A Healthier Long Island Sound: Nitrogen Pollution

Long Island Sound is home to hundreds of aquatic species ranging from fish, shellfish, crustaceans, seagrasses and marshes. They are part of an ecosystem that helps sustain shoreline habitats, including tidal marshes, dunes and coastal forests, that support countless other species, including resident and migratory waterfowl. The diversity and abundance of wildlife species are what helps the Sound thrive. Also thriving is a human population that flocks to the shoreline to live, work, and play. Long Island Sound is referred to as the "Urban Sea," reflecting its long history of human habitation and resource use.

Long Island Sound Study
A Partnership to Restore and Protect the Sound

Since its inception in 1985, the Long Island Sound Study (LISS) has focused on the dominant water quality problem for Long Island Sound: excessive amounts of nitrogen. Nitrogen pollution in the Sound reduces dissolved oxygen to unhealthy levels for aquatic life and contributes to harmful algal blooms and loss of tidal wetlands and seagrasses. Low dissolved oxygen levels, or hypoxia, have historically occurred most severely in the western, more narrow and restricted portion of Long Island Sound. Hypoxia not only harms aquatic life, impacting the health of this vital water body but also influences the region's economy, which benefits from recreation, tourism, and fishing.

The area of land where rain water ultimately flows to Long Island Sound, called its watershed, consists of over three million acres and extends as far north as Canada. The primary source of nitrogen to Long Island Sound is from sanitary wastewater treatment plants – not a surprise, given that nearly nine million people live within the watershed. Traditional septic tanks and outdated cess-pools – many located in densely developed coastal communities, also contribute to the wastewater load by only partially filtering wastewater on-site and releasing it underground. Fertilizer runoff from lawns, storm water from developed areas, and animal waste and fertilizer runoff from farms also contribute to nitrogen pollution, as does deposition of nitrogen emitted into the atmosphere.

New York Achievements

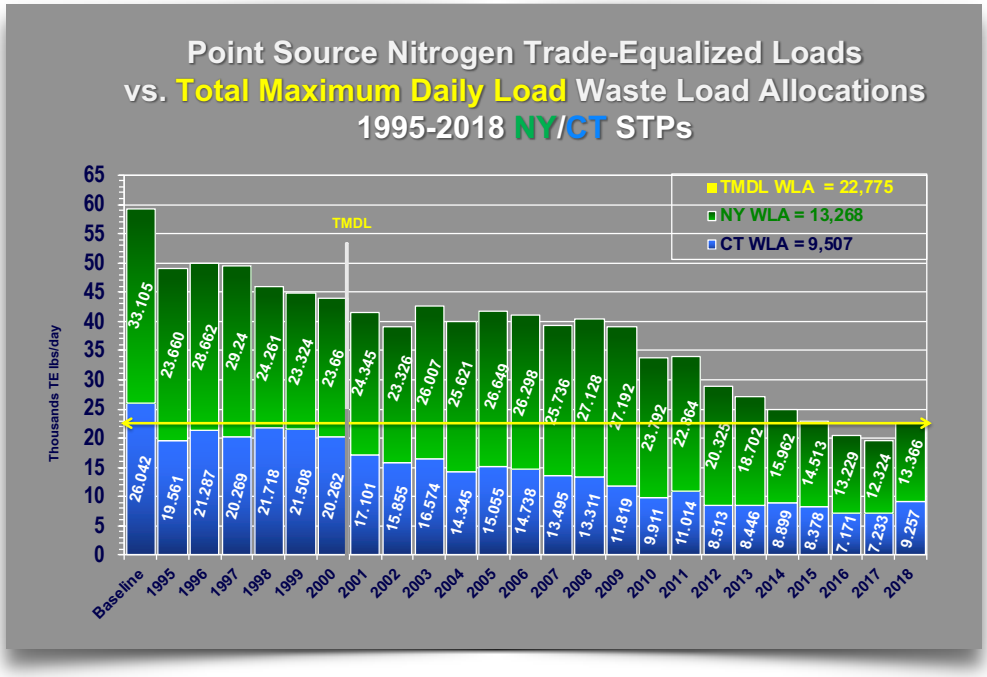
New York has 23 municipal wastewater treatment facilities that discharge directly into Long Island Sound. They range in size from the small community of Greenport in eastern Long Island to the more than 500 times larger Wards Island facility in New York City. Total infrastructure investments statewide to meet the nitrogen reduction targets exceeded $1.7 billion. To provide flexibility in targeting cost-effective upgrades, New York State issued permits that grouped reduction allocations by management zone. Using the group allocations and exchange ratios, New York City met its allocation while saving more than $660 million in construction costs compared to traditional approaches, while Westchester County saved more than $150 million.

The Plan

In 1998 the LISS adopted a plan, Phase III Actions for Hypoxia Management, that identified the sources and loads of nitrogen and recommended reduction targets. In 2000, Connecticut and New York incorporated these targets into a Total Maximum Daily Load to Achieve Water Quality Standards for Dissolved Oxygen in Long Island Sound (TMDL).

The LIS TMDL mandated a 58.5 percent reduction to sources of enriched nitrogen from Connecticut and New York. In addition, the TMDL identified actions and schedules to reduce nitrogen from upstream states (Massachusetts, New Hampshire, and Vermont), atmospheric sources, and to implement non-treatment alternatives such as bioextraction. The plan also identified steps to evaluate additional nitrogen reductions while continuing monitoring and research programs to assess the attainment of water quality standards.

In order to account for the differences in impacts to western Long Island Sound, where hypoxia occurs most severely, from nitrogen sources spread across the watershed, the TMDL includes a trade equalized calculation. This conversion factors in both “transfer efficiency” (how Sound currents carry nitrogen to areas that affect the hypoxic hotspots), and “river attenuation,” (the ability of streams and rivers to reduce nitrogen from inland sources as it travels downstream to the Sound).Trade equalization allows managers to focus their efforts on reducing nitrogen where the greatest benefits to the health of Long Island Sound will be realized.

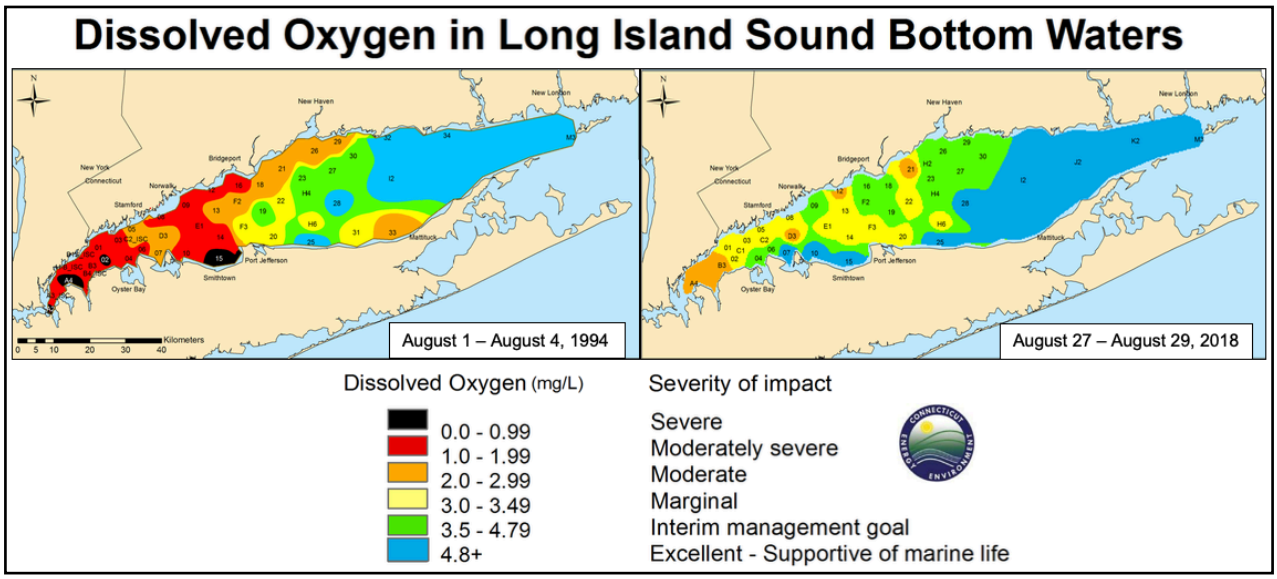


Implementation

The actions to reduce nitrogen pollution in Long Island Sound have yielded dramatic results, and the effort has reached an important milestone. Since 2017, wastewater treatment plants in the states of New York and Connecticut have been below the allocations set in the TMDL for reducing nitrogen pollution. Through infrastructure investments of more than $2.5 billion dollars to improve wastewater treatment, the total nitrogen load to Long Island Sound in 2018 was more than 42 million pounds less than the annual discharge in early 1991. The use of innovative permits and pollutant trading reduced implementation costs while accelerating progress.

Nitrogen has also been reduced from nonpoint sources, such as agricultural activities and atmospheric deposition. Continued Clean Air Act controls have reduced atmospheric deposition in the watershed by an average of 25% for total nitrogen and 50% for nitrate, exceeding the TMDL reduction target of 18%. Reductions in agricultural activity in the watershed and improved management have reduced fertilizer applications by 25% and livestock numbers by 40%, well exceeding the TMDL load reduction targets of 10%. Flow-normalized nutrient concentrations and fluxes from the major rivers draining to Long Island Sound have decreased from 1974 to 2013 and from 2001 to 2013. Inorganic nitrogen concentrations in Long Island Sound have also decreased.

Decreasing Hypoxia Area and Severity



Connecticut Achievements

In 2001, Connecticut established a Nitrogen Credit Exchange Program managed by a Nitrogen Credit Advisory Board. The state issued a statewide General Permit in 2002 that established annual nitrogen removal limits for all wastewater treatment facilities and set monitoring and reporting protocols. Facilities that discharge less nitrogen than permitted acquire weighted credits that they can sell to facilities that discharged more than permitted. The state has revised the permit in 2005, 2010, 2016, and 2019, with the nitrogen limits becoming more stringent each time . Connecticut's current and planned investments in upgrading the 79 municipal wastewater treatment plants in the state exceed $700 million. The trading program is estimated to have saved $300-400 million by targeting treatment facility upgrades with the greatest water quality benefit. In 2007, Connecticut's Nitrogen Credit Exchange program won an EPA Blue Ribbon Water Quality Trading Award.

The Results

Between 2014 and 2018 the peak area of hypoxic waters (defined as holding less than three milligrams/liter of dissolved oxygen) in Long Island Sound averaged 89 square miles, less than half the pre-2000 average of 205 square miles. The maximum area of hypoxic waters in 2017 was 70 square miles; in 2018 this dropped to 52 square miles. The severity of the hypoxia problem has also declined, with no area measurements of water below 1 mg/l dissolved oxygen in the past eight years. The hypoxic areas in 2015, 2018, and 2017 are the second, third and fourth smallest recorded in the past 32 years of monitoring.

Continuing Progress

Despite improvements in wastewater treatment, nitrogen from on-site wastewater treatment systems, residential turf fertilizer applications and stormwater runoff have remained level or increased. Nitrogen enters Long Island Sound when rainfall carries fertilizer from residential lawns along with the pollutants that have accumulated on pavement. Addressing stormwater and non-point source inputs are challenging since such inputs are widely dispersed.

Great progress has been made; as we learn more, we need to accomplish more to ensure that Long Island Sound — an estuary of national significance — remains a valuable and valued icon into the future.

In addition to negatively impacting water quality in the open Sound, excess nitrogen can contribute to harmful algal blooms, loss of tidal wetlands and eelgrass, coastal acidification, and hypoxia in coastal embayments. Some of these adverse impacts can result in coastal communities being less resilient to climate change and sea level rise.

To address this challenge, LISS targeted funding in 2015 for University of Connecticut Research Scientist Dr. Jamie Vaudrey to work with collaborators to assess the nitrogen loads to 110 embayments and the eutrophic status in fifteen embayments in Long Island Sound to predict nitrogen load problem areas and identify sources of impairments. This effort has become the cornerstone for greater emphasis on understanding the coastal sources of nitrogen, and the impacts of excess nitrogen to the many coves and embayments that line the shorelines of Long Island Sound coastal communities.

Reducing nitrogen from these embayments is critical to efforts to reduce nutrient loads to the Sound overall. While the embayment contribution to Long Island Sound's nitrogen load is relatively small (<20%), people are interested in the local effects of nitrogen on "their" embayment, and this local concern can be leveraged to generate actions to reduce loads to the embayments, and perhaps more importantly, to educate people about how and why nitrogen loading is impacting Long Island Sound overall.

In 2019 and beyond, LISS and its partners will continue work to further reduce nitrogen pollution, improve the underlying science, expand monitoring and assessment of harbor and embayment conditions, and develop the advanced circulation and water quality models to aid management. This will lay the groundwork for improved nitrogen management policies at the local and Sound-wide scales. To continue progress in reducing nitrogen pollution, EPA, CTDEEP, and NYSDEC are working to leverage and harmonize regional efforts to develop additional nitrogen reduction targets, expand water quality monitoring, and communicate with and involve the public.