga Lake Watershed Network identifies key threats to Cayuga Lake and its watershed, and it advocates for solutions that support a healthy environment and vibrant communities.

Cayuga Lake Watershed Network
PO Box 348
Aurora, NY 13026

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