

GEOGRAPHY, HISTORY, AND HEALTH OF THE SOUND

GEOGRAPHY AND HYDROLOGY

Long Island Sound is an estuary, a body of water where salt water from the ocean mixes with fresh water from rivers draining from the land. It abounds in fish, shellfish, and waterfowl, and provides feeding, breeding, nesting, and nursery areas for diverse animal and plant life. The Sound is not a typical estuary, having two openings to the sea—at both its western (Hell Gate to the East River) and eastern (the Race to Block Island Sound) boundaries—and being oriented parallel to the coast. Long Island Sound extends 110 miles along its length and 21 miles across at its widest point. To assist in management and communication, four regions of the Sound have been identified—the Narrows, the Western Basin, Central Basin, and Eastern Basin (Figure 2). Mid-Sound depths range between 60 and 120 feet. Through the connection with the East River to the waters of New York-New Jersey Harbor, the Sound is affected by the

New York City metropolitan. For purposes of environmental management, the nearshore watershed of the Sound has been designated as the Long Island Sound Coastal Boundary Area (Figure 3). Through the series of south-flowing rivers, including the Housatonic, Connecticut, and Thames, large portions of New England also affect the Sound. In total, the Long Island Sound watershed (or drainage basin) drains an area of more than 16,000 square miles, covering

FIGURE 2. Long Island Sound Basins and Characteristics –

- A.** With its weaker currents and finer sediments, the Western Basin is more likely to trap pollutants.
- B.** The Central Basin is a transition zone between the two extremes.
- C.** The narrow channel and deep-bottom at the Race leads to fast moving currents that help to flush out pollutants.

(Map by Mapping Specialists and Lucy Reading-Ikkanda)

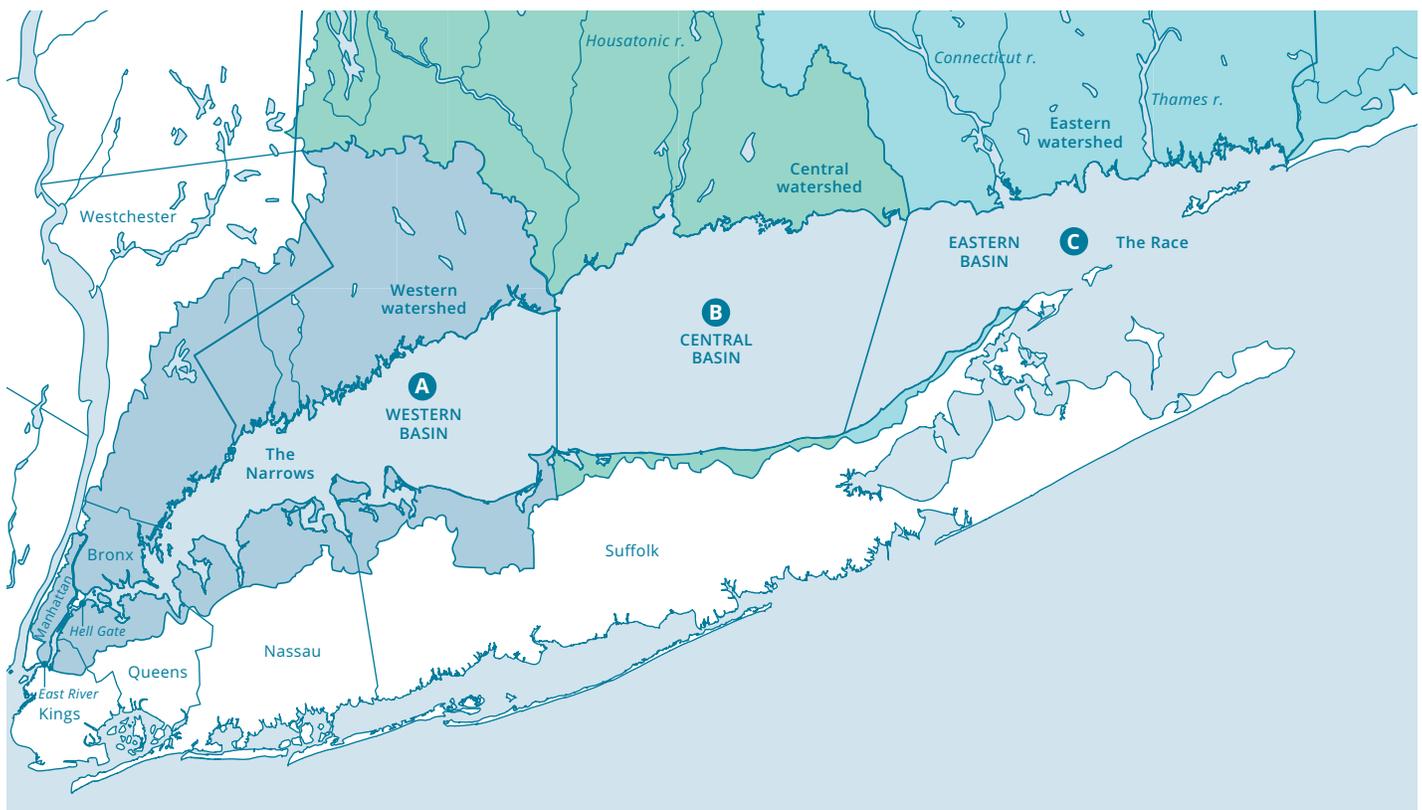
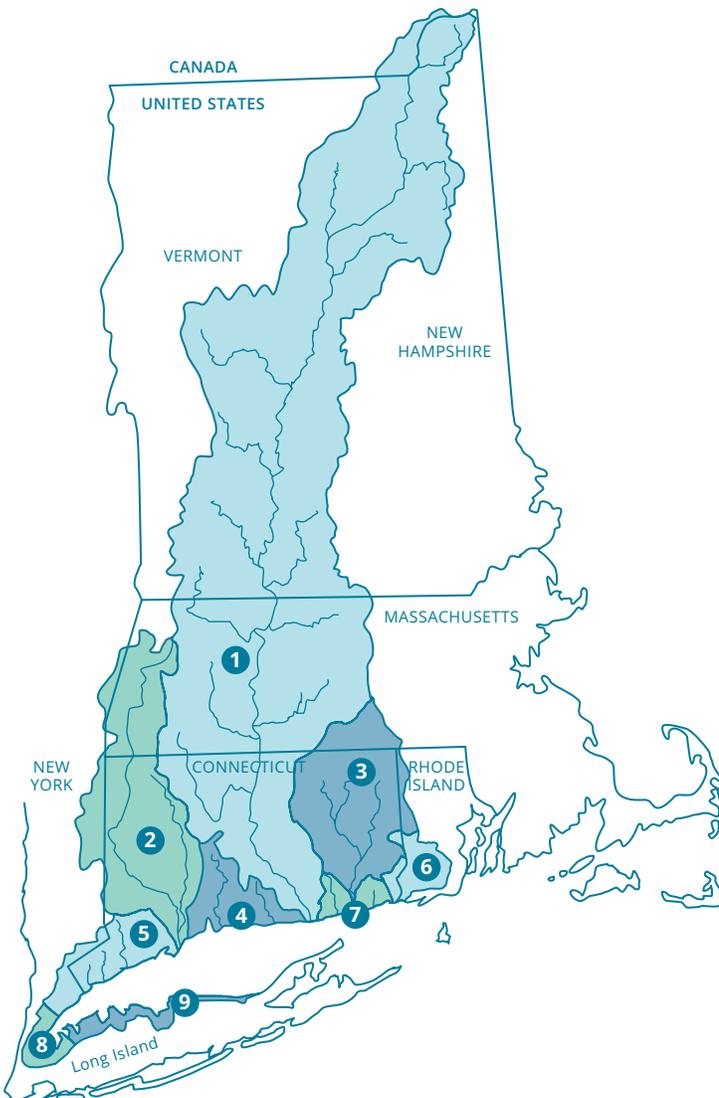




FIGURE 3. Long Island Sound Coastal Boundary Area
(Map Source: LISS)



virtually the entire state of Connecticut, portions of New York, Rhode Island, Massachusetts, Vermont, and New Hampshire as well as a small area at the source of the Connecticut River in Quebec (Figure 4).

The physical setting for Long Island Sound and its watershed has been shaped by climatic and geologic events through time. The collision of the large tectonic plates that made up ancient Pangaea dramatically shaped the region's landscape, creating a north-south oriented bedrock grain sculpted and eroded by wind and water, then scoured by multiple glaciations. Rivers formed from melting glaciers during their waning and retreat incised the rocky northern shoreline of Long Island Sound. This coastline is irregular and includes many coves and peninsulas. The Connecticut and Rhode Island coastlines are the longest stretch of low-energy, bedrock-dominated shoreline on the US Atlantic coast. In contrast, the south shore of Long Island Sound is formed largely from the coarse sediments deposited during glacial retreat. Long Island itself is a terminal moraine—a long ridge of sediment and rock pushed south by advancing glaciers and left behind during retreat. Within the recent geologic past, glacial meltwater formed the large freshwater lake known as Lake Connecticut, in the location now occupied by Long Island Sound. Large-scale watershed erosion brought massive amounts of sediment into the basin from the north. As the sea level rose with the melting of glaciers, marine waters flowed around Long Island and into the basin to form Long Island Sound.

The Sound has been in its present configuration for nearly 10,000 years. These geological and physical processes, together with the effects of increasingly dominant human activities since its European settlement in the early 1600s, have helped mold Long Island Sound into the "Urban Sea."

- FIGURE 4.** Land Area Draining to Long Island Sound –
1. Connecticut River
 2. Housatonic River
 3. Thames River
 4. South Central Coast
 5. Southwest Coast
 6. Pawcatuck River
 7. Southeast Coast
 8. New York City
 9. Long Island

(Map source: US Geological Survey)

HISTORY AND HEALTH

It is estimated that as many as 10,000 to 15,000 Native Americans lived on the shores of Long Island Sound prior to colonial exploration, thriving as hunters, fishermen, and farmers. Between 1612 and 1613, the Dutch merchant Adriaen Block became the first European to sail the length of Long Island Sound, helping to chart the Sound as he sailed (Figure 5). Block and his crew were searching for new commodities, particularly beaver pelts, for export to European markets. So began an intensified regional economy of natural resource exploitation. European settlers bought furs from local Native Americans, exploited oyster beds for food, and later dammed tributaries to power mills for industry (Andersen 2004).

From colonial times until the 1970s, many uses of Long Island Sound and the surrounding watershed were made without considering the environmental impacts. Overharvesting, habitat destruction, and pollution resulted in declines in fishery and wildlife resources. Diadromous fish populations suffered first, with Atlantic salmon and American shad runs becoming a tiny fraction of historic numbers along with declines in other herring species. Fishermen harvested menhaden intensively all along the Atlantic coast and exploited oyster reefs in the Sound with little thought of sustainability. Deforestation and industrialization resulted in the discharge of chemicals and deposition of sediments into the Sound. As the human population grew, sewage fouled waters and led to disease outbreaks.

Today, Long Island Sound lies in the midst of one of the most densely populated areas of the United States, with nearly 9 million people living in the watershed. Millions flock yearly to the Sound for recreation and the passive enjoyment of nature, and the Sound provides a critical transportation corridor for goods and people. Side-by-side these human uses, Long Island Sound continues to provide feeding, breeding, nesting, and nursery areas for diverse animal and plant life. The ability of the Sound to support these uses is dependent on the quality of its waters, habitats, and living resources.

Under the aegis of the 1994 CCMP, the LISS assessed conditions for each priority issue addressed. Technical support documents provided detail on each assessment. As recommended in the 1994 CCMP, LISS partners have continued to support and enhance data collection, management, analysis, and reporting on conditions. The LISS has regularly integrated this

information to characterize conditions in a series of reports entitled, *Sound Health: Status and Trends in the Health of Long Island Sound* (LISS 2012). The LISS also tracks and reports on more than 60 environmental indicators (LISS 2014) from diverse data sources to characterize conditions. The 2015 CCMP relies on the extensive documentation of conditions in Long Island Sound from these sources as well as the scientific synthesis book, *Long Island Sound: Prospects for the Urban Sea* (Latimer et al. 2014). A brief summary of conditions and how they vary along the length of the Sound is presented in the following paragraphs.

Today, Long Island Sound lies in the midst of one of the most densely populated areas of the United States, with nearly **9,000,000** people living in the watershed.

Overall, the densely populated and developed Western and Narrows basins are the most stressed, with fair water quality the majority of the time, and with sediment and turbidity conditions rated as poor for half of the basin area (EPA 2008). Coastal development has resulted in a 60 percent loss of tidal wetlands in the most developed portions of the basin (Rozsa 1995). Contaminant levels in sediments, while declining, remain high, reflecting the legacy of historical industrial discharges. Extensive development and high population density results in more pollutants flushed from hard surfaces, such as roads and parking lots, into storm drains that connect to the Sound. The higher population also contributes a higher volume of sewage to wastewater treatment facilities and septic systems, more polluted runoff from stormwater, and increased vehicle emissions that deposit air pollution into the Sound and onto its watershed area. Here and elsewhere, aged sewage infrastructure can “leak” pathogens, particularly during rain events, causing the closure of bathing beaches or shellfish beds.



FIGURE 5. A section of a map of New Netherland showing Long Island Sound, as charted by Adriaen Block in 1614. (From the American Geographical Society Library, University of Wisconsin-Milwaukee Libraries)

In contrast, the Eastern Basin water quality is good most of the time (NCA 2008), reflecting subwatersheds with much less coverage by hard surfaces, much higher tidal basin flushing rates, and stronger subsurface currents (Poppe and Polloni 1998). Sediment and benthic conditions also improve from west to east, but pockets of impaired sediment remain in industrialized harbors in the east. Prior to the implementation of current wetland regulations, coastal development resulted in a 25 to 35 percent loss of tidal wetlands. In addition, tidal marshes that were not filled or dredged were often ditched for mosquito control, which altered hydrology and modified the marsh plant and animal communities (Dreyer and Niering 1995).

As a transitional zone between the Western and Eastern Basins, the water and sediment quality in the Central Basin varies, but is also typically better than in the Western Basin. The Central Basin waters have moderate currents that deposit fine sediments in the broad basin. The water is more quickly flushed and the

surrounding land less developed than in the Western Basin, leading to improved water quality. Scientists consider the Central Basin as a harbinger of change in the Sound; it may either tend toward degradation or improvement depending upon human interventions.

Levels of contaminants in the water, sediments, and wildlife have declined over time. Nitrogen pollution is declining. By the end of 2014, wastewater treatment facilities achieved 94 percent of the nitrogen reduction goal established in the 2000 Dissolved Oxygen Total Maximum Daily Load (TMDL), which means 108,000 fewer pounds of nitrogen were discharged into the Sound every day. Eelgrass (*Zostera marina*), a rooted underwater plant with ribbon-like strands that forms meadows ecologically important for fish and shellfish, increased by 4.5 percent between 2009 and 2012, and 29 percent between 2002 and 2012 (Tiner et al. 2013). Additional actions to control nitrogen runoff from streets, landscaping, and farms, along with further wastewater treatment facility (WWTF) upgrades, are underway to reach defined reduction goals by 2017, with further improvements to water quality expected.

Since 1984, the overall biomass of finfish in the Sound has been relatively stable, in part due to cooperative federal-state fishery management programs and regulations beyond the purview of the LISS. However, cold-adapted species (such as winter flounder and Atlantic herring) have declined in abundance, particularly in spring, while warm-adapted species (such as black sea bass, butterfish, and summer flounder) have increased (Howell and Auster 2012). These changes are most likely due to steadily increasing water temperatures. Oyster populations are susceptible to old and new disease outbreaks, stimulated by warmer waters. Likewise, the die-off of lobsters in 1999 and the recent increase in the population of blue crabs can be attributed in part to warming waters (Pearce and Balcom 2005).

These findings indicate a Long Island Sound cleaner and healthier, but still impaired from pollution and habitat loss. Further improving the quality of Long Island Sound requires both addressing ongoing challenges and adapting to new conditions—already being felt—from climate change.