

# Long Island Sound – An Urban Sea Change

by Mark Tedesco

Long Island Sound was designated in 1987 as an Estuary of National Significance by the US Environmental Protection Agency (USEPA) under the Clean Water Act. In the 20 years since, what has changed, both for the better and for the worse, regarding the health of this great body of water? Not surprisingly, for a 110-mile long body of water, the answers are complex. The Sound can be healthy and vibrant or distressed and impaired, depending on the issue, location, and season. Reflecting the landscape and the people around it, the Sound is diverse and its current condition is partly a consequence of more than 400 years of intensive human habitation.

The Long Island Sound Study (LISS), a cooperative effort sponsored by EPA and the states of New York and Connecticut, has developed more than 40 environmental indicators updated annually to assess the ecological condition of the Sound. Every two years conditions are summarized in a report titled, “Sound Health,” available at: [www.longislandsoundstudy.net](http://www.longislandsoundstudy.net).

These indicators provide evidence that the health of Long Island Sound is improving. Pollutant discharges of nitrogen, toxic contaminants, and pathogens are decreasing. Contaminant levels in water, sediment, and biota are, overall, in decline. Populations of seals, ospreys, and striped bass have made remarkable recoveries. Dissolved oxygen levels show evidence of improvement as well despite warmer water temperatures in recent years. However, there are also negative signals: a die-off in lobsters in 1999, wetlands die-backs, invasive species, continued development of the watershed, challenges to maintaining and improving wastewater infrastructure, and the threat of climate change.

What follows is a short summary of conditions in Long Island Sound. Readers desiring more information should visit: <http://www.longislandsoundstudy.net/indicators/index.htm>.

## Eutrophication and Hypoxia

An atypical estuary in many ways, Long Island Sound has two connections with the Atlantic Ocean, both of them narrow with respect to the overall size of the Sound. The Sound itself is characterized by



Figure 1. Basins demarcate water quality in Long Island Sound.



Photo courtesy of EPA LIS Office, Stamford, CT

The research vessel John Dempsey is used by the Connecticut Department of Environmental Protection Fish Trawl Survey and the Water Quality Monitoring Program, which is funded by the Long Island Sound Study.

three basins, the western, central and eastern, demarcated by sills that form partial barriers to water movements (Figure 1).

As expected, the western basin, with its densely developed shoreline, is the most stressed, with fair water quality most of the time. Water quality improves in the central basin, and in the eastern basin water quality is good most of the time. The gradient in improving water quality from west to east reflects both the decrease in population density and conditions in the basins themselves. For example, the eastern basin is deep (as much as 350 feet) and rocky-bottomed. The Race and other passages that exchange waters with the Atlantic Ocean are characterized by strong tidal currents that scour the bottom and mix the water. At the western terminus at Hell Gate, the Sound connects with New York Harbor and the Atlantic Ocean via the East River. The western basin is shallower, generally less than 60 feet deep, and narrower. Currents are weaker, and in the summer months, mixing between surface and bottom water layers is limited.

The reduced mixing and high nutrient input makes the western Sound susceptible to hypoxia – low levels of dissolved oxygen. Research suggests that hypoxia is not natural to the Sound. Instead, degradation began in colonial times with deforestation of the watershed, picked up speed in the mid-19th century with industrialization and increased population of the watershed. Increased sewage has led to the over fertilization of the Sound, increasing the productivity of plants and the oxygen demand from organic material delivered to the sediments.

Long Island Sound now receives about eight times as much nitrogen as it did under natural conditions. New York State has 23 sewage

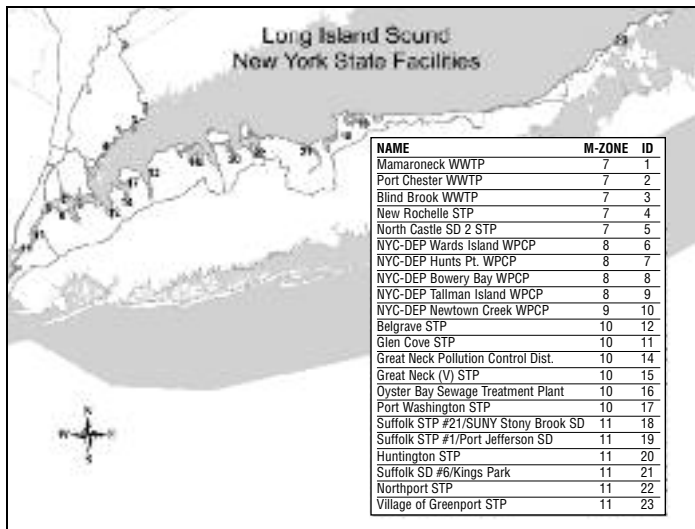


Figure 2. Location of New York wastewater treatment plants (WWTPs) in Long Island Sound

treatment plants discharging to Long Island Sound (Figure 2). The largest are in New York City along the East River; these six plants alone discharge more than a billion gallons of treated effluent a day – prior to nitrogen control initiatives around 25,000 metric tons of nitrogen per year. Another 10,000 metric tons of nitrogen are contributed by the 17 New York wastewater treatment plants and the 106 Connecticut plants. At least 8,000 metric tons were estimated to originate from nonpoint, stormwater and atmospheric sources in Connecticut and New York.

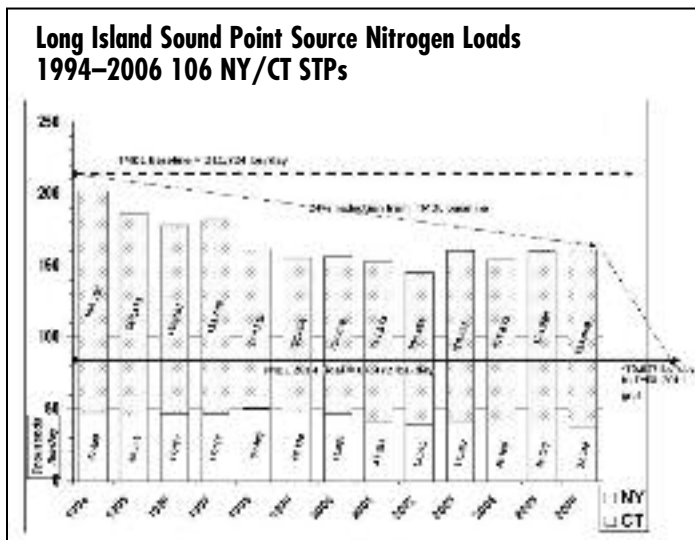


Figure 3. Upgrades have achieved a 25 percent reduction in nitrogen loads to LIS from sewage treatment plants relative to a 1990 baseline.

In 2000, after more than a decade of extensive research, modeling, and economic analysis, CT and NY submitted a nitrogen management plan, or Total Maximum Daily Load (TMDL). The TMDL, approved by EPA in April 2001, forms the legal and regulatory foundation for attaining a 58.5 percent reduction in nitrogen loads from CT and NY. The TMDL and its implementation includes mechanisms to increase effectiveness and lower costs, such as allowing pollutant trading through aggregate “bubble” permit limits or through a statewide general permit. Trades use watershed equivalency factors that identify the relative impact that sources have on water quality.

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Upgrades completed to date in CT and NY have achieved about a 25 percent reduction in nitrogen loads to LIS relative to the 1990 baseline (Figure 3). While improvements in dissolved oxygen concentrations have not yet been dramatic, there are signs amidst all the natural variability that conditions are starting to improve (Figure 4).

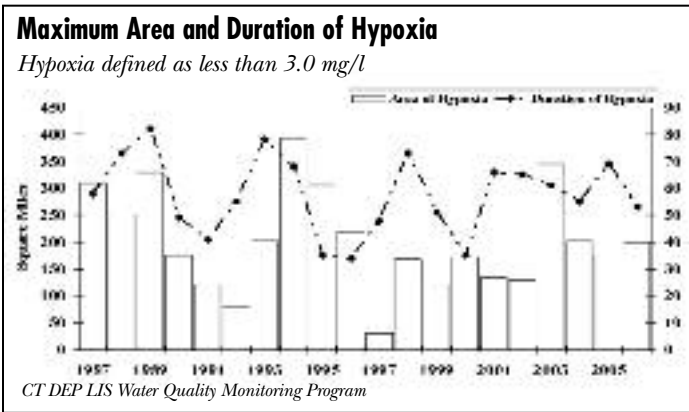


Figure 4. The maximum area of hypoxia has averaged 203 square miles from 1987 through 2006, with a low of 30 square miles in 1997 and a high of 393 square miles in 1994. The duration of hypoxia has averaged 58 days during that same period, with a low of 34 days in 1996 and a high of 82 days in 1989. The severity of hypoxia varies year to year, in large part due to variations in weather conditions, with an apparent cycle of peaks and lows every four to five years. While 2003 was the second worst year area-wise, 2004 and 2005 were closer to the average at 202 and 177 square miles, and 55 and 69 days, respectively.

Nitrogen is also believed to have played a key role in the demise of eelgrass beds in many LIS coves and embayments where it once was prominent. Presently, the only major eelgrass beds in the New York

waters of the Long Island Sound are in the shallows of Fishers Island. Historical accounts indicate that eelgrass was once distributed throughout the Sound. Current Long Island Sound Study research is studying the relationship between nitrogen loads and eelgrass health in the hopes of developing nitrogen criteria for the protection of eelgrass beds in the Sound.

### Toxic Contaminates

Overall, toxic contaminant releases as reported under EPA's Toxic Release Inventory have declined dramatically. Since 1988, toxic chemical discharges directly to the Sound and its tributaries have decreased by 88 percent. Airborne emissions throughout the watershed have declined by 85 percent. With tighter controls and product bans, contaminant levels in the sediments and biota have also declined. Contaminants, many legacy pollutants from historical discharges, still pose a risk and contaminant concentrations in the western Sound still are among the highest reported in the National Oceanic and Atmospheric Administration's National Status and Trends Program. In addition, chemicals from personal care products and pharmaceuticals are increasing in the environment; additional research on these emerging contaminants is needed to better understand their health risks.

### Pathogens

Long Island Sound has more than 240 swimming beaches, providing millions of beach visits each year. However, reducing the numbers of beach closures and shellfishing areas due to pathogen contamination continues to be a difficult challenge. Polluted stormwater is the primary source of pathogens to the Sound, either through street runoff or from leaking or combined sewer systems. Continued long-term improvements in infrastructure, stormwater management, and



Photo by Richard Howard

The Connecticut Department of Environmental Protection conducts an annual trawl survey that tracks the abundance and distribution of fish in Long Island Sound. The survey has also documented that fish numbers decline in areas with low dissolved oxygen levels.

low impact development will be needed to fully realize the recreational and economic benefits.

## Living Resources

The abundance and diversity of living resources such as oysters, clams, lobsters, finfish, and birds are indicators of ecosystem health and human impact. These living resources are important to the regional economy through commercial and recreational fishing, bird watching, and ecosystem services they provide. They are influenced by water quality, habitat loss and degradation, harvesting, and other factors from within the Sound and from the region. Understanding how all these factors interact to affect populations is complex.

However, some patterns are emerging with important implications for the future. Abundances of warm water fish species, such as summer flounder, are either stable or increasing. Cold water fish species, such as winter flounder, are either stable or decreasing. This corresponds to warmer regional water temperatures.

The warmer water temperatures predicted to result from climate changes can affect more than fish populations. For example, warmer than average water temperatures may have been partially responsible for the die-off of lobsters that occurred in 1999 and 2002, and might also be blamed for impacts on eelgrass and wetlands and in fostering the success of invasive species. The die-back of some wetland vegetation in the Sound could be related to a variety of climate change effects, including the possibility of enhanced fungal invasions that find the warmer conditions more favorable.

## The Future

Long Island Sound, despite the pressures of human development

(and partly because of it), remains true to its sobriquet The American Mediterranean (Weigold, 1974) or, if you prefer, The Urban Sea (Koppleman et al. 1976). Both suggest a paradise of recreation and respite from long settled and often densely developed lands, while demurely hinting at what F. Scott Fitzgerald bluntly described as "that great wet barnyard, in his novel The Great Gatsby.

The Long Island Sound Study has continued to support research, monitoring, and modeling to understand the ecosystem. Environmental indicators are being evaluated to provide more integrated, spatially explicit information. Nitrogen reduction to address hypoxia and loss of eelgrass habitat will continue to be a priority. Restoring the ecological functions of degraded or converted habitats will continue to be a priority. In addition, the new Stewardship Initiative, a bi-state cooperative effort, will focus on protecting and enhancing critical natural areas. Under this initiative, the LISS approved 22 inaugural "stewardship areas" in September 2006. These areas represent diverse coastal habitats that are essential to the Sound's living resources and ecological functioning.

Long Island Sound, despite problems, is still an extremely valuable and valued asset to residents and visitors from throughout the region. In 1990, Dr. Marilyn Altobello estimated the annual value of water quality dependent recreational, commercial and environmental activities at about \$5.5 billion. Adjusted for inflation that figure is more than \$8 billion now. Continued investments in water and habitat quality improvements are surely warranted.

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