Long Island Sound Water Quality Monitoring Program

August 2025

From the Connecticut Department of Energy and Environmental Protection (WQAUG25)

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Background

Hypoxia is a condition in which low or depleted dissolved oxygen concentrations are observed in the waters of Long Island Sound (LIS). Hypoxia impacts up to half of the LIS waters each summer. The primary cause of hypoxia is excess nitrogen from human sources. These sources include sewage treatment plant discharges, storm water runoff and atmospheric deposition.

The water temperature of Long Island Sound plays a crucial role in influencing hypoxia levels through several interconnected mechanisms. As water temperature increases, its ability to dissolve oxygen decreases, meaning warmer water naturally holds less dissolved oxygen. Additionally, higher temperatures elevate the metabolic rates of aquatic organisms, leading to increased oxygen consumption and further depletion of oxygen levels. Thermal stratification during warmer months results in a less dense, warmer layer sitting atop a denser, cooler layer, preventing the mixing of oxygen-rich surface waters with the deeper layers. This lack of mixing can isolate the bottom layers from essential oxygen, leading to hypoxia. Warmer temperatures also contribute to increased nutrient runoff from surrounding lands, enriching the water with nitrogen and phosphorus, which stimulate the growth of algae and phytoplankton. When these algae die and decompose, the process consumes a significant amount of oxygen, exacerbating hypoxia. Furthermore, higher temperatures boost the biological oxygen demand due to heightened activity levels of bacteria and microorganisms decomposing organic matter, further reducing oxygen levels. Consequently, the combination of reduced oxygen solubility, thermal stratification, enhanced nutrient runoff, eutrophication, and increased biological oxygen demand due to warmer water temperatures creates conditions where dissolved oxygen levels fall below the thresholds necessary to support healthy marine life, resulting in hypoxic zones in Long Island Sound.

Dissolved oxygen (DO) levels below 3.0 mg/L are considered hypoxic in LIS. Hypoxic conditions cause impairment and, in some cases, death to aquatic life. Some studies have found DO can become limiting below 4.8 mg/L for sensitive fish species, while more tolerant species are not affected until DO falls below 2.0 mg/L (Simpson et. al., 1995, 1996).

Since 1991, the Connecticut Department of Energy and Environmental Protection (CT DEEP) has conducted an intensive water quality monitoring program on Long Island Sound (LIS). The program is funded through a grant from the U.S. Environmental Protection Agency's (EPA) Long Island Sound Partnership. Data from the surveys are used to quantify and identify annual trends and differences in water quality parameters relevant to hypoxia, in particular nutrients, temperature, and chlorophyll. These data are also used to evaluate the effectiveness of the LIS management programs' efforts to reduce anthropogenic nitrogen inputs, since nitrogen is a primary contributor to the excessive algae growth that leads to hypoxia in LIS.

During the summer (June - September), surveys across LIS are conducted at bi-weekly intervals to better define the areal extent and duration of hypoxia. During these surveys stations are sampled for in-situ parameters including dissolved oxygen, temperature, pH, and salinity. The sampling calendar lists the expected survey dates.

The WQAUG25 survey was conducted 29 - 31 July 2025 aboard the R/V John Dempsey. A total of 37 stations were sampled.

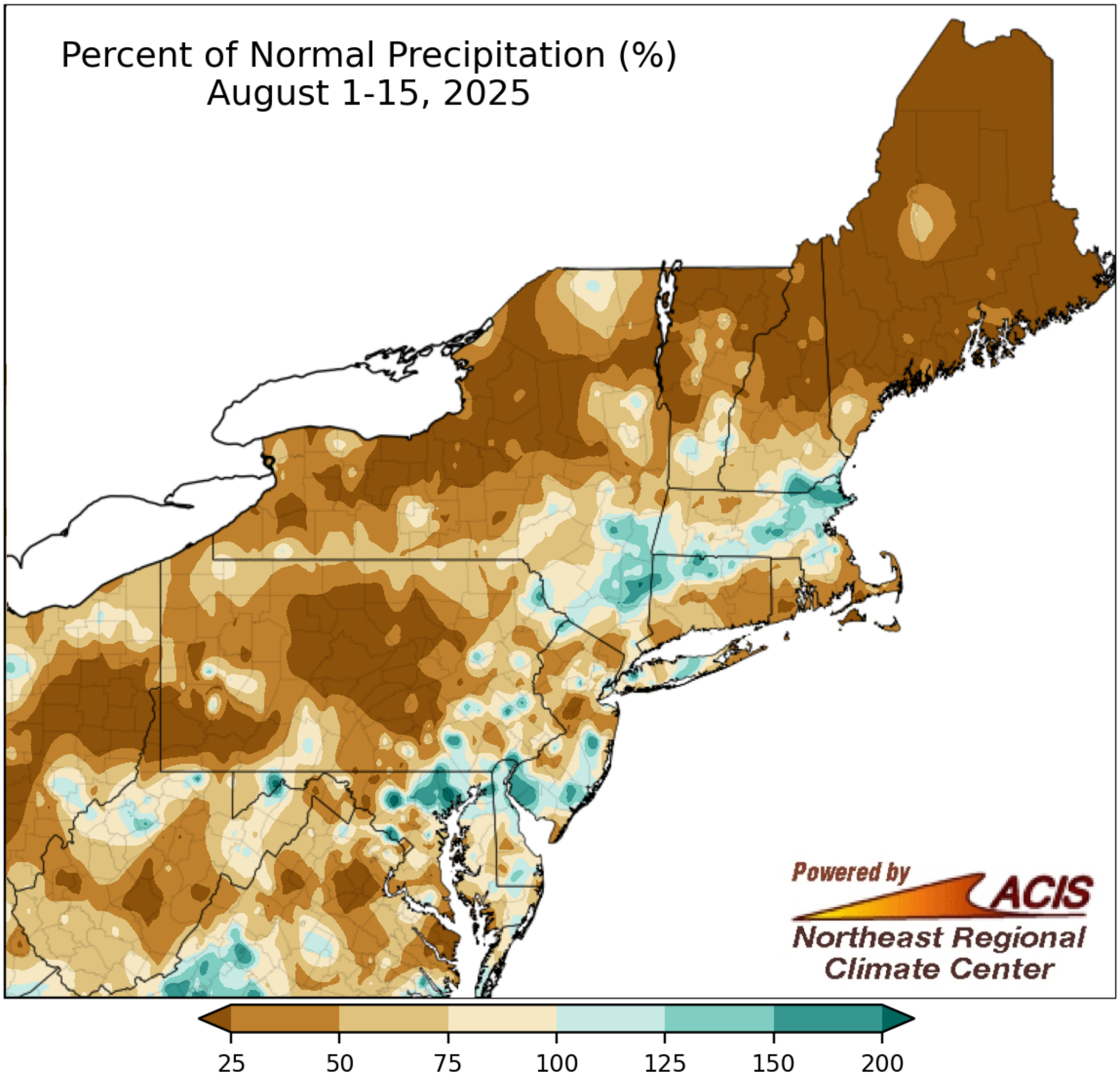
Weather

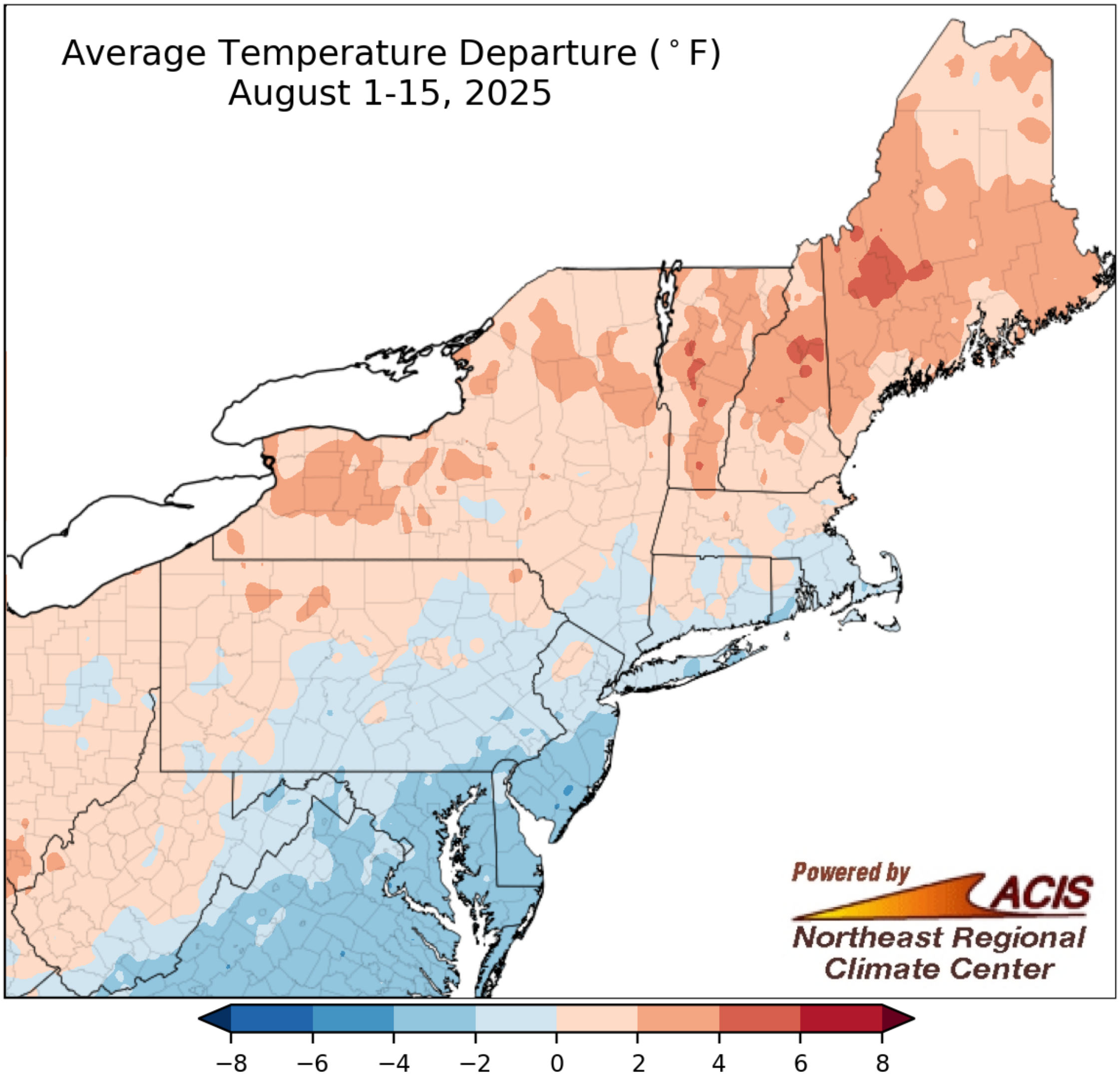
Precipitation and temperature are important factors to keep track of in order to determine the effects it will have on the environment. Increased precipitation has an impact on human safety such as increased flooding in vulnerable municipalities across the Northeast. Precipitation also decreases salinity in estuaries which effects sensitive organisms that use that environment as a nursery. However, decreased precipitation will lead to droughts and dryness which can negatively effect crops and increase the risk of forest fires especially with warmer temperatures. Besides forest fire risks, increased temperatures can also lead to stronger storms that will damage many coastal communities.

Bridgeport, CT experienced a cooler than normal first half of August with an average temperature of 71.5 °F, which is -1.2 °F below normal, ranking it their 15th coolest August 1-15 period on record. Similarly, Hartford, CT had an average temperature of 72.1 °F, which is -0.8 °F below normal, ranking this their 22nd coolest. Meanwhile in New York, Islip saw an average temperature of 73.8 °F, which is -0.5 °F below normal, ranking it their 28th coolest. LaGuardia Airport, NY had a slight decrease with an average of 78.2 °F, which is -1.0 °F below normal, ranking this August 1-15 their 12th coolest. However, like the others, JFK Airport, NY also saw a cooler period with an average of 78.9 °F, which is -0.9 °F below normal, ranking it their 18th coolest of all time. Overall, all stations had a decrease in temperature compared to normal for the first half of August.

Precipitation across these locations was notably low overall, contributing to drier conditions. In Bridgeport, CT, rainfall totaled 0.92 inches, which is 28% of normal (3.29 in), making this the 5th driest August 1-15 on record. Similarly, Hartford, CT received 1.45 inches of rain, which is 35% of normal (4.14 in), ranking it their 7th driest. New York stations showed a comparable dryness. In Islip, NY, it rained 1.78 inches, which is 53% of normal (3.35 in), ranking this their 14th driest period. LaGuardia Airport, NY had even less with 1.12 inches, which is 26% of normal (4.31 in), placing it among the 20 driest at 9th. JFK Airport, NY totaled 1.34 inches, which is 35% of normal (3.83 in), making this their 11th driest August 1-15. Overall, the monitored stations were predominantly dry, with all below 60% of normal precipitation.

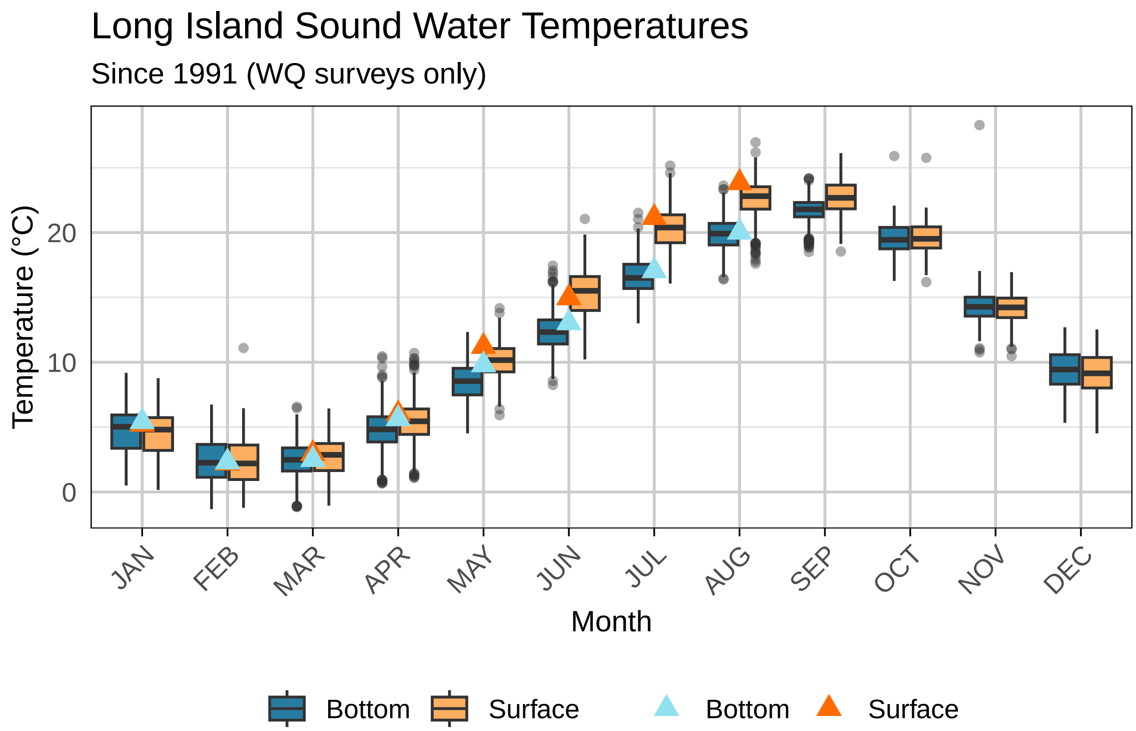
NRCC Graphics for August 16, 2025





Temperature

The graph below displays the range and median of the average monthly surface (orange boxes) and bottom (blue boxes) water temperature of Long Island Sound as recorded by CTDEEP during the year-round water quality surveys from 1991-present. The graph also displays the average temperature for the current survey (orange and blue triangles).



Delta T (ΔT) represents the difference between surface and bottom water temperatures. Variations in water temperature contribute to stratification, which in turn exacerbates hypoxic conditions. Typically, shallower coastal stations exhibit the smallest temperature differences due to their increased susceptibility to mixing, weather, and anthropogenic influences. The greater the Delta T, the higher the potential for severe hypoxia.

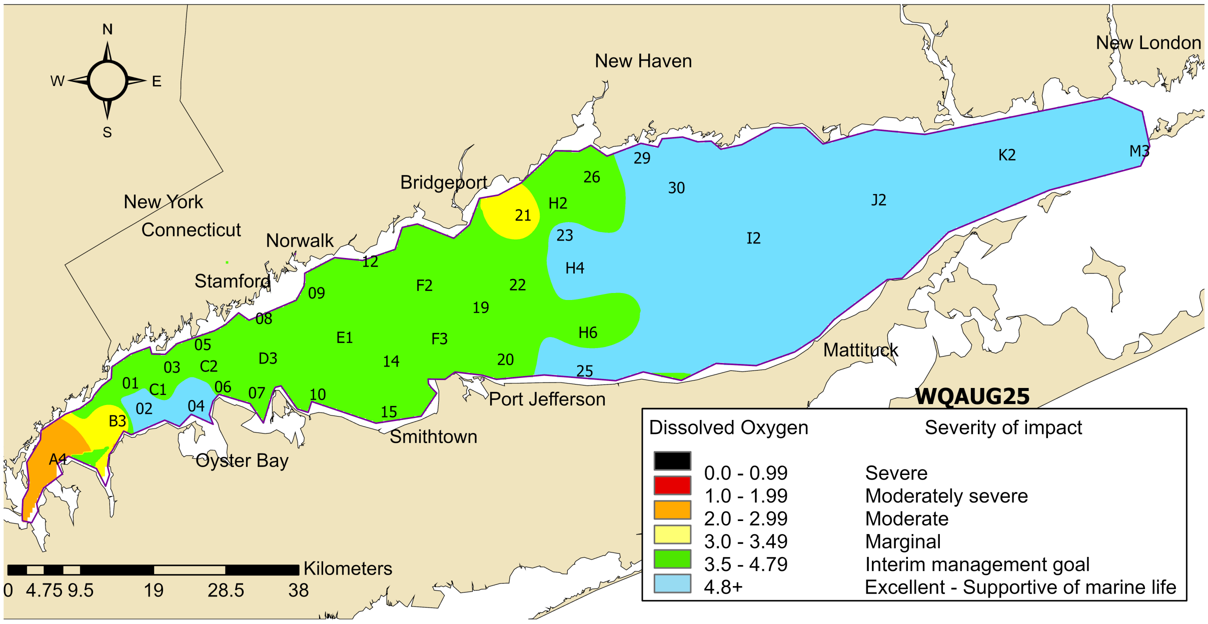
Overall, across the 17 stations analyzed, bottom temperatures showed a mild increase with an average change of +0.29°C. No stations showed bottom temperature changes reaching ±1°C, with the largest increases at I2 (+0.95°C) and H4 (+0.77°C). In contrast, surface temperatures experienced a decrease with an average change of -0.68°C, pointing to widespread cooling at the surface level with notable drops ocurring at 15 (-1.47°C), C1 (-1.28°C), E1 (-1.16°C), B3 (-1.11°C), D3 (-1.07°C), and F3 (-1.05°C).

Spatial Distribution of Bottom Water Dissolved Oxygen Levels

During the WQAUG25 survey, one station had DO concentrations below 3.0 mg/L, 2 stations had DO concentrations between 3.0 and 3.5 mg/L, and 23 stations had concentrations between 3.5 and 4.8 mg/L. Areal estimates are below:
47.5 km^2 (18.34 mi^2) below 3.0 mg/L
74.2 km^2 (28.65 mi^2) between 3.0 mg/L and 3.5 mg/L
1061.2 km^2 (409.73 mi^2) between 3.5 and 4.8 mg/

Dissolved Oxygen in Long Island Sound Bottom Waters

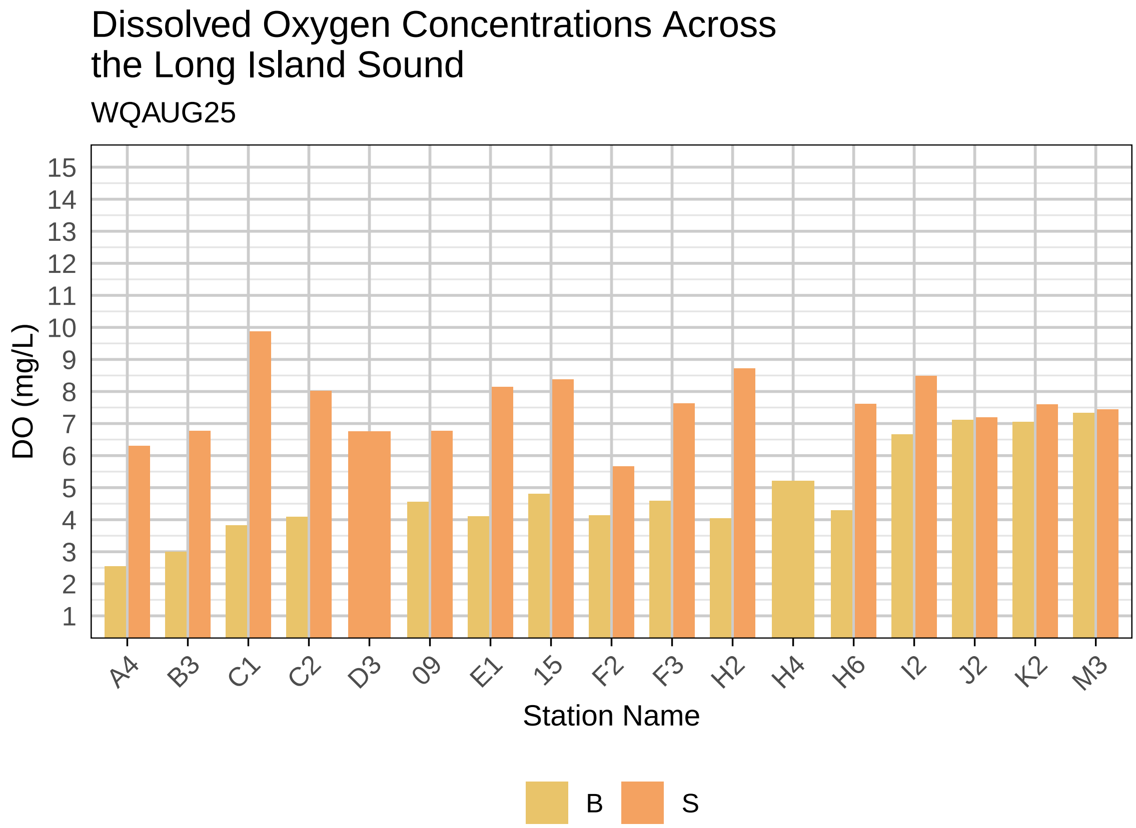
29 - 31 July 2025



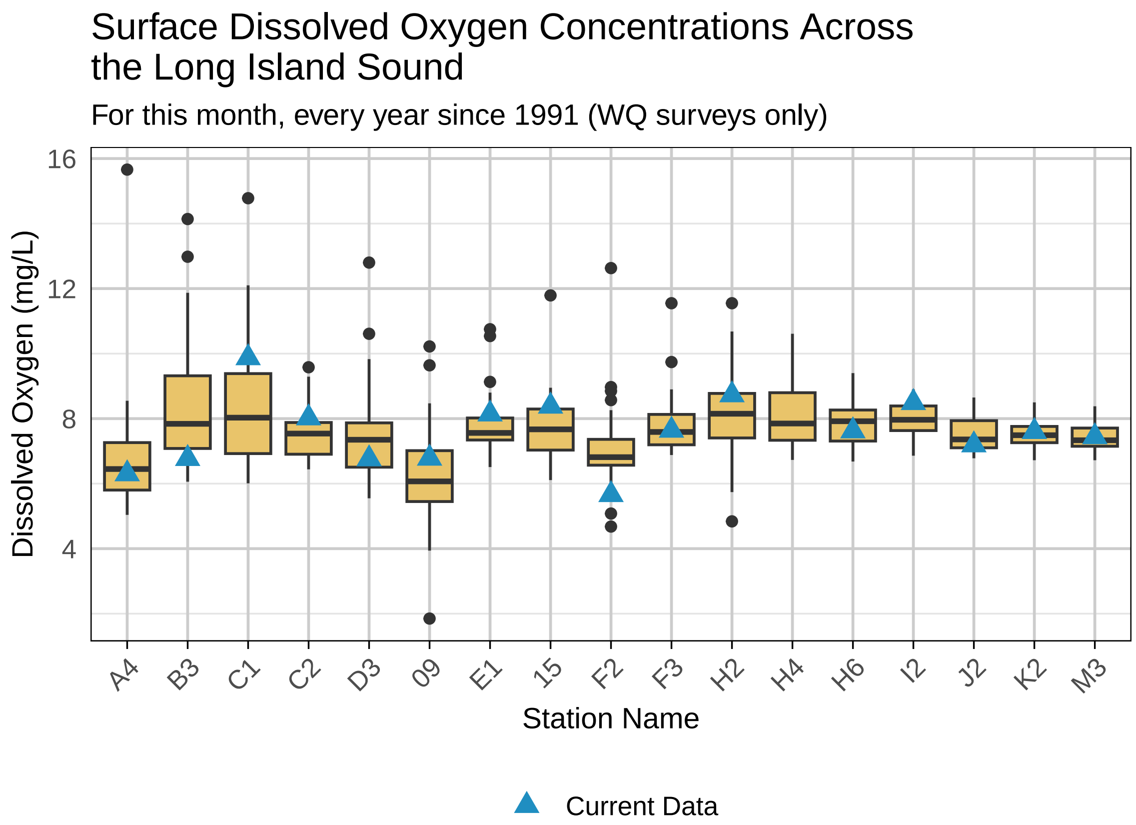
Dissolved Oxygen

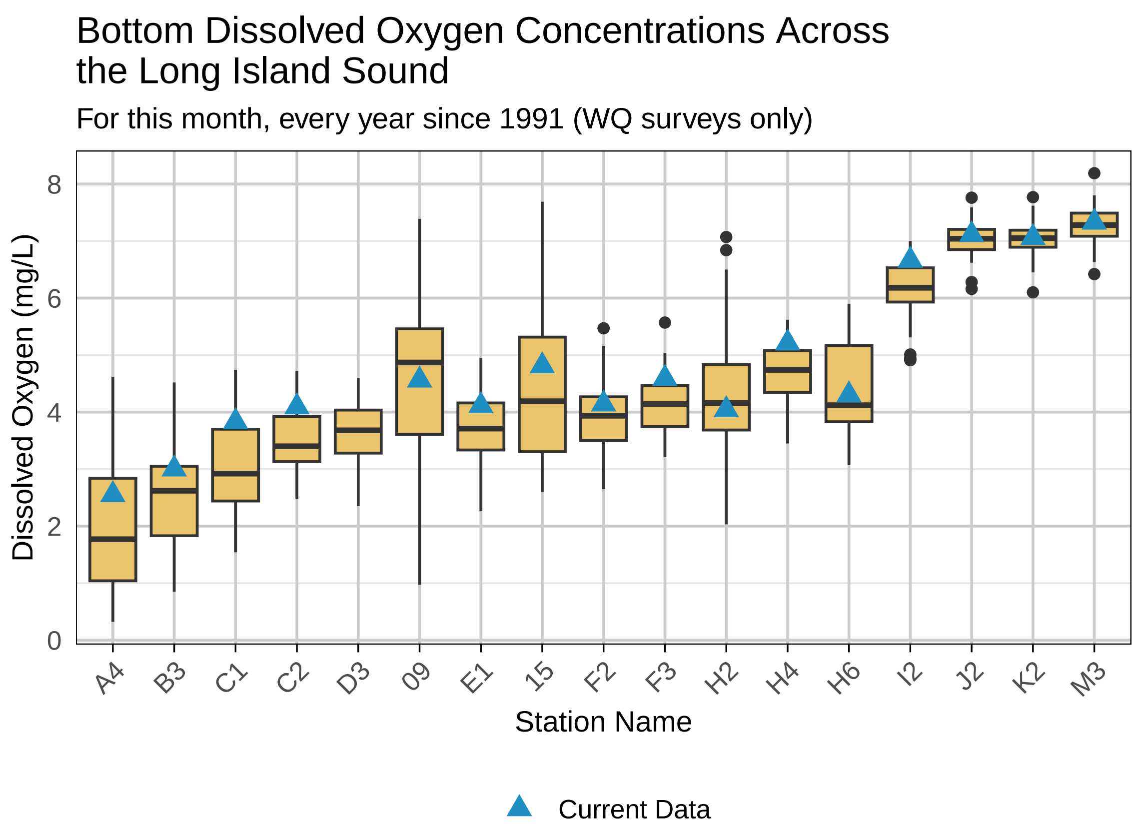
In the WQAUG25 survey, the average surface dissolved Oxygen (DO) concentration was 7.49 mg/L and the average bottom DO concentration was 4.53 mg/L. The highest surface DO concentration was 11.04 at Station 02, and the lowest surface DO was 5.04 at Station 08. The highest bottom DO concentration was 7.33 mg/L at Station M3 and the lowest bottom DO was 2.47 at Station A4.

Measured Dissolved Oxygen level across the Long Island Sound by station



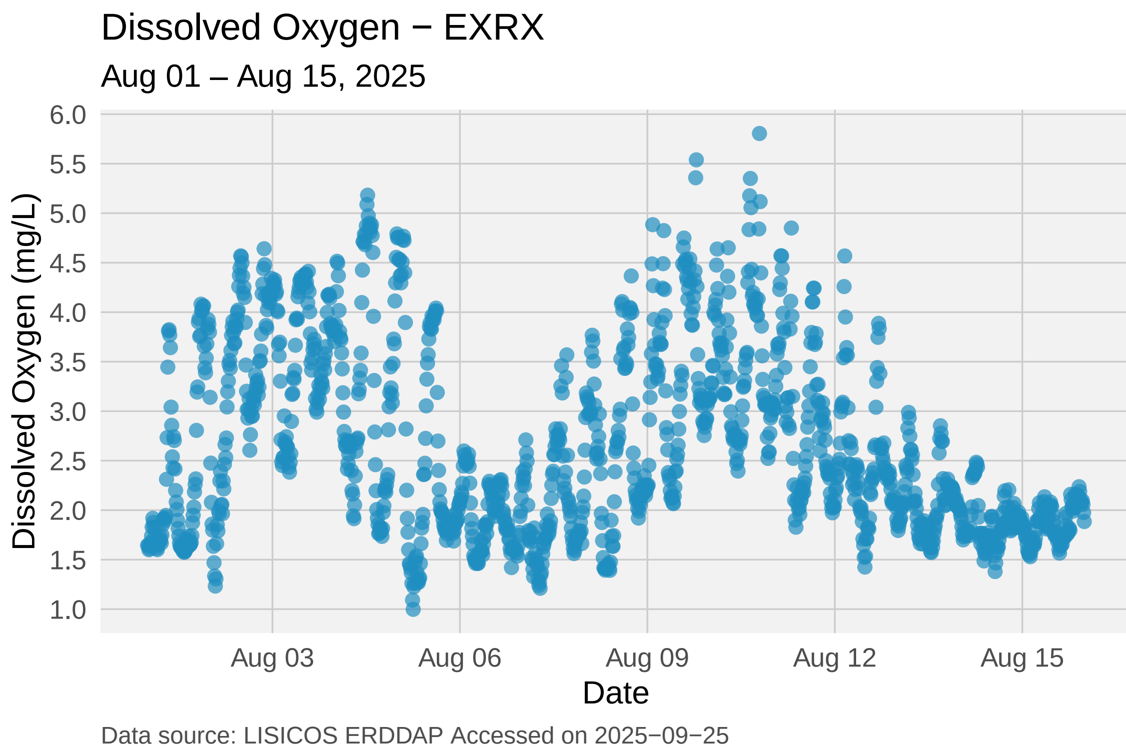
Comparing the average Long Island Sound DO values for each month since 1991





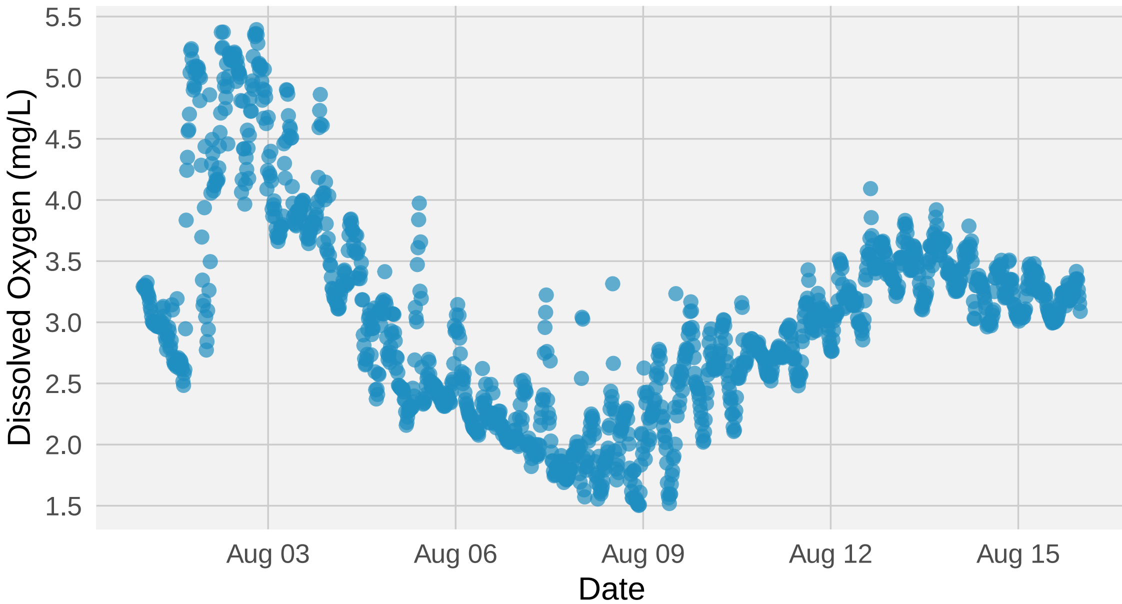
Recent Dissolved Oxygen Levels at EXRX, WLIS, and ARTG Stations

The Long Island Sound Integrated Coastal Ocean Observing System (LISICOS) collects and reports real-time continuous meteorological, water quality, and wave height data. The system is operated and maintained by the University of Connecticut with funding from the Long Island Sound Partnership and the Northeast Regional Association of Coastal Ocean Observing Systems (NERACOOS). The following graphs depict time series data from the LISICOS buoys (downloaded from the UCONN ERDDAP server) for the period surrounding the WQAUG25 survey.



Dissolved Oxygen − WLIS

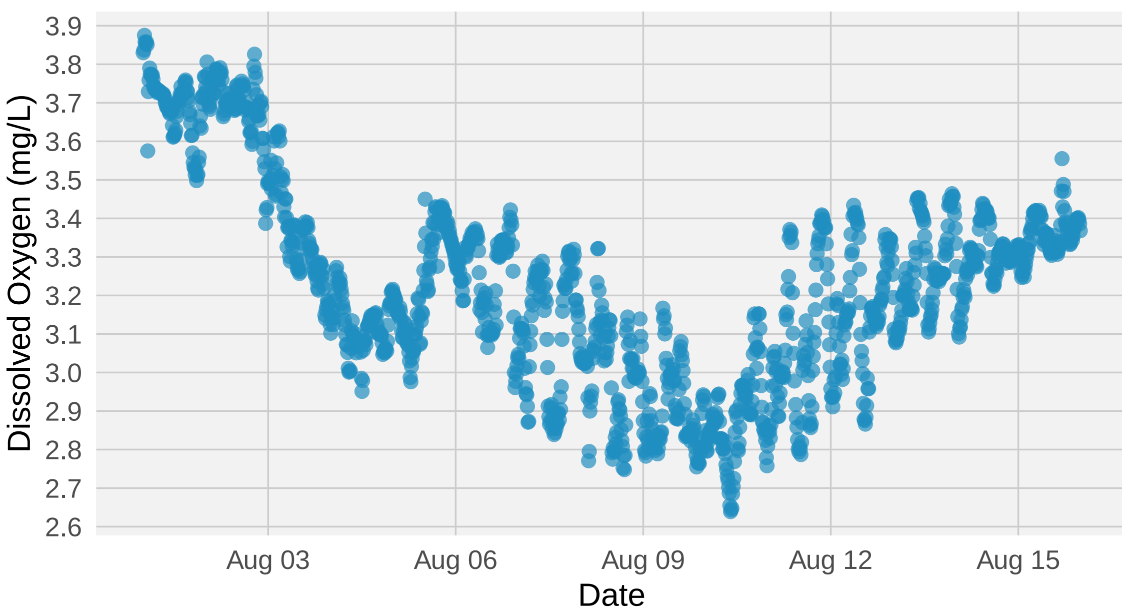
Aug 01 – Aug 15, 2025



Data source: LISICOS ERDDAP Accessed on 2025−09−25

Dissolved Oxygen − ARTG

Aug 01 – Aug 15, 2025



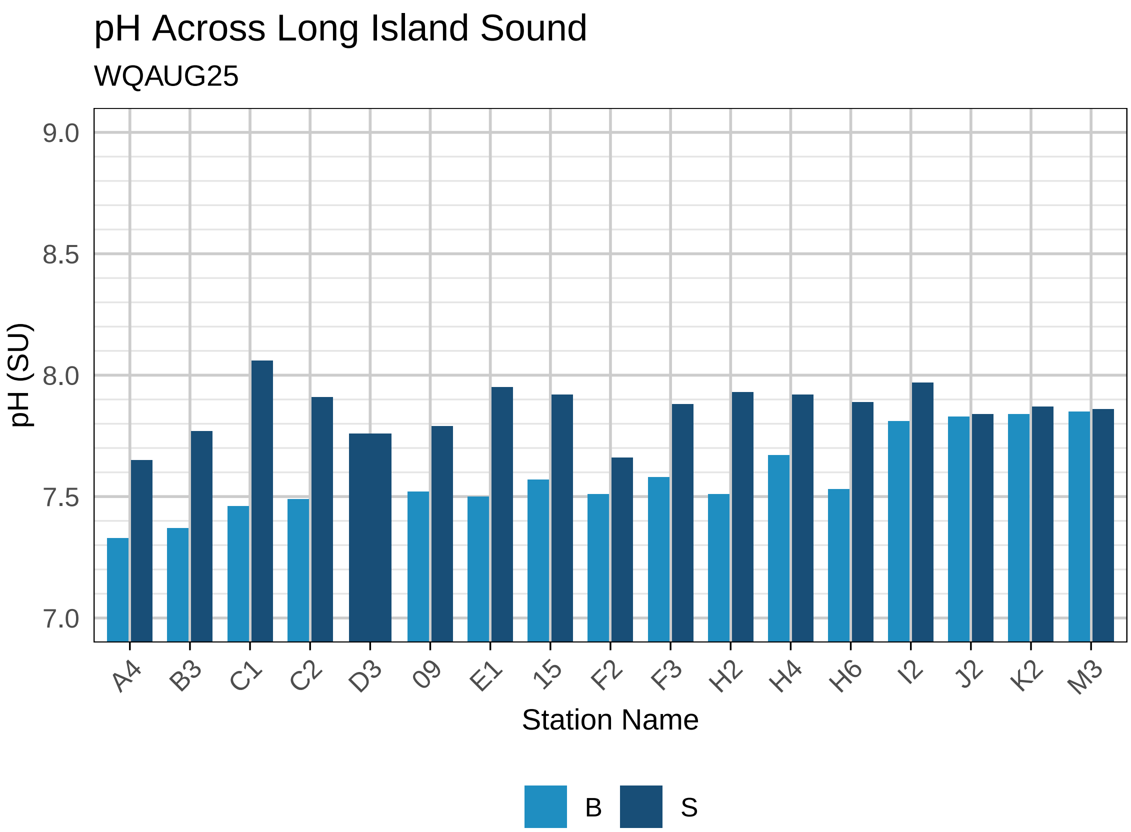
Data source: LISICOS ERDDAP Accessed on 2025−09−25

pH

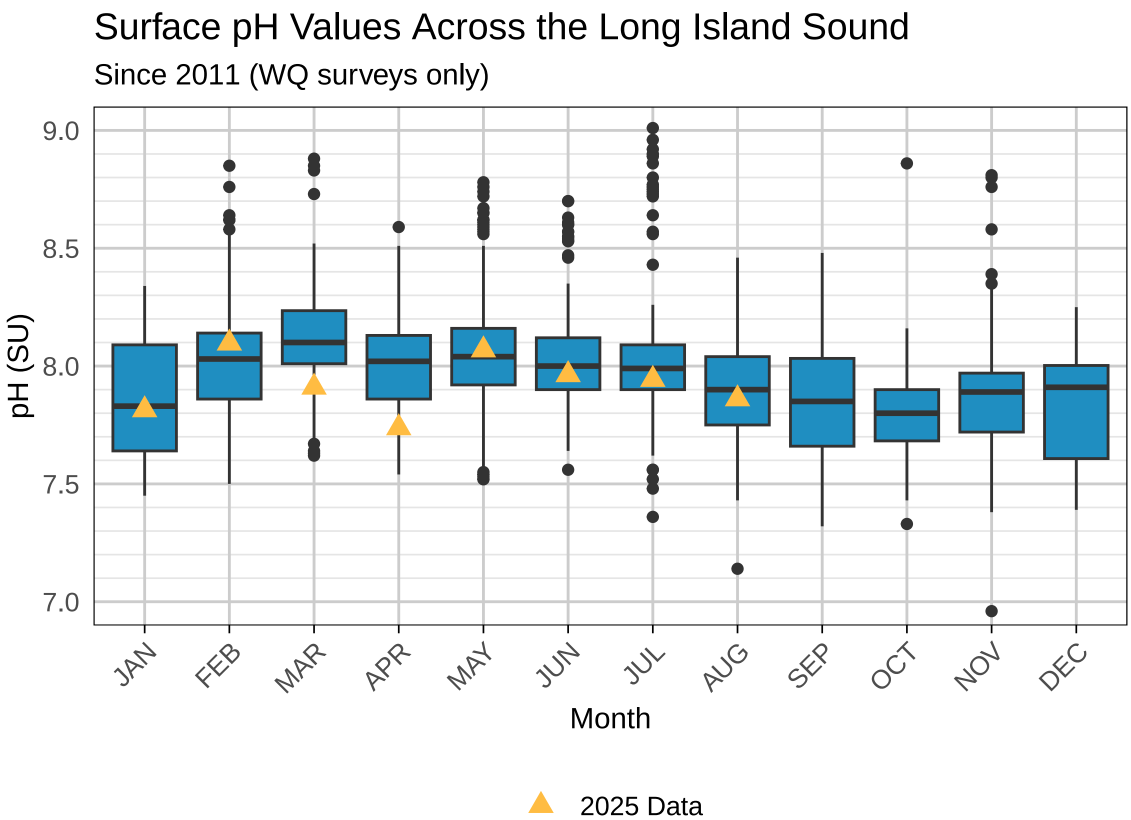
Ocean acidification has detrimental effects on marine life. Waters with a lower pH value, and therefore a greater acidity, have fewer carbonate ions. Calcifying species use available carbonate ions to produce their calcium carbonate shells. Therefore, ocean acidification harms the growth of calcifying species. This includes certain species of clams, oysters, and coral. Studies also show that increased ocean acidity can stunt the growth of many fish species.

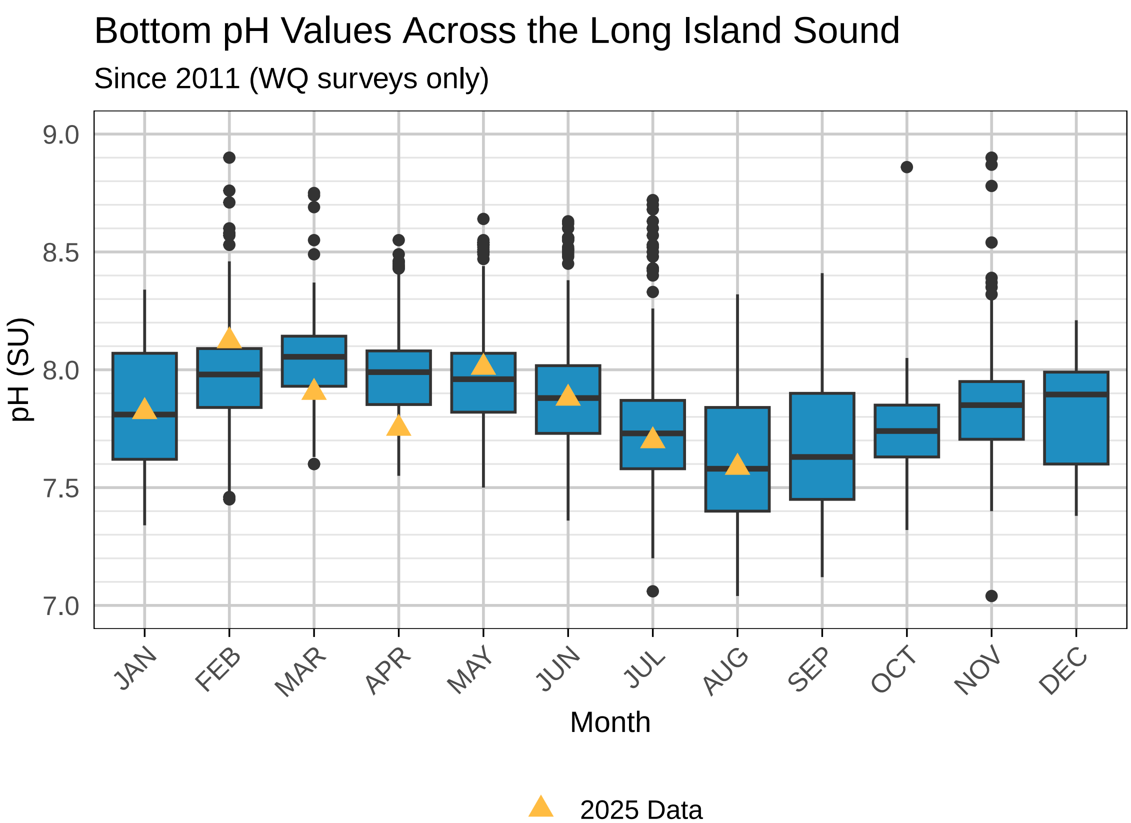
The average acidity of the ocean is around 8.1. This is a 0.06 decrease since 1985. However, the average pH of the Long Island Sound has been found to decrease by 0.04 each decade - a much more drastic change.[1]

The average surface and bottom pH from all stations across the LIS during the WQAUG25 survey were 7.86 and 7.59 respectively. The highest surface pH was 8.06 at Station C1, and the lowest surface pH was 7.65 at Station A4. The highest bottom pH was 7.85 at Station M3 and the lowest bottom pH was 7.33 at Station A4.



Comparing the average Long Island Sound pH values for each month since 2010





Salinity

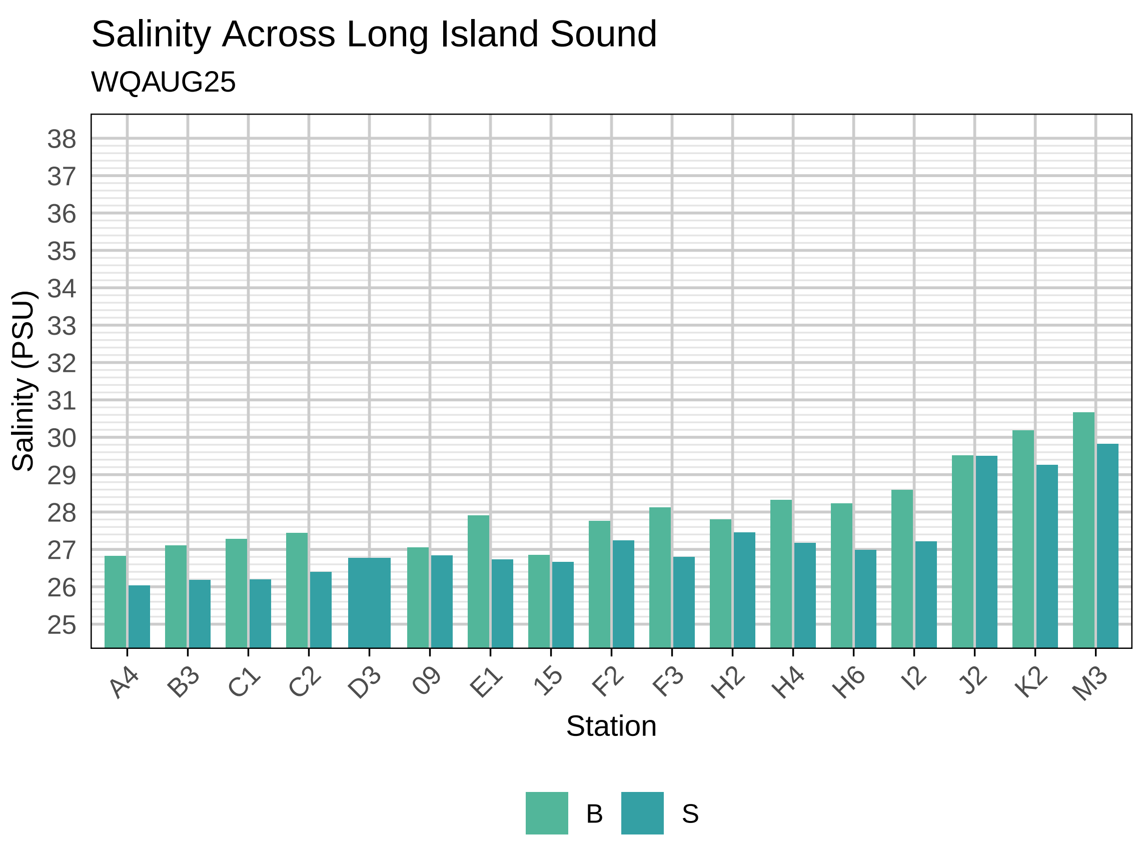
The Long Island Sound is an estuary, meaning its waters are a mix of both fresh and salt water. This is referred to as brackish water. The salt water is supplied by the Atlantic Ocean, while the majority of LIS fresh water comes from three major Connecticut Rivers: the Thames, the Connecticut, and the Housatonic - from east to west.[4] Estuaries are considered to be some of the most ecologically productive ecosystems on Earth.[4]

Many species rely on estuaries for breeding and nursing their young. Furthermore, many major marine species that spend most of their time in the ocean spend part of their life cycles within an estuary. This includes salmon, herring, and oysters.[3] The average salinity of the Long Island Sound is approximately 28 PSU, compared to the ocean, which has a higher average salinity of 35 PSU.

The average surface and bottom salinities from all stations across the LIS during the WQAUG25 survey were 27.25 PSU and 28.11 PSU respectively. The highest surface salinity was 29.83 PSU at Station M3, and the lowest surface salinity was 26.04 PSU at Station A4. The highest bottom salinity was 30.67 PSU at Station M3 and the lowest bottom salinity was 26.83 PSU at Station A4.

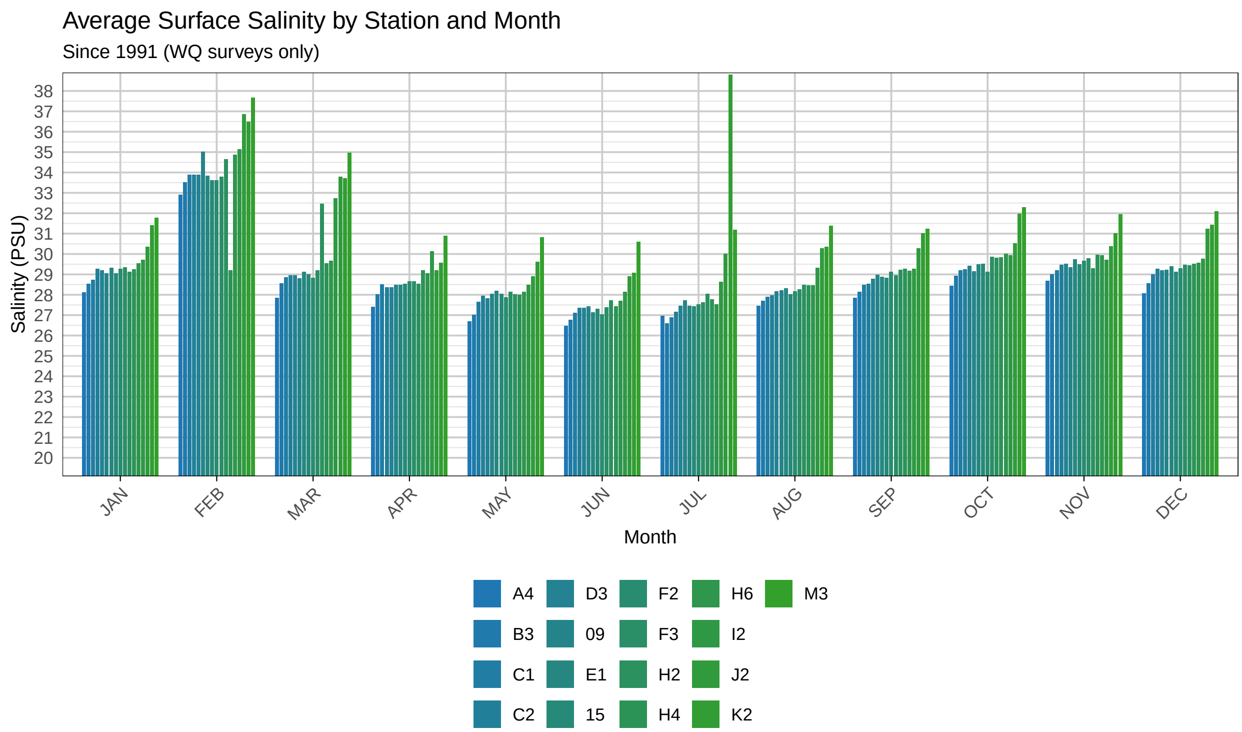
Average salinity across the Long Island Sound by station

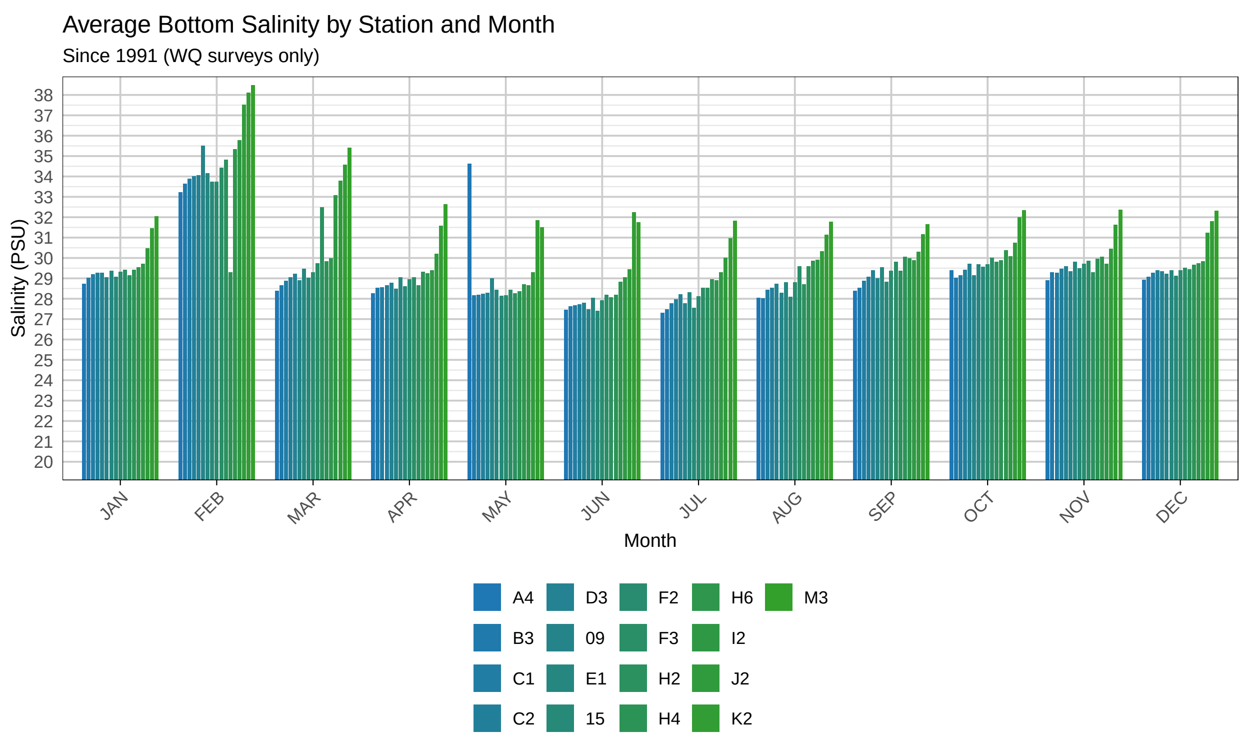
Eastern stations near the Atlantic Ocean tend to have higher salinities due to ocean exchange.



Changes in salinity throughout the year

Surface salinities generally decrease slightly from January through May due to snow melt and spring rains.



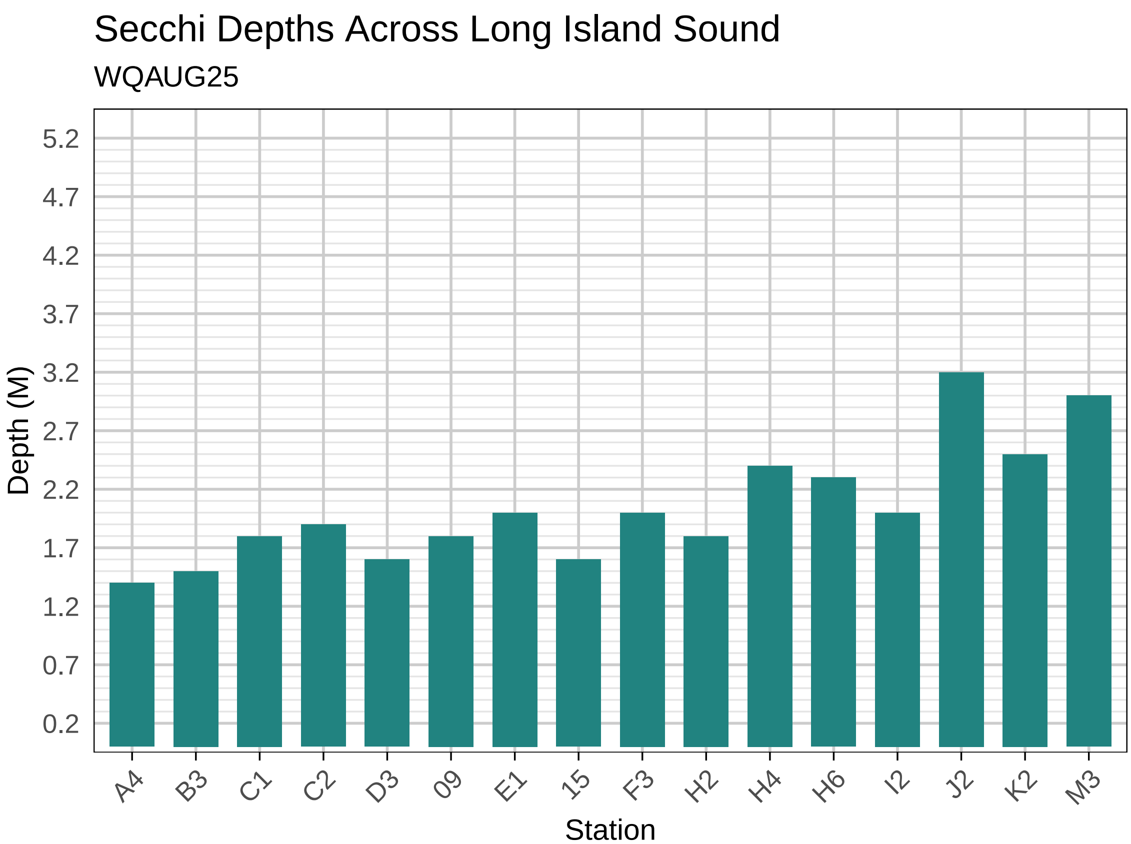


Secchi Disk Depth

Secchi disks are used to measure the transparency of a water body. They are lowered into the water until they are no longer visible to the observer. The depth of disappearance, also called the Secchi depth, is indicative of the water clarity.[5] Clarity is reduced as the presence of suspended solids, plankton, and organic matter increases.

The average secchi disk depth from all stations across the LIS during the WQAUG25 survey was 2 m. The greatest disk depth was 3.2 m at station J2. The lowest disk depth was 1.4 m at Station A4.

Secchi disk depths at different stations across the Long Island Sound



The Long Island Sound Report Card developed by Save the Sound through the LIS partnership utilizes the following thresholds:[2]

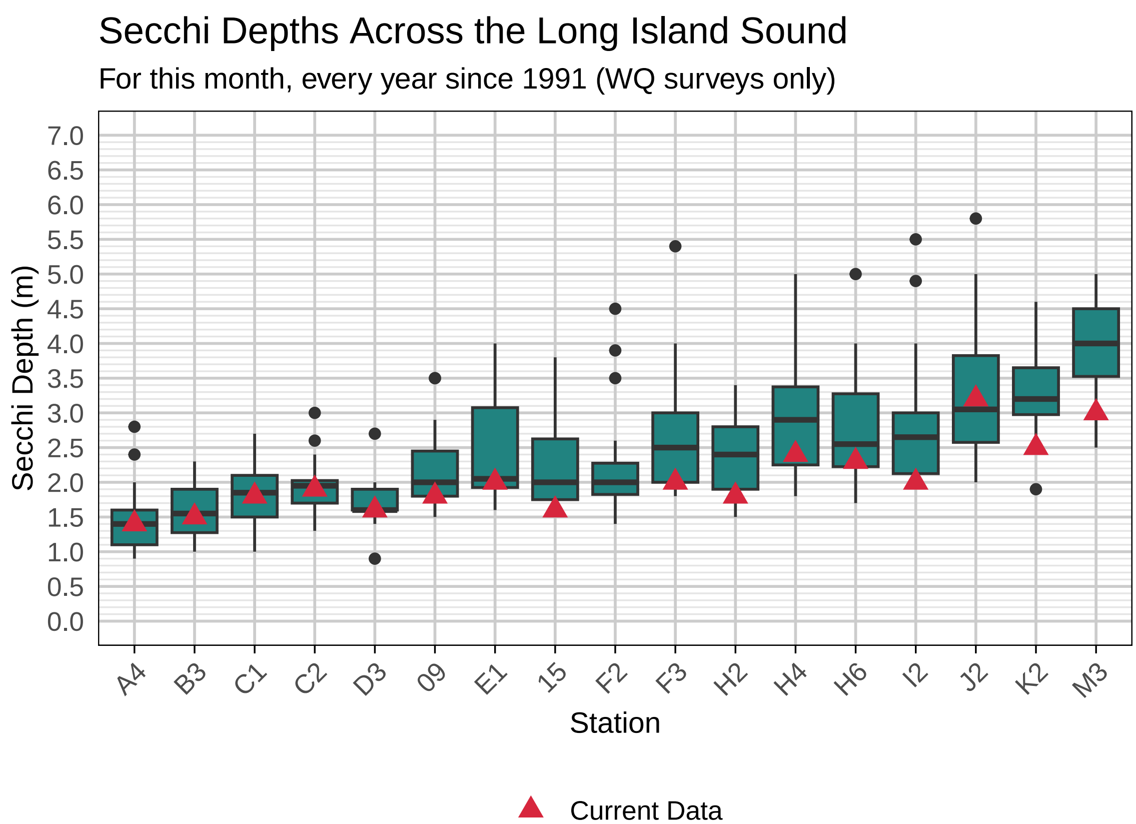
Secchi Depth Grading Thresholds

Grade	Depth Range (meters)	Score Equivalent
A	> 2.28	90–100%
B	2.12 – 2.28	80–90%
C	1.95 – 2.12	70–80%

Grade	Depth Range (meters)	Score Equivalent
D	1.80 – 1.95	60–70%
F	< 1.80	< 60%

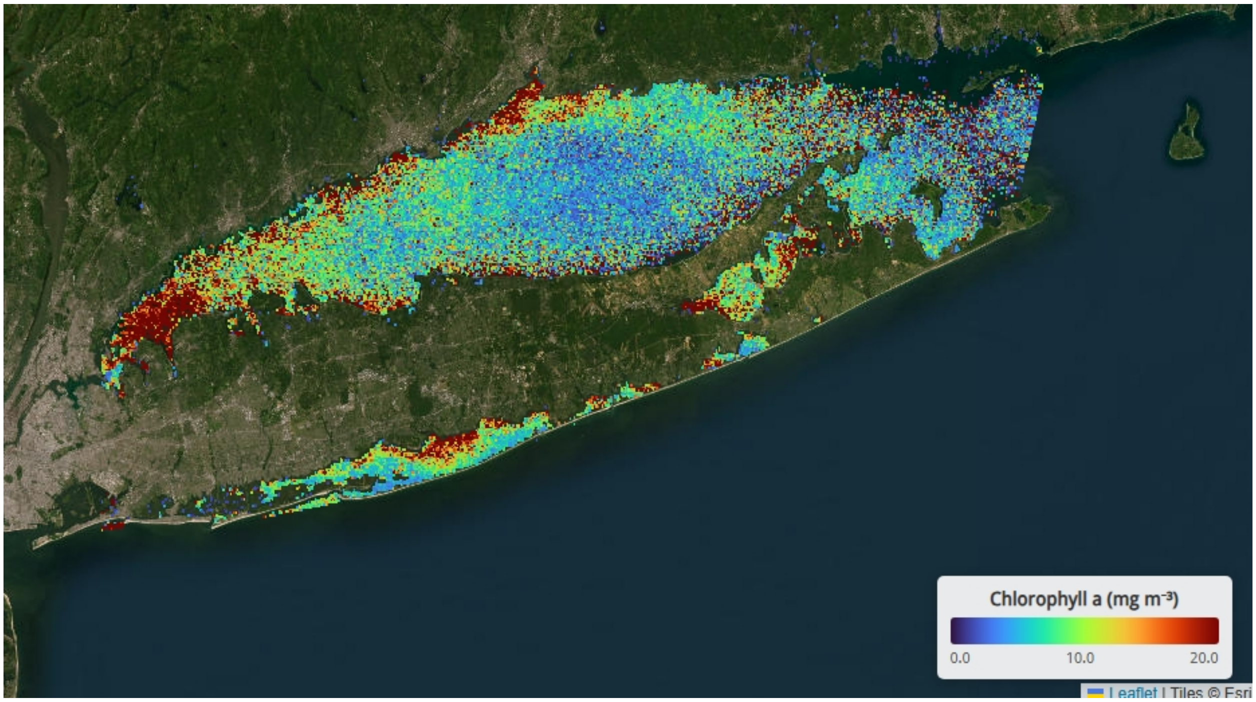
In the WQAUG25 survey, 5 stations received a grade of A, 3 stations received a grade of C, 1 station received a grade of D, 7 stations received a grade of F.

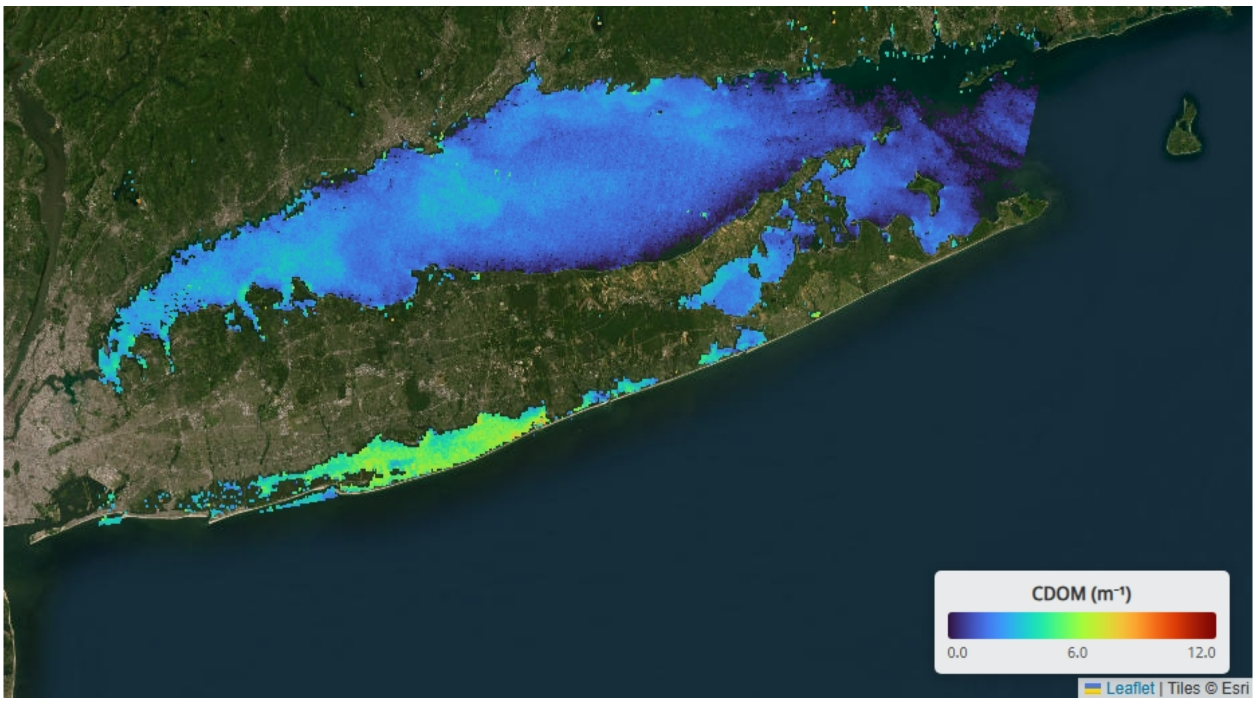
Looking at the change in Secchi depth since 2000

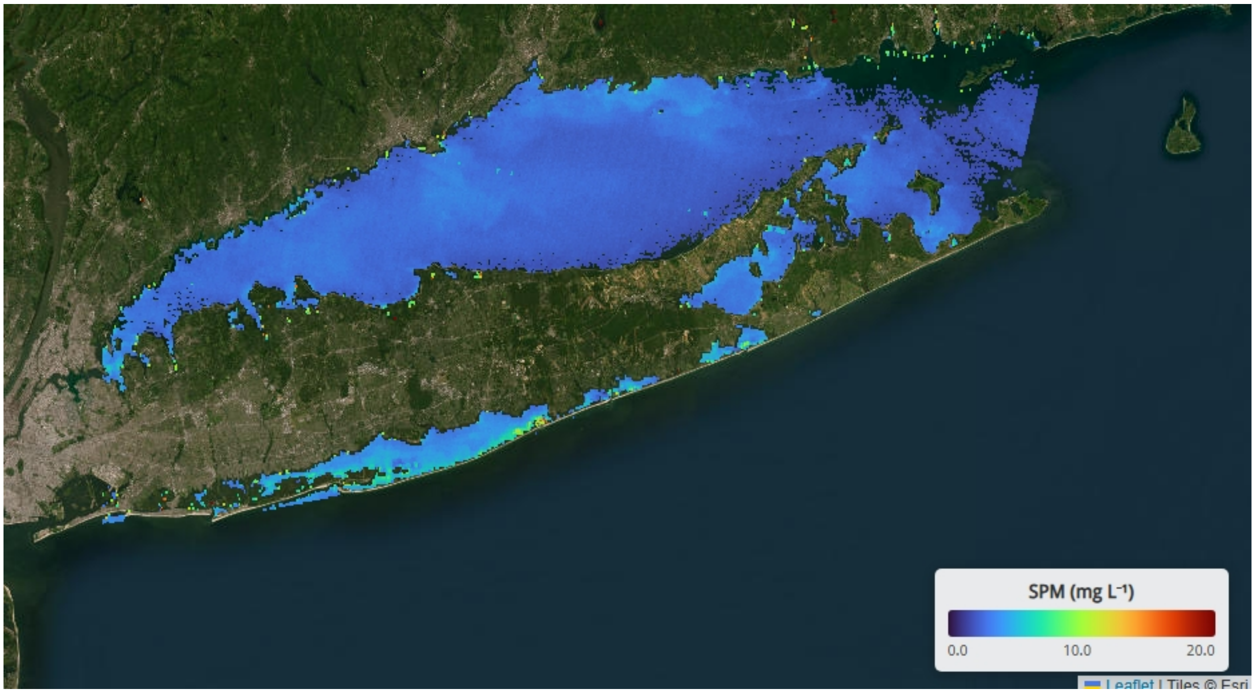


Remote sensing- CHLA, CDOM, SPM

The LIS Ocean Color Website curated by the Tzortziou Bio-optics Lab at the City University of New York displays Long Island Sound optimized chlorophyll (CHLA), colored dissolved organic matter (CDOM), and suspended particulate matter (SPM) remote sensing imagery. The images below were collected during the WQAUG survey and excerpted from the website. CHLA imagery provides a measure of plankton biomass. CDOM and SPM provide a measure of turbidity.


Chlorophyll a (mg m⁻³)
0.0
10.0
20.0
Leaflet | Tiles © Esri


CDOM (m⁻¹)
0.0
6.0
12.0
Leaflet | Tiles © Esri



For more information: Please visit the Long Island Sound Water Quality and Monitoring Program website at: https://portal.ct.gov/deep/water/lis-monitoring/lis-water-quality-and-hypoxia-monitoring-program-overview

Or contact us: Katie.Obrien-Clayton@ct.gov 79 Elm Street Hartford, CT 06106 (860) 424-3176

References

[1] "Climate Explained: Ocean Acidification." Save the Sound, Save the Sound, 30 Oct. 2023, www.savethesound.org/2023/10/23/climate-explained-ocean-acidification/.

[2] "Long Island Sound Report Card." Save the Sound, www.savethesound.org/report-card. Accessed 13 June 2025.

[3] "Life in an Estuary." National Ocean and Atmospheric Association, U.S. Department of Commerce, 25 Mar. 2025, www.noaa.gov/education/resource-collections/marine-life/life-in-estuary.

[4] Van Patten, Peg, et al. "Sound Facts." UConn.Edu, Connecticut Sea Grant, 2009, seagrant.uconn.edu/wp-content/uploads/sites/1985/2020/09/SoundFactsFinal.2009.pdf.

[5] "What Is a Secchi Disk?" The Robert Carlson Secchi Dip-In, North American Lake Management Society (NALMS), www.nalms.org/secchidipin/monitoring-methods/the-secchi-disk/what-is-a-secchi-disk/. Accessed 13 June 2025.