



Long Island Sound Study

A Partnership to Restore and Protect the Sound

Returning the Urban Sea to Abundance:

A five-year review of the 2015 Comprehensive Conservation and Management Plan

December 2020

Acronyms

CAC: Citizens Advisory Committee

CCMP: Comprehensive Conservation and Management Plan

CIRCA: Connecticut Institute for Resilience and Climate Adaptation

CSC: Climate Smart Communities

CTDEEP: Connecticut Department of Energy and Environmental Protection

EPA: US Environmental Protection Agency

GIS: Geographic Information System

IA: Implementation Actions

LISFF: Long Island Sound Futures Fund

LISS: Long Island Sound Study

NFWF: National Fish and Wildlife Foundation

NYCDEP: New York City Department of Environmental Protection

NYSDEC: New York State Department of Environmental Conservation

STAC: Science and Technical Advisory Committee

STS: Save the Sound

TMDL: Total Maximum Daily Load

URI: Urban Resources Initiative

USFWS: US Fish and Wildlife Service

UWS: Unified Water Study

Yale FES: Yale School of Forestry and Environmental Studies

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Credits

Cover: Jennifer H. Mattei, Stratford Point Living Shoreline

p3 (below): Black-bellied plovers on reef balls, Scott Kruitbosch

p5: CCMP cover, LISS/NEIWPCC

p08: Bronx River Alliance staff, Steven DeWitt; Kelp, SoundWaters

p09: GreenSkills job crew, Urban Resources Initiative

p12: Planting saltmarsh grasses, Save the Sound; Forest, CTDEEP

p13: Fishway, Anthony Allen, Save the Sound

p16: Pavement, Town of Mamaroneck; WildLife Guards, Scott Kruitbosch

p17: Summer camp students, Judy Benson

p18: The integrated model framework, HDR

p20: Striped sea robin, Ivar Babb/LISMARC Research Team
(UConn, U of New Haven, USGS), LISS, CTDEEP

p20: Wastewater treatment system, TNC; Schoolyard Habitats, Audubon CT;
Youth restoring tidal wetlands, Joaquin Cotten, Rocking the Boat

p21: Saltmarsh grass research, Dr. Beth Lawrence/UConn

Inside back cover: Humpback whale, Hannah Doyle



Concrete reef balls installed along Stratford Point, CT absorb and disperse waves, reducing shoreline erosion, which has helped newly planted saltmarsh grasses grow and thrive (see cover). This living shoreline project led by Sacred Heart University received the 2020 Best Restored Shore Award by the American Shore and Beach Preservation Association.

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Introduction

Report Purpose

Returning the Urban Sea to Abundance summarizes the progress made from 2015-2019 in restoring the health of Long Island Sound. It provides an assessment of the first five years of action by the Long Island Sound Study (LISS) under the 2015 Comprehensive Conservation and Management Plan (CCMP), which established general goals and measurable targets to restore the health of the Sound by 2035. This report is part of the LISS's program to apply leading practices for performance assessment and reporting. Insights from this assessment are being used to update the CCMP with a new five-year action plan covering the years 2020-2024.

History of the Program

In 1987, Congress created the National Estuary Program through amendments to the Clean Water Act. The US Environmental Protection Agency (EPA) designated the Long Island Sound as an "Estuary of National Significance" in 1988 and joined with the states of Connecticut (CT) and New York (NY) to form the LISS

Management Conference, a partnership of federal, interstate, state, and local agencies, industry, community groups, and the public. In 1990, Congress amended the Clean Water Act again, passing the Long Island Sound Improvement Act, which established an EPA Long Island Sound Program Office and further strengthened EPA's role in coordinating implementation strategies through cross-jurisdictional partnerships.

The LISS Management Conference coordinates science and management activities to protect and restore the Sound, an estuary impaired by decades of pollution and habitat loss. Unlike traditional regulatory approaches to environmental protection, the LISS Management Conference works to address a broad range of issues and encourages coordinated solutions through public-private partnerships.

Comprehensive Conservation and Management Plan

Guided by early research, the LISS released its first CCMP in 1994. The plan prioritized the problem of low

What is the Long Island Sound Management Conference?

The Long Island Sound Management Conference refers to the organizational partnership working to protect and restore the Sound. It is structured around multiple committees and work groups, and is coordinated by a program office. The Policy Committee, comprised of the administrators of the EPA Region 1 and Region 2 offices and the commissioners of the Connecticut Department of Energy and Environmental Protection (CTDEEP) and the New York State Department of Environmental Conservation (NYSDEC), approves major policy initiatives and plans such as the CCMP. The Management Committee meets quarterly to develop annual work plans and budgets, plan and oversee projects, and assess progress and challenges. This Management Committee is comprised of representatives of the relevant federal, state, and interstate environmental agencies and organizations, and the co-chairs of the two advisory committees—the Science and Technical Advisory Committee (STAC) and the Citizens Advisory Committee (CAC). The Management Conference also includes technical work groups such as the Habitat Restoration and Stewardship Work Group and the Water Quality Monitoring Work Group.

concentrations of dissolved oxygen, or hypoxia, which threatens the health of fish populations and other aquatic life. Overall, the plan laid out initiatives to improve water quality, restore coastal habitats, including wetlands and underwater vegetation, protect existing

natural areas, and educate and involve the public. Cooperating LISS partners translated the plan, year-by-year, into actions that resulted in a Long Island Sound with cleaner water, healthier habitats, and a more aware and engaged public. Despite the progress, many

challenges persisted and new issues emerged, such as the need for increased habitat and coastal community resilience to a changing climate.

To respond to new priorities and incorporate scientific and technological advances, the LISS completed a major revision of the CCMP in 2015. The CCMP



The 2015 Comprehensive Conservation and Management Plan.

set 20 ecosystem targets and associated numerical indicators to measure the health of Long Island Sound. Ecosystem targets incorporate environmental data and performance objectives to help inform decisions and track progress toward restoration and management goals. The 2015 CCMP also included 139 specific Implementation Actions (IAs) to support identified objectives and outcomes and to help achieve the ecosystem targets and overall goals. These actions are organized around four major themes: *Clean Waters and Healthy Watersheds, Thriving Habitats and Abundant Wildlife, Sustainable and Resilient Communities, and Sound Science and Inclusive Management*. Throughout the four themes, the CCMP incorporates integrative principles that have emerged as key challenges and environmental priorities. These include resiliency to climate change, long-term sustainability, and environmental justice.

The CCMP calls for the LISS Management Conference to review and report on implementation progress every five years and to use that analysis in updating actions.

"The vision for the Sound is of waters that are clean, clear, safe to swim in, and charged with life. It is a vision of waters nourished and protected by extensive coastal wetlands, by publicly accessible, litter-free beaches and preserves, and of undeveloped islands. It is a vision of abundant and diverse wildlife, of flourishing commercial fisheries, of harbors accessible to the boating community, and of a regional consciousness and a way of life that protects and sustains the ecosystem."

— Vision statement from the 2015 Comprehensive Conservation and Management Plan

This report is organized by the four CCMP themes. For each theme, we assess overall progress made in implementing actions and characterize attainment of related ecosystem targets. Success stories highlight projects that illustrate what can be achieved through successful partnerships. We conclude with a description of the challenges and opportunities for implementation over the next five years to meet the long-term vision of a restored and healthy Sound.

Additional detail and supporting material used for this evaluation report

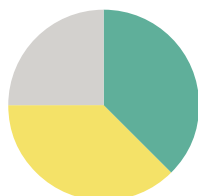
can be found at longislandsoundstudy.net. The website provides detail on each of the 20 ecosystem targets – their status and trends, challenges in making progress, data sources, and importance. Also available is an assessment of progress for each of the 139 IAs, along with recommendations for continuing efforts. In total, this report and its supporting material comprise the LISS's effort to apply leading practices for performance assessment and reporting to drive continued improvements in the quality of Long Island Sound.

Clean Waters & Healthy Watersheds

Goal: Improve water quality by reducing contaminant and nutrient loads from the land and the waters impacting Long Island Sound.

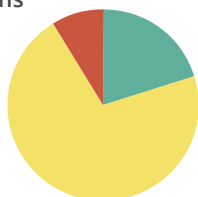
Progress made on Ecosystem Targets

- On track/ahead of schedule (38%)
- Behind schedule (38%)
- Data unavailable (25%)



Progress made on Implementation Actions

- Complete/significant progress (20%)
- Progress (71%)
- No progress (9%)



Ecosystem Target Progress

Achievement of the targets for reducing nitrogen pollution from wastewater treatment plants and for reducing the area of waters with unhealthy levels of dissolved oxygen are major accomplishments.

In 2019, the annual discharge of nitrogen was 42 million pounds lower than the Long Island Sound Total Maximum Daily Load (TMDL) baseline (the amount discharged in the early 1990s). This remarkable achievement was a result of all 106 NY and CT wastewater treatment plants discharging to the Sound meeting the reductions set in the TMDL by 2017.

Water quality benefits of decreased nitrogen pollution include reduced occurrence and area of hypoxia (low

dissolved oxygen). **In 2019, the five-year rolling average for the maximum summertime area of hypoxia was 89 square miles, a 57 percent decline compared to the pre-2000 average of 205 square miles.** The ecosystem target to reduce the extent of hypoxia is currently well ahead of schedule.

While nitrogen pollution has been greatly reduced, improved practices on land are still needed to achieve healthy water quality. One ecosystem target requiring additional focus is increasing the area of natural vegetation within 300 feet of any stream or lake in the Sound watershed to 75 percent by 2035. Out of the seven ecosystem targets, 38 percent are on track or ahead of schedule, 38 percent are behind schedule, and 25 percent do not have data available to support an assessment.

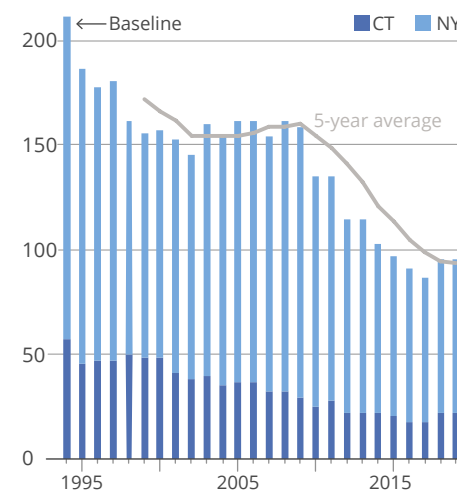
Implementation Action Progress

The Clean Waters and Healthy Watersheds theme had 34 IAs for 2015-2019. Progress has been made in 91 percent of the IAs. Twenty percent of the IAs were completed or had significant progress, which addressed two major CCMP challenges—further reducing nitrogen pollution from smaller, more

diffuse sources and improving water quality in bays and harbors.

Nine percent of IAs were not implemented or saw no progress, though for some, initial steps have been taken that will provide a foundation for future action. Certain actions may show no environmental progress despite extensive implementation efforts. For example, although land protections for riparian and wetland buffers were established, more action will be needed to actively restore vegetated corridors to counter losses from ongoing development.

Point Source Nitrogen Loads (Thousands of pounds per day)



SUCCESS STORIES: Collaborating to Monitor Water Quality

The Unified Water Study (UWS) is an innovative water quality monitoring program that enables communities around the Sound to collect comparable data in local bays and harbors. Historically, the monitoring was conducted by multiple groups with different methods, making it difficult to accurately compare water quality conditions. By standardizing the sampling and testing protocol, the UWS is delivering

more reliable data to better inform actions to restore and protect the Sound.

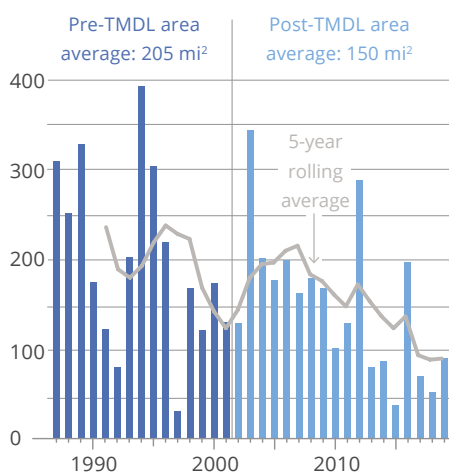
Led by Save the Sound (STS) and funded by the LISS, the project began sampling in 2017 and by 2019 had expanded to include 22 groups monitoring 39 embayments. Partnering organizations include the Bronx River Alliance, Coalition to Save Hempstead Harbor, and Cornell Cooperative Extension in NY and the Connecticut River Conservancy, New England Science and Sailing Foundation, and Town of Stratford Conservation Department in CT.

Annual training required for all participating groups ensures consistency of data collection and creates camaraderie among participants. An equipment loan program facilitates participation of interested groups that may otherwise lack the necessary equipment. A partnership with the Interstate Environmental Commission for the lab analyses lowers study expenses and further strengthens data comparability. Results of the lab analysis are uploaded into the EPA Water Quality Exchange using a uniform data entry template that streamlines and simplifies both data entry and retrieval.

Maximum Area of Hypoxia

June – September

(Area in miles²)



Status of Priority Implementation Actions

Visit the LISS website for a full list of actions.

C Complete/significant progress P Progress N No Progress

WW-4	Further improve nitrogen removal at wastewater treatment facilities.	P
WW-6	Enhance implementation and evaluate revision of the dissolved oxygen TMDL.	P
WW-7	Improve reporting requirements of municipal separate storm sewer system communities for dissolved oxygen TMDL implementation tracking.	P
WW-9	Develop a nonpoint source and stormwater tracking system tool for the watershed.	P
WW-10	Develop improved policies for performance of decentralized and on-site wastewater treatment systems.	P
WW-11	Improve denitrifying decentralized and residential, on-site wastewater treatment systems.	C
WW-12	Improve resiliency of waste treatment systems to accommodate sea level rise.	P
WW-14	Develop local ordinances and increased land protection for riparian corridors and wetland buffers.	N
WW-24	Enhance utility of water quality monitoring of nutrient loads to science and management efforts.	C
WW-28	Determine the spatial and temporal sampling needed to assess water quality impacts from climate change.	P
WW-31	Assess sources of nutrient and pathogen contamination to embayments.	P
WW-32	Monitor occurrences and contributing factors of biotoxin and harmful algal blooms outbreaks.	P



Bronx River Alliance staff measuring water quality samples where the Bronx River connects to the East River and the Sound.
© Steven DeWitt/Witness Tree Media.

Data from the UWS have been used by STS to develop its 2020 Long Island Sound Report Card and will also inform federal and state nitrogen management programs. The UWS educates and encourages residents to take an active role in their community and be responsible stewards of their environment. Ultimately, by identifying the impacts of pollutants on waterways, the monitoring data will provide an important roadmap for prioritizing restoration and mitigation efforts.

Putting Nature to Work

Excess nutrients, predominantly nitrogen and phosphorus, can have negative effects on waterbodies. Bioextraction is a method of removing nutrients from the water by growing and harvesting shellfish and seaweed. Nutrient bioextraction can reduce the frequency and intensity of algal blooms and hypoxia, and improve conditions for seagrass.

Since 2015, the LISS Bioextraction Initiative has been demonstrating new approaches to improve the health of the Sound by researching the potential for shellfish aquaculture to reduce eutrophication, assessing the ecosystem services and economic benefits of shellfish bioextraction, and piloting seaweed aquaculture technologies.

In 2018, the LISS hired a Bioextraction Coordinator to provide information and guidance to facilitate seaweed and shellfish cultivation. A recently developed Shellfish and Seaweed Aquaculture Viewer aids in identifying possible locations for commercial aquaculture operations while minimizing potential user conflicts. The Bioextraction Initiative continues to work with the aquaculture community



During the 2019-2020 winter-growing season, crew from the SoundWaters project pulled up long lines seeded with juvenile kelp to measure the linear rate of growth, using the hole-punch technique.

to address regulatory and economic challenges that may impact the viability of shellfish and seaweed bioextraction.

The LISS has also supported pilot projects to test and demonstrate seaweed

bioextraction. Adelphi University is analyzing the growth of and potential nitrogen uptake by sugar kelp, a brown seaweed, at three sites in the Oyster Bay complex. SoundWaters, an environmental education organization, is developing a seaweed farm in the Stamford/Greenwich, CT area that will also serve to educate students, teachers, and the public about the benefits of seaweed bioextraction.

Combating Stormwater Runoff

The LISS has assisted many communities in implementing green infrastructure, the use of plant and soil systems or other permeable surfaces to reduce runoff by storing and infiltrating stormwater. Incorporating green infrastructure to control and treat stormwater runoff from urban landscapes aids communities in reducing pollution and flooding.

New Haven, CT, has demonstrated the feasibility of installing bioswales, a type of green infrastructure, in right of ways and on public land. The plants and soil media in the bioswales capture nutrients and other pollutants in the stormwater. These garden-like bioswales include sidewalk curb cuts that divert the flow of polluted



Common Ground High School students, interning with URI's green-jobs training program, learning to maintain bioswales in the Newhallville section of New Haven.

stormwater into the garden where it is infiltrated and treated.

In 2015, New Haven partnered with the Urban Resources Initiative (URI) on Long Island Sound Futures Fund (LISFF) grants totaling over \$241,000 to install

and monitor 15 bioswales. Through community engagement, the URI used this opportunity to explore different bioswale designs and construction methods in collaboration with EMERGE Connecticut, a non-profit that provides employment services to formerly incarcerated individuals. Researchers and students at the Yale School of Forestry and Environmental Studies (Yale FES) monitored the bioswales to assess their effectiveness.

In 2017, the URI received a \$43,000 LISFF grant to continue its ongoing partnership with Yale FES to monitor the cumulative impact of multiple bioswales installed downtown. The monitoring provided data to assess the impact on reducing stormwater runoff and combined sewer overflows, and to inform future management and maintenance actions. Using the results of these pilot projects, New Haven is installing 175 bioswales throughout downtown. Since the stormwater ultimately flows to New Haven Harbor and the waters leading to Long Island Sound, installing bioswales throughout the city has the potential to make an important contribution toward improving the health of the Sound.

Looking Ahead

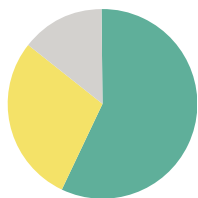
The 2020-2024 Action Plan will expand efforts to model the flow of nutrients and the associated impacts to the Sound and its embayments. This information will support regional stakeholder coordination and education efforts and improve mitigation actions. Further investment is needed to incorporate nitrogen-reducing technologies into existing and new on-site wastewater treatment systems and into green infrastructure to treat stormwater. Additional work with state and local governments to improve permitting processes for aquaculture projects is needed to facilitate and expand bioextraction. The increasing risk of ocean acidification will need to be assessed and incorporated into mitigation efforts. Continued monitoring and investigation of occurrences of biotoxin and harmful algal bloom outbreaks are vital to protecting human health, recreation, and wildlife.

Thriving Habitats & Abundant Wildlife

Goal: Restore and protect the Sound's ecological balance in a healthy, productive, and resilient state to benefit both people and the natural environment.

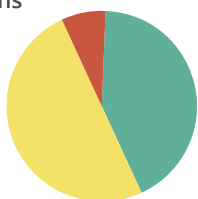
Progress made on Ecosystem Targets

- On track/ahead of schedule (57%)
- Behind schedule (29%)
- Data unavailable (14%)



Progress made on Implementation Actions

- Complete/significant progress (42%)
- Progress (50%)
- No progress (8%)



Ecosystem Target Progress

The LISS has made great progress in achieving the targets for restoring coastal habitat, protecting open space, and restoring river miles for fish passage, resulting in healthier habitat for coastal wildlife.

Between 2015-2019, the partnership restored 410 acres of coastal habitat.

This adds to the 1,646 acres of coastal habitat restored between 1998-2014. The partnership achieved a major milestone by accomplishing its short-term goal to restore 2,000 acres of coastal habitat by 2020 three years ahead of schedule.

The 2015 CCMP set a goal to open an additional 200 miles of migratory fish habitat by 2035. **Since 2015, the partnership reconnected 111 river**

miles to the Sound, resulting in a total of 419 miles of fish passage restored since 1998.

In 2015, the LISS adopted the goal of protecting 7,000 acres of open space habitat (4,000 in CT and 3,000 in NY) by 2035. From 2015-2019, the partnership protected 3,345 acres of undeveloped natural landscapes that will support the local ecosystem or serve as resource-based, natural recreational areas. This adds to the 3,500 acres of land protected within the Sound's coastal watershed boundary between 2006-2014.

While LISS has made significant progress in restoring terrestrial habitat, more work needs to be done to achieve the ecosystem targets for important habitats such as eelgrass and tidal wetlands. Out of the seven ecosystem targets, 57 percent are on track or ahead of schedule, 29 percent are behind schedule, and 14 percent do not have data available to support an assessment.

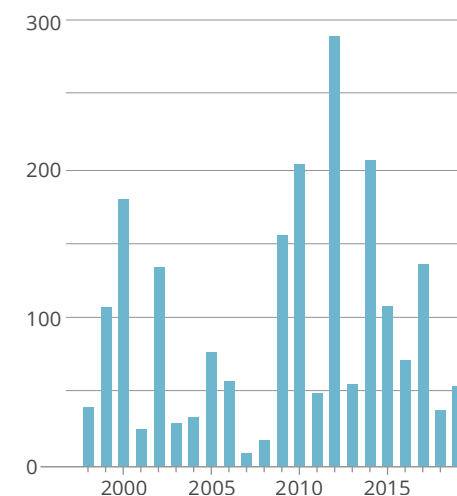
Implementation Action Progress

The Thriving Habitats and Abundant Wildlife theme had 26 IAs for 2015-2019. Progress has been made in 92 percent of the IAs, while 42 percent were completed or had significant

progress. These projects restored and protected habitat, reconnected riverine migratory corridors, surveyed eelgrass habitat, and researched the causes for marsh loss and change. Significant progress has also been made on the creation of leading-edge design and mapping tools and models to determine the impact of sea level rise on coastal habitat and identify areas for marsh migration.

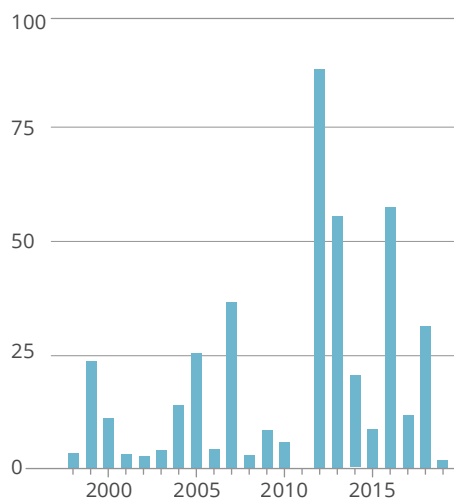
Eight percent of the IAs were not implemented or saw no progress. However, steps were taken to lay

Coastal Habitat Restored (Acres restored per year)



the groundwork for action. For example, while no progress was made developing habitat connectivity models to provide metrics for restoration and stewardship projects, the LISS conducted a pilot project to determine if it could accomplish this task in-house and discussed options for tracking connectivity with partners. As a result, it was determined that the LISS should capitalize on existing tools and models rather than initiate new in-house efforts that would be more costly and challenging.

River Miles Restored for Fish Passage
(Miles restored per year)



SUCCESS STORIES: Restoring Coastal Habitat Complexes

In 2012, Hurricane Sandy caused devastation throughout much of the mid-Atlantic coast. Despite all of Hurricane Sandy's negative impacts on this area, its storm surge had the beneficial effect of washing away a manmade earthen berm at the mouth of Sunken Meadow Creek at Sunken Meadow State Park in Kings Park, NY. The berm, built in the 1950s during park infrastructure development, had essentially cut off tidal flow from the Sound to the creek, degrading water quality and habitat. The berm's breach restored tidal flow to the creek for the first time in more than 60 years and created the possibility for tidal wetland restoration within the waterway.

Through a LISFF grant, STS, NYS State Office of Parks, Recreation, and Historic Preservation, NYSDEC, The Nature Conservancy, the US Fish and Wildlife Service (USFWS), and other partners were already working on designs in 2012 for breaching and restoring the creek. After Hurricane Sandy breached the berm, the group focused their efforts on restoration. In 2014, the partners developed a restoration plan for the

Status of Priority Implementation Actions

Visit the LISS website for a full list of actions.

C Complete/significant progress P Progress N No Progress

HW-1	Complete coastal habitat restoration projects.	C
HW-3	Restore habitat connectivity. Generate geographic information system data to measure extent of connectivity.	P
HW-4	Develop habitat connectivity models to provide metrics for restoration projects.	N
HW-5	Determine sites likely to be impacted by sea level rise and sites ideal for habitat migration.	C
HW-6	Develop habitat quality metrics and assessment methodology across targeted habitat types.	C
HW-8	Prioritize conservation investment for imperiled terrestrial and intertidal coastal habitats.	C
HW-9	Conduct an ecological assessment and design low impact development pilot projects.	P
HW-10	Protect high-priority conservation land through property acquisition and create registry of protected land.	C
HW-11	Develop living shoreline habitat protection methods and monitoring protocols.	P
HW-16	Collect data on, and restore habitat for, listed and forage species.	P
HW-24	Continue Long Island Sound eelgrass abundance surveys and promote eelgrass management.	C
HW-26	Assess locations of tidal marsh loss and create a suitability model for restoration sites.	C



Volunteers join a New York State Parks employee in planting saltmarsh grasses at Sunken Meadow State Park.

creek, and NFWF awarded another grant to STS to strengthen the park's resiliency. From 2015-2019, the project included tidal wetland restoration, fish passage feasibility studies, an 18-acre parking lot green infrastructure retrofit, and education and outreach. To date, the project has restored four acres of tidal wetland habitat. More than 100 volunteers have assisted in the restoration at the park by planting the native tidal wetland grass *Spartina alterniflora*.

Protecting Natural Areas

The Preserve, a 1,000-acre site located mostly in Old Saybrook, CT, encompasses three watersheds, a critically important coastal forest, 114 acres of wetlands, 3,100 linear feet of watercourses, a 30-acre scrub-shrub swamp, and 38 highly productive vernal pools. The Preserve's ecosystems support habitat for river herring, 25 species of amphibians and reptiles, 30 species of mammals and 57 species of birds. Three fishways connect The Preserve's streams to the Sound, allowing migratory fish to access their historic spawning grounds. The Preserve is also located only two miles from the Connecticut River, which was designated in 2012 by the US Department of the Interior as America's first National Blueway.

Despite its natural beauty and importance as the largest unprotected coastal forest located between New York City and Boston, the site was threatened with development. The Trust for Public Land, Town of Old Saybrook, CTDEEP, and numerous additional partners teamed up and developed a plan to purchase and protect the property. With more than a dozen individual funding sources



A freshwater forest wetland in The Preserve.

contributing toward the purchase price, and over 25 partners in all, the Preserve was finally acquired in 2015. The Preserve, jointly managed by the Town of Old Saybrook and CTDEEP, is available to the public for recreational purposes and contains numerous hiking trails.



Lindsay Suter, the dam owner (foreground), surrounded by the engineering/construction team and project partners CTDEEP and Save the Sound on the Pages Millpond Dam and fishway during a project inspection in May 2020.

Restoring River Access

The work of restoring fish passage to the waters upstream of the Pages Millpond Dam in North Branford, CT, began more than 15 years ago when owner Lindsay Suter noticed fish unsuccessfully attempting to surmount the dam.

Conversations began among the Suters, Hammonasset chapter of Trout Unlimited, CTDEEP, and South Central Connecticut Regional Water Authority. While a fishway design was completed by 2008, complications with timing and availability of funding delayed its construction.

STS joined the project in 2017 and secured construction funding through various programs, including the LISFF in 2018. A flurry of activity occurred in 2019 to finalize designs, engage contractors, complete site preparations, and secure permits. With all the pieces in place, the team led by STS completed fishway construction in spring 2020.

The Pages Millpond Dam, first built 323 years ago, was the final historically-significant barrier for migratory fish on the Farm River. Anadromous fish spend most of their adult lives in the sea but must return to freshwater to reproduce. Unfortunately, dams constructed all over the northeast since colonial times have blocked access to spawning areas. It is estimated that there are at least 4,000 dams in CT alone. With the Pages Millpond Dam fishway completed, populations of alewife and other forage fish, such as American shad and gizzard shad, now have access to the Farm River's historical habitat for the first time in more than 300 years. The project provides access to an additional 3.6 river miles and 4.25 acres of lake habitat along the Farm River and represents another step toward the goal of reconnecting 100 stream miles to Long Island Sound.

Looking Ahead

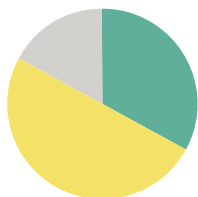
The 2020-2024 Action Plan will continue to prioritize coastal habitat restoration and land protection within the Long Island Sound coastal boundary. In addition, the LISS will emphasize developing living shorelines, reducing threats to Species of Greatest Conservation Need, restoring and monitoring eelgrass habitat, developing an annotated list of current and innovative restoration projects and techniques, and the management, monitoring, and research of tidal wetlands under advanced sea level rise scenarios. Moving forward, the LISS will continue to focus on how climate change may impact coastal habitats and wildlife and be prepared to adjust restoration, management, monitoring, and stewardship efforts in response.

Sustainable & Resilient Communities

Goal: Support vibrant, informed, and engaged communities that use, appreciate, and help protect Long Island Sound.

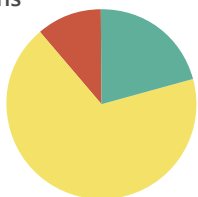
Progress made on Ecosystem Targets

- On track/ahead of schedule (33%)
- Behind schedule (50%)
- Data unavailable (17%)



Progress made on Implementation Actions

- Complete/significant progress (11%)
- Progress (68%)
- No progress (21%)



Ecosystem Target Progress

Significant progress has been made on the targets related to increasing coastal resiliency and decreasing marine debris in the Sound.

Plan development for shoreline resiliency and infrastructure sustainability in the Sound's coastal municipalities is ahead of schedule in achieving its 2025 target. This progress is significant. As climate change effects intensify, coastal municipalities need to develop and implement plans to protect infrastructure and property from sea level rise or extreme weather events, while still preserving the environment.

All 36 CT coastal communities developed and adopted plans for coastal resiliency, conservation and development, and natural hazard

mitigation. However, the 96 NY coastal municipalities have not been surveyed and assessed.

The LISS is also on track to achieve the target for reducing marine debris in the Sound by 2035. Marine debris can impair human use and impact aquatic life through entanglement and ingestion. From 2015-2019, an average of 355 pounds per mile of marine debris was collected during the fall International Coastal Cleanup. **This is a 29 percent decrease from the 2013 baseline of 475 pounds per mile.**

While significant progress has been made in coastal planning and in reducing marine debris, continued efforts are needed to further improve the resiliency and sustainability of coastal municipalities and increase public access to beaches and waterways along the Sound. Out of the six ecosystem targets, 33 percent are on track or ahead of schedule, 50 percent are behind schedule, and 17 percent do not have data available to support an assessment.

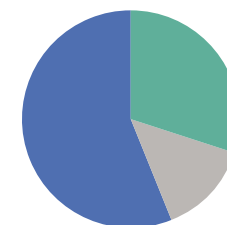
Implementation Action Progress

Progress has been made in 79 percent of the 38 IAs. Eleven percent of the IAs were completed or had significant progress. These actions provided natural landscap-

ing guidance to encourage alternatives to chemicals, provided K-12 educators opportunities to include Long Island Sound instruction in their classrooms, and developed and implemented a municipal sustainability recognition program to incentivize sustainable development.

Twenty-one percent of the IAs were not implemented or had no progress. Initial and ongoing work on some of these IAs has begun. For example, the LISS funded development of a Marsh Migration viewer. This tool will provide an ecosystem services score that will aid sustainability-

100% of CT Municipalities Adopted Coastal Resiliency (CR) Plans



Of the 36 coastal municipalities in CT:

- 30% adopted a standalone CR plan
- 14% incorporated a CR plan into their Townwide Plan of Conservation & Development
- 56% incorporated a CR plan into their Regional Council of Government Natural Hazard Mitigation Plan

minded management decisions and advance local initiatives.

SUCCESS STORIES: Promoting Resilient Municipalities

Connecticut: The University of Connecticut and CTDEEP established the Connecticut Institute for Resilience and Climate Adaptation (CIRCA) in 2014 to help communities adapt to climate change, increase the resilience of essential infrastructure, and protect ecosystem services. CIRCA provides many

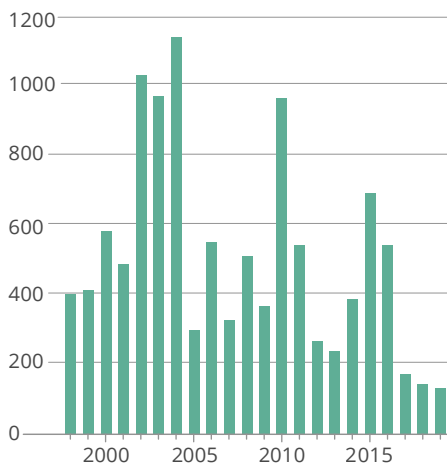
services and resources to assist Sound communities in improving resilience.

Its Municipal Resilience Planning Assistance helps municipalities by providing science, policy, and planning tools to assess vulnerable infrastructure and plan for adaptation needs. CIRCA provides sea level rise, flooding, and storm surge projections that facilitate planning, and develops public forums, reports, research, and guidance that promote mitigation and adaptation efforts. Another CIRCA program, Resilient Connecticut, aims to increase coordination among stakeholders to develop adaptation strategies that utilize partner expertise and create a roadmap to statewide resilience.

In 2018, the City of Milford developed and implemented a plan to restore and maintain a degraded dune using living shorelines. With support from the LISS and CIRCA, this project engaged the public by educating residents and visitors about dune restoration, living shorelines, and general resiliency efforts.

Another implementation success was the Town of Waterford's Municipal Infrastructure Resilience project, developed after it identified that sewer pump stations were highly vulnerable to impacts from sea level rise and flooding. The

**Debris Collected During the Fall
International Coastal Cleanup**
(Pounds of debris per mile of beach)



Status of Priority Implementation Actions

Visit the LISS website for a full list of actions.

C Complete/significant progress **P** Progress **N** No Progress

SC-5	Provide technical and grant assistance to increase appreciation of the Sound for underprivileged and nontraditional audiences.	P
SC-6	Produce materials to encourage stewardship and increase the public's understanding of the sound.	P
SC-14	Technical and grant assistance to develop behavior change campaigns.	P
SC-20	Develop and implement regional outreach and training programs on flood and erosion control.	P
SC-22	Use social science research methods to support campaigns to reduce pollution.	P
SC-23	Develop materials to aid in development of sustainability and resiliency plans.	P
SC-24	Conduct region-wide workshops to develop sustainability and resiliency plans.	P
SC-25	Support communities to develop new or updated stand-alone Municipal Sustainability Plans.	P
SC-26	Support communities to develop new or updated Coastal Resiliency Plans.	P
SC-29	Recommend removal or protection of sensitive infrastructure in the coastal zone.	N
SC-30	Implement standards for green infrastructure/low impact development.	P
SC-37	Develop a Public Access Plan to increase public access points.	N

SUSTAINABLE & RESILIENT COMMUNITIES



Green infrastructure features at the Mamaroneck Town Center, such as the porous pavement sidewalk and bioretention garden in the background, are helping to prevent more than 280,000 gallons of polluted stormwater from entering the Mamaroneck River and the Sound each year.

town developed a list of priority actions to reduce the vulnerability of their sewer pump stations and created a process that can be applied to other communities.

New York: NYSDEC, in collaboration with multiple state agencies, created the Climate Smart Communities (CSC) program to engage, educate, and recognize municipal efforts to implement sustainable practices and increase resilience to climate change. The CSC program provides information on over 100 climate adaptation actions, conducts a grant program to support implementation, and recognizes local governments that implement recommended actions.

The Town of Mamaroneck is a bronze-certified Climate Smart Community in NY. To earn this certification, the town completed 35 actions, as outlined in the CSC program, including working with Pace University's Land Use Law Center to identify green infrastructure as a priority sustainability element. Mamaroneck received a grant from the LISFF to install porous pavement, rain gardens, and rain barrels at the Town Center to capture and filter runoff. This green infrastructure project helps reduce flooding and



Audubon Wildlife guards, shown here on Pleasant Beach, encourage the public to share the coast with beach-nesting coastal birds.

improves the quality of water entering Mamaroneck Harbor and thus the Sound.

Engaging Youth to Protect Coastal Birds

In 2016, Audubon Connecticut received a grant from the LISFF to engage students and municipal employees to

reduce disturbance to coastal bird nesting areas. Audubon CT employed 10 students to encourage beachgoers to share 54 acres of beach and dune habitat with beach-nesting coastal waterbirds at Pleasure Beach in Bridgeport, CT. The project also provided coastal stewardship training



In 2019, summer camp students from the YWCA in New Britain, and Taraea Ellis, second from left, a teacher at the YWCA, held up stickers they received while visiting Lighthouse Point Park from a “Don’t Trash Long Island Sound – Break the Single Use Plastic Habit” campaign event.

to 25 municipal employees. Together, the students and municipal employees helped protect nesting sites of least and common terns, American oystercatchers, and piping plovers, while conducting outreach to thousands of people through face-to-face conversations, articles,

social media, and a website. Audubon CT addressed the need to manage beach and dune habitat for coastal birds while increasing appreciation and understanding of the value of natural resources by the public in a populated area of Long Island Sound.

The program’s success has resulted in additional LISFF grants and expansion to other locations, including Sandy Point in West Haven, CT.

Reducing Marine Debris

From 2017-2019, the LISS held summer #DontTrashLISound social media campaigns to educate the public about the problem of marine debris in Long Island Sound and its shoreline. The social media posts shared information about the dangers of plastic pollution to wildlife and actions to reduce marine debris such as retrieving abandoned lobster traps from the bottom of the Sound and volunteer beach cleanups. In addition to the messages, which were seen over 300,000 times on Facebook, Twitter, and Instagram, the campaign co-sponsored beach cleanups. The LISS also distributed thousands of “Protect Our Wildlife” stickers for residents to put on their reusable water bottles on their trips to the beach or local park to help “Break the Single-Use Plastic Habit.” The popular stickers present some of the Sound’s wildlife, including the diamondback terrapin, the American oystercatcher, the longfin squid, and the northern red anemone.

Looking Ahead

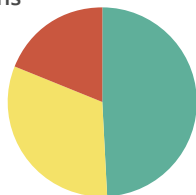
The 2020-2024 Action Plan will continue to foster and support public engagement and knowledge, with added emphasis on environmental justice initiatives. The LISS will focus on building environmental stewardship for urban waters with increased attention to the needs and perspectives of disadvantaged communities. A new five-year strategic communications plan will be developed to increase the knowledge of and engagement in the Sound’s restoration efforts by key stakeholders. A new Sustainable and Resilient Communities Work Group will recommend actions to help communities plan for climate change impacts while strengthening ecological health and protecting local economies. Supporting state and local government entities, particularly waterfront municipalities, in developing and adopting sustainability and resiliency plans and projects, will reduce costs to people, infrastructure, and the environment.

Sound Science & Inclusive Management

Goal: Manage Long Island Sound using sound science and cross-jurisdictional governance that is inclusive, adaptive, innovative, and accountable.

Progress made on Implementation Actions

- Complete/significant progress (49%)
- Progress (32%)
- No progress (19%)



Implementation Action Progress

The Sound Science and Inclusive Management theme supports all 20 of the LISS ecosystem targets with none specific to it. This theme had 41 IAs for 2015-2019, with progress made in 81 percent of them, including 20 actions completed or having significant progress. These actions support research, monitoring, and modeling initiatives to improve the science underlying management of the Sound. This theme also addresses the inclusive involvement of stakeholders and coordination of the many partners involved in CCMP implementation and adaptive management. Actions with little progress are either a focus of current or future activities (data management, value and return-on-investment assessments); await future modeling (bioextraction

impact assessment); or were delayed to incorporate new reporting methods (implementation tracking).

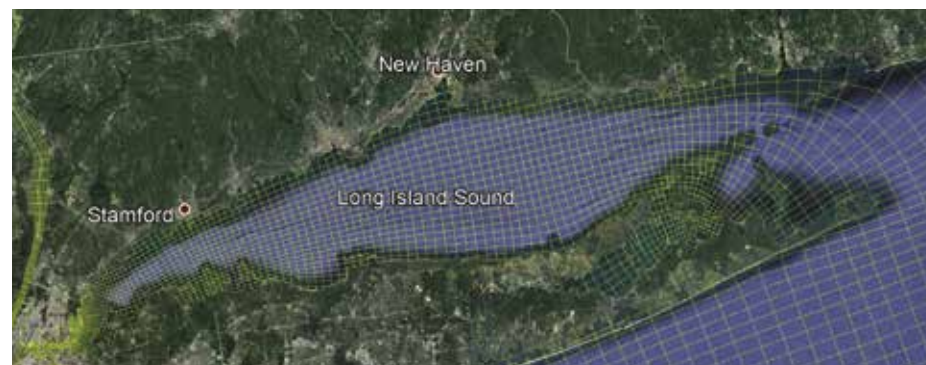
SUCCESS STORIES: Advancing Science Tools

LISS partners have made great progress in reducing nitrogen pollution to attain water quality standards for dissolved oxygen. While water quality is improving from current reductions, further progress is needed. And in addition to negatively impacting water quality in the open Sound, excess nitrogen can contribute to other impairments such as harmful algal blooms, loss of tidal wetlands and eelgrass, coastal

acidification, and hypoxia in coastal bays. Some of these adverse impacts can result in coastal communities being less resilient to climate change and sea level rise.

As a result, since 2015 multiple initiatives are underway to better understand how nutrient pollution is affecting Long Island Sound, provide a strong scientific foundation to set nitrogen thresholds for nearshore bays and large riverine systems, and assess the dissolved oxygen TMDL. These activities are coordinated under CT's Second-Generation Nitrogen Strategy, NY's Long Island Nitrogen Action Plan, and the EPA Nitrogen Reduction Strategy.

The integrated model framework will encompass the Long Island Sound and NY/NJ Harbor estuaries, and the ocean waters off the Long Island and New Jersey coasts.



LISS partners are developing computer models that represent the physical, chemical, and biological processes on the land and water, and gathering data necessary to run and test the models' ability to represent real-world conditions. These models will greatly improve the understanding of the sources and amounts of nutrients generated in the Long Island Sound watershed, how they are delivered via rivers or groundwater to the Sound and its bays, and the effect these nutrients have on water quality.

The modeling approaches are tailored to the conditions and needs in each state, recognizing the distinct geological features between CT and NY, which drive differences in nutrient sources and transport mechanisms (the main transport mechanism for CT is surface waters, while on Long Island it's groundwater).

Ultimately, these watershed and embayment models will be linked to a regional model, which was initiated in 2020 and is described in the looking ahead section. Together, these tools will advance water quality management by linking the water cycle from rivers and groundwater to the open waters of the Sound through its bays and harbors.

Mapping Seafloor Habitats

Underneath the surface of the Sound exists a wide range of seafloor habitats—from the shallow, sandy bottom in the Narrows near New York City, to the deep and rocky recession in the Race near Fishers Island. Mapping the seafloor can provide a framework to better understand and manage the resources dependent on these diverse habitats.

A 2004 settlement resolving a permitting dispute between the states of CT and NY, two power companies, and a cable company created a \$7 million fund that is supporting the Long Island Sound Seafloor Habitat Mapping Initiative. This federal, state, and academic partnership is applying advanced technologies to develop data and map products on a range of scales, from big-picture features of the underwater landscape to the fine scale distribution of organisms living on and in the seafloor.

Scientists are using modern technologies to send acoustic signals from ships to measure water depth, depict seafloor features, and describe historical changes from sediment profiles. Direct physical sampling of the seafloor provides information on the grain size of sediments and characterizes the plants and animals that live in the sediment, while video and

Status of Priority Implementation Actions

Visit the LISS website for a full list of actions.

C Complete/significant progress P Progress N No Progress

SM-1	Identify high-priority science needs and support research programs to fulfill these needs.	C
SM-8	Coordinate and leverage community water quality monitoring programs.	C
SM-10	Improve the use and utility of Long Island Sound data for geographic information system applications.	P
SM-11	Enhance modeling of eutrophication to support nitrogen management and dissolved oxygen TMDL implementation.	C
SM-16	Optimize structure and function of Management Conference with focus on implementation of CCMP.	C
SM-19	Support involvement of local governments, which have front line authority for implementing CCMP.	P
SM-20	Reach out to traditionally underrepresented stakeholders and encourage participation in Management Conference.	P
SM-24	Develop bi-state framework for Coastal and Marine Spatial Planning.	C
SM-28	Develop innovative, locally appropriate funding mechanisms to restore and protect ecosystem services.	P
SM-35	Refine ecosystem metrics and targets based on underlying science to identify characteristics of a "restored" Long Island Sound.	P
SM-38	Issue a "report card" on water quality conditions in Long Island Sound.	C
SM-41	Develop a comprehensive, specific, target-oriented implementation plan engaging all Long Island Sound partners every five years.	P



A striped sea robin, *Prionotus evolans*, cruises boulder habitat in search for small crustaceans and other invertebrate prey. The photo was taken with a camera attached to an underwater Remotely Operated Vehicle, operated by UConn scientists on board the *RV University of Connecticut*.

still imaging of the seafloor characterizes the plants and animals that live on or near the bottom. Long-term measurement of the bottom water current strength further characterizes the seafloor habitat. These data are presented in Geographic Information System (GIS) maps to provide comprehensive, up-to-date information to better manage current and proposed uses of the Sound.

The Initiative piloted the mapping program in an area of the central Sound between Bridgeport, CT and Setauket, NY, evaluating the entire process needed to comprehensively map seafloor habitats and develop products useful for management. The Phase I final report was completed in 2015. Phase II mapping of the eastern Sound from west of the Connecticut River to Fishers Island Sound began in March 2017. The field work has been completed with data analysis continuing. Planning is now underway for Phase III mapping in the western Sound.

Building Partnerships

The Long Island Sound Futures Fund (LISFF), started in 2005 as a partnership among the NFWF, EPA, and USFWS, provides communities and local organizations with funding to implement



LISFF grants fund projects throughout the Sound, including (top left, clockwise): Uplands Farm Sanctuary Plant-Based Wastewater Treatment System (The Nature Conservancy, Cold Spring Harbor, NY); Youth Restoring Tidal Wetlands (Rocking the Boat, Bronx); and Schoolyard Habitats (Audubon CT, New Haven).

the CCMP. For the past 15 years, the grant program has supported 450 on-the-ground projects such as installing rain gardens to capture pollutants, restoring tidal wetlands, and providing inner city youth with opportunities to experience the

shores and waters of Long Island Sound. From 2015-2019, LISFF projects reached more than 2.3 million residents through environmental education and conservation programs, treated 19 million gallons of water pollution, collected 198,000



UConn undergraduate and graduate students assisting faculty member Dr. Ashley Helton quantify the percent coverage of salt marsh vegetation in the Barn Island Wildlife Management Area in a project funded by the Long Island Sound Research Grant Program.

pounds of floating trash, installed 154,000 square feet of green infrastructure, and prevented 59,000 pounds of nitrogen from entering Long Island Sound. Additionally,

the projects opened 28 miles of river for passage of native fish and restored 166 acres of habitat, including coastal forests, rivers, dunes, marshes, and riparian habitat for fish and wildlife.

Funding Sound Science for Management

Wise decision making depends on sound science. That's why the LISS started the Long Island Sound Research Grant Program in 1999. From 2015-2019, the Research Grant Program funded ten projects that are improving scientific understanding of the Sound on a range of topics. Scientists, for example, are characterizing the major nitrogen sources to embayments, assessing the impact of sea-level rise on the ecological value of tidal wetlands, studying satellite images of phytoplankton assemblages, and evaluating the effectiveness of programs and policies designed to encourage less polluting landscaping practices. From 2015-2017, three different research teams collaborated in studies of nitrogen and oxygen exchange between the seafloor and water column, and two projects started in 2019 are measuring water column respiration rates and related parameters. Such focused efforts will provide important information

for the integrated water quality modeling framework being initiated.

The LISS Research Grant Program serves to involve natural and social scientists at universities throughout the region. Engaging academic institutions brings in

outside expertise to address immediate issues impacting the Sound and helps to build the regional research infrastructure needed to tackle future important management challenges.

Looking Ahead

The 2020-2024 Action Plan will continue support for science and coordination, with additional emphasis on addressing climate change impacts and protecting ecosystem services and human uses. Expanded water quality monitoring requires improved data sharing and visualization tools as well as enhanced coordination among monitoring groups. In addition, more effort is needed to increase involvement of all stakeholders, including historically underrepresented groups.

Another major initiative will address deficiencies in regional circulation and water quality models. Through a cooperative agreement with the EPA, the New York City Department of Environmental Protection (NYCDEP) is designing an integrated model framework that includes physical, biogeochemical, and ecological sub-models to represent how these components drive water circulation, mixing, dissolved oxygen, and a host of other water quality parameters.

The model framework will forecast how the Sound responds to changes in human and natural drivers impacting the ecosystem, including pollution and temperature changes. The completed model results will be made accessible to all stakeholders including the academic community, federal, state and local agencies, environmental organizations, and regulated entities. This multi-year project, begun in 2020 and continuing to 2024, will strengthen management and investment decision-making for the next decade as well as support compliance with regulatory goals at multiple scales.

Funding

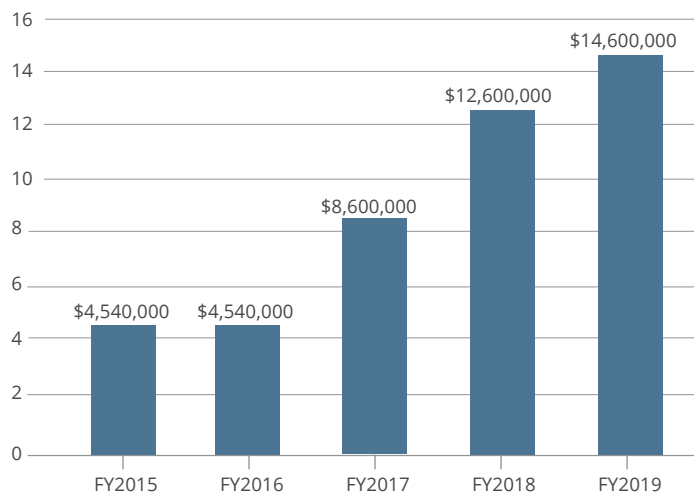
The LISS is established under Sections 320 and 119 of the federal Clean Water Act. Congress passed *America's Water Infrastructure Act* in 2018, which authorizes appropriations of \$40 million per year to the LISS under §119 through 2023. Funding for the LISS has increased since 2015, reaching \$14.6 million in 2019. Each year, the LISS Management Conference develops a work plan to implement projects based on appropriations approved by Congress. LISS partners who receive grants under these appropriations must meet matching fund requirements—40 percent for implementation projects and five percent for education and outreach projects. The

states and municipalities provide additional funds for projects to implement the CCMP. Detailed annual work plans, which provide a comprehensive list of projects undertaken by the Study and its partners, are available at longislandsoundstudy.net in the Reports section.

Importantly, for every federal dollar appropriated to the program from 2015 to 2019, LISS partners leveraged an additional \$40 to implement projects, more than \$2 billion in total, demonstrating a great return on investment and reflecting the broader regional commitment to restore and protect the Sound.

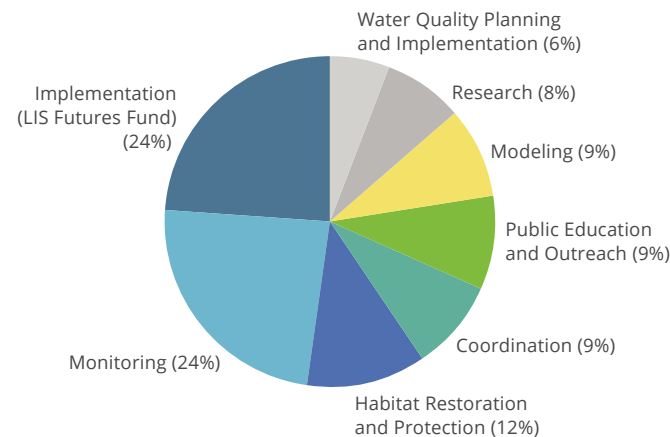
Long Island Sound Study Funding

Total Enacted Funding per Federal Fiscal Year (millions of dollars)



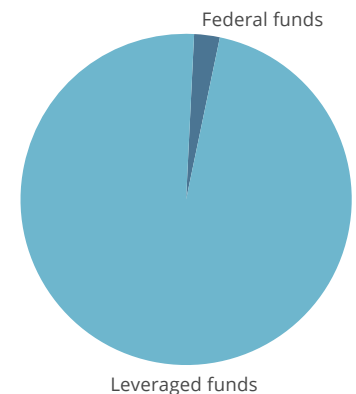
Total Budget by Program Element

Average percent of budget FY 2015 – 2019



Leveraged Ratio of Federal Funds

40:1 leveraging ratio





A humpback whale feeding on menhaden near New Rochelle, NY in 2017.
Sightings of whales and dolphins over the past few years are a sign of a healthier Long Island Sound.

EPA LONG ISLAND SOUND OFFICE

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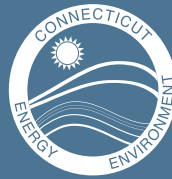
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