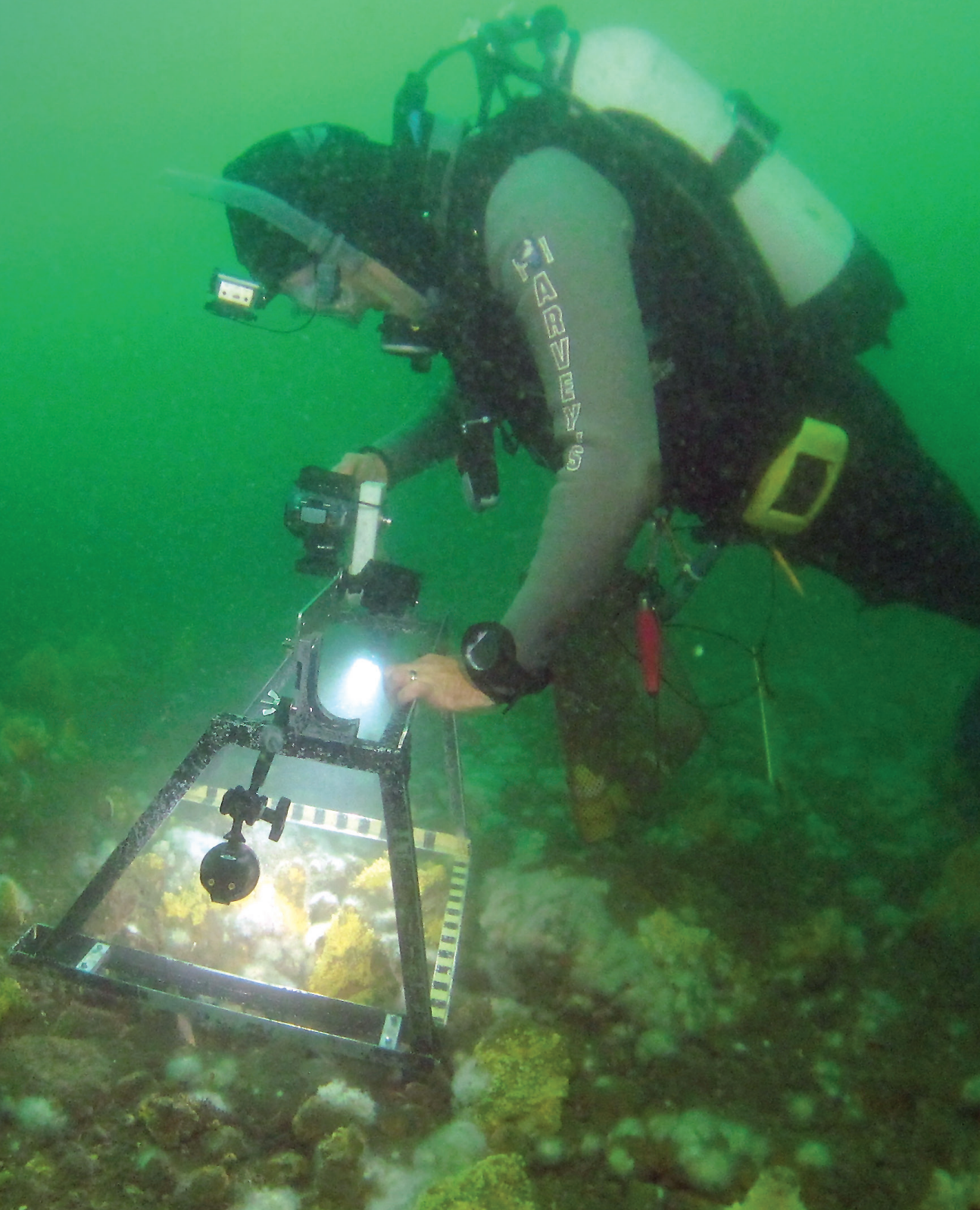**Long Island Sound Study**
A Partnership to Restore and Protect the Sound

# Returning the Urban Sea to Abundance:

A Two-Year Review (2020–2021)
of Implementation of the Comprehensive
Conservation and Management Plan

December 2022

## 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 Environmental Protection Agency (EPA) Region 1 and Region 2 offices and the commissioners of the Connecticut Department of Energy and Environmental Protection (CT DEEP) and the New York State Department of Environmental Conservation (NYSDEC), approves major policy initiatives and plans such as the Comprehensive Conservation and Management Plan (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, interstate, and local 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 including the Climate Change and Sentinel Monitoring Work Group, Environmental Justice Work Group, Habitat Restoration and Stewardship Work Group, Nitrogen Coordination Work Group, Sustainable and Resilient Communities Work Group, Water Quality Monitoring Work Group, and Watersheds and Embayments Work Group.

## Management Committee Members

**Mark Tedesco,** EPA Long Island Sound Office, Chair

**Rick Balla,** EPA Region 2

**Christopher Bellucci,** Connecticut Department of Energy and Environmental Protection, Water Planning and Management Division

**Mel Coté,** EPA Region 1

**Sylvain De Guise, PhD,** Connecticut Sea Grant College Program

**Holly Drinkuth,** The Nature Conservancy in Connecticut, CAC CT Co-chair

**Nancy Ferlow,** US Department of Agriculture, Natural Resource Conservation Service Connecticut District

**James Hagy, PhD,** EPA Office of Research and Development

**Jonathan Hoffman,** New York City Department of Environmental Protection

**Kamazima Lwiza, PhD,** Stony Brook University, STAC NY Co-chair

**Arthur Johnson**, Massachusetts Department of Environmental Protection

**Jonathan Morrison,** US Geological Survey, New England Water Science Center

**Suzanne Paton,** US Fish and Wildlife Service

**Evelyn Powers,** Interstate Environmental Commission

**Todd Randall**, US Army Corps of Engineers, New England District

**Nancy Seligson,** CAC NY Co-chair

**Rebecca Shuford, PhD,** New York Sea Grant College Program

**Julia Socrates,** New York State Department of Environmental Conservation, Division of Marine Resources

**Jennifer Street,** New York State Department of State

**Susan Sullivan,** NEIWPCC

**Brian Thompson,** Connecticut Department of Energy and Environmental Protection, Land and Water Resources Division

**Susan Van Patten,** New York State Department of Environmental Conservation, Division of Water

**Penny Vlahos, PhD,** University of Connecticut, STAC CT Co-chair

**Gary Wikfors, PhD,** National Oceanic Atmospheric Administration, National Marine Fisheries Service

A ribbon-cutting ceremony on Nov. 2021 for a sustainable schoolyard project in Queens. The new surface can capture over 1.7 million gallons of stormwater a year. See p. 16.

# Contents

# Introduction

## Long Island Sound

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. Lying in the midst of one of the most densely populated areas of the United States, nearly nine million people reside in the Long Island Sound watershed. Millions flock yearly to the Sound for recreation, and the Sound provides a critical transportation corridor for goods and people. Alongside these human uses, Long Island Sound provides feeding, breeding, nesting, and nursery areas for diverse animal and plant life. The ability of the Sound to support these uses depends on the quality of its waters, habitats, and living resources.

Volunteers plant *Spartina alterniflora* to restore native salt marsh as part of Save the Sound's restoration work in partnership with New York State Parks at Sunken Meadow State Park in Smithtown, Long Island.

## Report Purpose

*Returning the Urban Sea to Abundance* highlights ongoing projects during 2020 and 2021 to restore the health of Long Island Sound. It builds upon the previous *Returning the Urban Sea to Abundance* report, which summarized progress made from 2015 to 2019 by the Long Island Sound Study (LISS) under the 2015 Comprehensive Conservation and Management Plan (CCMP). The CCMP established 20 ecosystem targets that incorporate environmental data and performance objectives to help track progress toward restoration and management goals. The 2015 CCMP also included specific Implementation Actions (IAs) to support achievement of ecosystem targets and overall goals and objectives. 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 addresses cross-cutting principles. These include resiliency to climate change, long-term sustainability, and environmental justice. This report is part of the LISS's performance assessment and reporting practices, and helps satisfy the directive by Congress that the EPA report on progress every two years.

## Program Updates

Since publishing *Returning the Urban Sea to Abundance* in 2020, the LISS updated the CCMP with 136 IAs covering the period 2020 to 2024. The updated IAs reflect continued priorities for improving water quality, restoring and conserving vital habitats, fostering sound science, and educating and engaging the public. The update also reflects renewed emphasis on the program's cross-cutting principles of resiliency to climate change, long-term sustainability, and environmental justice. In 2020, the LISS formalized two new work groups to advance progress on these priorities. The Sustainable and Resilient Communities Work Group and Environmental Justice Work Group each developed five-year workplans to help achieve the desired outcomes in these focus areas.

Figure 1.

**Number of Projects Initiated Each Year with an Increasing Budget**



Projects Initiated

LISS Budget (millions of dollars)
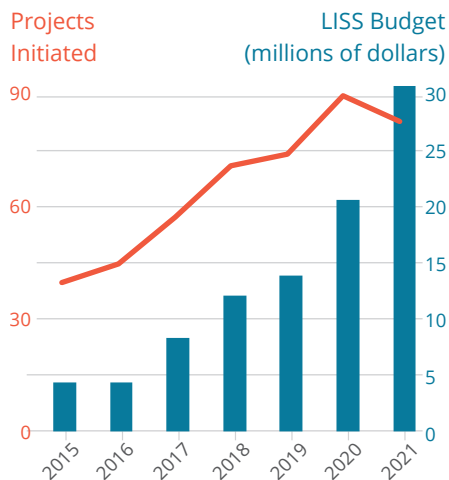
## Program Growth

Increases in federal funding for the LISS have allowed the program to expand support for implementing the CCMP. With a budget of $21.6 million in 2020 and $31.7 million in 2021 (compared to $4.5 million in 2015), the LISS was able to initiate many new projects to improve human health and the environment (Figure 1). In particular, the increases have allowed the LISS to allocate more funding for

on-the-ground projects to improve water quality, restore and protect habitat, and strengthen scientific understanding. In 2021, new investments were made to help communities become more sustainable and resilient to climate change (Figure 2).

To monitor and assess CCMP implementation and the rate of progress, the LISS developed an internal Microsoft SharePoint site in 2021. This collaborative tool allows the LISS to record information on implementation of the 136 CCMP actions and track progress toward meeting the 20 ecosystem targets. Data from this tool is published to the *Program Implementation and Progress* LISS webpage to keep partners and the public informed about investments, activities, and environmental progress.

## Program Results

Program investments have allowed the LISS partners to better characterize the health of the Long Island Sound watershed and waterbody. Water quality monitoring has expanded from the open sound to embayments (bays and harbors). Researchers have been able to

document water quality improvements due to decreased nitrogen loading from wastewater treatment facilities despite climate change making it harder to maintain water quality standards. The program continues to support local wildlife and fish by investing in the protection of open space habitat; this led to 1,007 habitat acres preserved from 2020 to 2021. Public involvement and education activities, such as the International Coastal Cleanup events, enhance the sustainability and resiliency of the watershed by reducing the amount of marine debris that flows into the waterbody. These activities collectively contribute to the overall health of Long Island Sound.

The Bipartisan Infrastructure Law passed in 2021 appropriated $106 million over five years for the LISS. The LISS is poised to continue investing in improving water quality, restoring and protecting habitats, and increasing sustainability and resiliency of the Long Island Sound and watershed communities, while advancing environmental justice goals across program activities.

Figure 2.

**Budget by Program Element**

Millions of Dollars per Fiscal Year
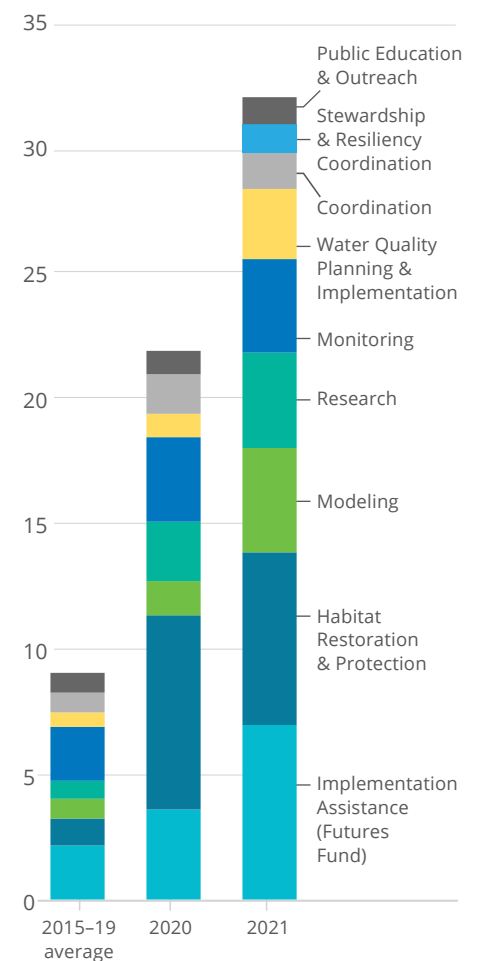
# Clean Waters & Healthy Watersheds

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

**Ecosystem Target Funding Allocation**
Millions of Dollars, 2020 — 2021
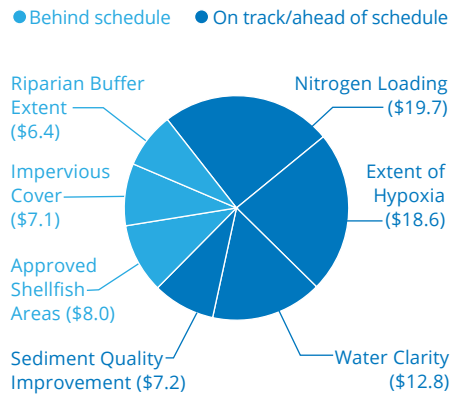
● Behind schedule  ● On track/ahead of schedule



- Riparian Buffer Extent ($6.4)
- Impervious Cover ($7.1)
- Approved Shellfish Areas ($8.0)
- Sediment Quality Improvement ($7.2)
- Nitrogen Loading ($19.7)
- Extent of Hypoxia ($18.6)
- Water Clarity ($12.8)

This chart includes projects initiated at the beginning of the 2015 CCMP that continued to draw down funds during 2020 and 2021. The size of the slice represents the total amount of dollars spent during fiscal years 2020 and 2021 to achieve each ecosystem target.

## Ecosystem Target Progress

During 2020 and 2021, the LISS contributed funding for this theme towards projects focused on the Nitrogen Loading Ecosystem Target (Figure 3), which is being met. Achievement of the target, however, is mainly the result of nitrogen reductions at wastewater treatment facilities in Connecticut and New York (Figure 4). As a result, the LISS has increased efforts to reduce nitrogen from nonpoint source (diffuse contamination that does not have a single origin) and stormwater inputs. For example, significant investments were made towards developing protection plans for CT and NY embayment subwatersheds (WW-14) and improving water quality models to better inform nutrient management (WW-27). These investments support practices aimed at reducing nonpoint source and stormwater inputs of nitrogen to the Sound and fully achieving the Nitrogen Loading Ecosystem Target.

NY developed a watershed plan for Suffolk County, and the adjacent Nassau County's subwatershed plan is nearing completion. The plans are essential to setting a data baseline for Long Island and incorporate modeling to understand a variety of groundwater characteristics that influence nitrogen loading to embayments. The plans were highly anticipated in both counties and welcomed by constituents.

CT initiated data collection to support modeling of both embayments (bays and harbors) and freshwater resources across the state. This effort focuses on the impact of nutrients on water quality in embayments and includes the development of a statewide watershed model of nutrient freshwater transport to embayments and Long Island Sound. To

**Trade Equalized Nitrogen Loads From Wastewater Treatment Plants**
(Thousands of Pounds per Day)
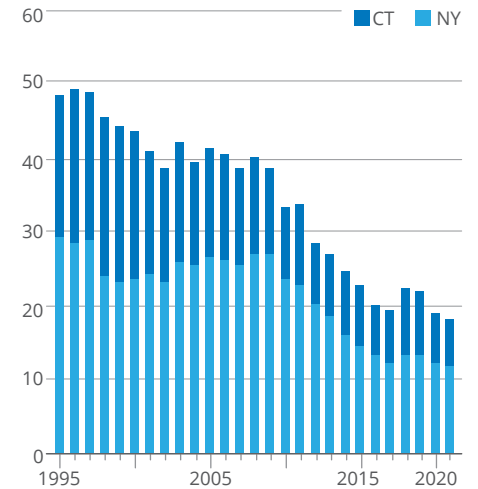


complement this effort, the US Geological Survey (USGS) developed a groundwater transport model for Connecticut's coastal waters. Modeling will allow managers to identify and assess the impact of nutrients on water quality and refine efforts to reduce nutrient inputs (e.g., on-site septic systems, agricultural runoff, lawn fertilizer, stormwater, and wastewater treatment plants).

Four of the seven Clean Waters and Healthy Watershed Ecosystem Targets are on-track, ahead of schedule, or meeting

goals (Figure 1). Approved Shellfish Areas, Riparian Buffer Extent, and Impervious Cover are behind schedule. The LISS has invested 27 percent of the funding directed to this theme toward projects that address these three targets. In 2020, the LISS funded a project to develop a tool that focuses on the impact of natural land cover protection and restoration with an emphasis on riparian buffers.

## Implementation Action (IA) Investments

The LISS invested over $10.7 million toward implementing the 10 highest funded IAs in the Clean Waters and Healthy Watersheds theme during 2020 and 2021 (Table 1). The four highest funded IAs, WW-2, WW-14, WW-28, and WW-27, support progress toward understanding and reducing nitrogen loading into Long Island Sound and its embayments. Funds covered preparation of plans for quality assurance, field sampling, and model development, as well as the collection of field data needed to develop the models. Models are important tools that provide insight to regional, state, and local partners on how to efficiently implement best management practices (BMPs). The models under development in CT and NY simulate

### Table 1. The theme's ten highest funded 2020—2024 Implementation Actions.

| | | |
|---|---|---|
| WW-2 | Continue to collaborate with municipalities, local partners and stakeholders to strategically plan for and implement capital improvements, Best Management Practices (BMPs), and improved operation and maintenance to mitigate point and nonpoint source pollution loadings, incorporating the analysis of potential future changes in loading (WW1). | $2,789,365 |
| WW-14 | Support collaborative and inclusive development of new and updated restoration/protection plans for Connecticut and New York embayment sub-watersheds with pollution load reduction targets. | $1,546,933 |
| WW-28 | Maintain and enhance the management utility of water quality monitoring of watershed nutrient loads and ecosystem responses to Long Island Sound and its embayments. | $1,366,638 |
| WW-27 | Improve ability of models and/or studies to estimate contaminant and nutrient loads to embayments and evaluate the effectiveness of remedial actions. | $1,291,844 |
| WW-8 | Conduct studies and research to better understand the ecosystem's response to nitrogen reductions to support an evaluation of the 2000 Dissolved Oxygen Total Maximum Daily Load. | $983,212 |
| WW-35 | Assess sources of pathogens and nutrients and work with communities to abate or alleviate those sources. | $861,682 |
| WW-25 | Evaluate challenges to implementation of bioextraction in Long Island Sound, including use conflicts, economic viability, permitting and testing requirements and potential environmental impacts, and make recommendations to overcome them. | $734,469 |
| WW-1 | Evaluate how drivers of pollutant loads and management responses will affect current and future pollutant loads from point and nonpoint sources. | $483,066 |
| WW-4 | Pursue opportunities to further improve nitrogen removal, including low-cost retrofits, at Wastewater Treatment Facilities throughout the watershed but particularly in the upstream states. | $392,719 |
| WW-20 | Support activities to achieve trash-free waters. | $299,460 |

Jennifer Lafayette, USGS Hydrologic Technician, Performing Storm Sampling to Support the CT Watershed Model Project.

the effects of reduced nitrogen loading on water quality in Long Island Sound and the embayments. New York's Solute Transport Model improves the ability to estimate nutrient loads to embayments and promotes collaboration with municipalities, local partners, and stakeholders through engaged conversations around the tool. Efforts related to these IAs support initiatives to increase green infrastructure projects throughout coastal communities.

## SUCCESS STORIES
### Collaborative Modeling: Elevating Science to Support the Strategies for the Sound

Scientists have not previously been able to characterize the occurrence of legacy nitrogen in a manner usable to decision makers. In 2018, the USGS, working with the New York State Department of Environmental Conservation (NYSDEC) and the Peconic Estuary Partnership, started developing a Solute Transport Model (STM) for the eastern part of Long Island. This three-dimensional model simulates nitrogen storage and its transport through groundwater pathways. The model can be used to estimate nitrogen concentrations in groundwater aquifers and travel times of nitrogen



USGS enhanced monitoring network to support the CT Watershed Model Project.
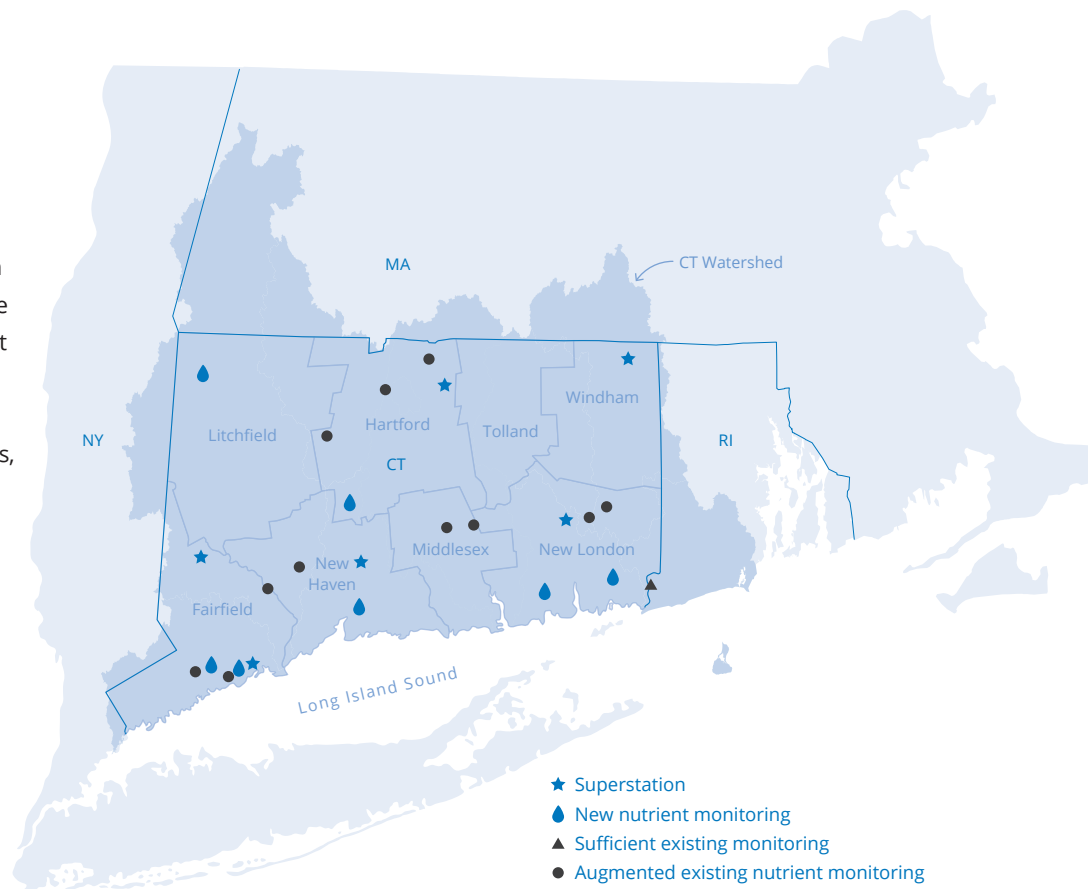
to embayments. Suffolk and Nassau counties have used estimates of nitrogen travel times to prioritize areas in their respective subwatershed plans.

Funding granted by the LISS in 2020 extended the model area into central and western Long Island, including Queens and Brooklyn, and will include nitrogen reduction scenarios for the Long Island Sound subwatershed.

Expanding the model area will allow regional, state, and local stakeholders to better understand where legacy and current nitrogen is entering Long Island Sound embayments through groundwater pathways and aid in BMP planning and placement. The model will be used to simulate how various wastewater management actions can reduce groundwater nitrogen loads,

thus allowing decision makers to develop cost effective implementation strategies. One example of how the STM will be utilized is to evaluate management actions included in the subwatershed plans for Nassau and Suffolk counties.

## Connecticut Watershed Model Update Launches Sound Science into the Future

CT DEEP and the LISS initiated a three-phased update to the Connecticut Watershed Model (CTWM). When completed, the CTWM will support the planning and implementation of CT's Second-Generation Nitrogen Strategy by assessing sediment and nutrient inputs to freshwaters around the state as well as the Sound. During 2020 and 2021, efforts focused on expansion of the USGS stream monitoring network and completion of planning materials. The enhanced monitoring expanded the USGS network to include six new stream gages, discrete water quality sampling and lab analyses, and continuous water quality monitoring at six stations. This effort increased the temporal and spatial coverage of freshwater nutrient and sediment data, which are required inputs



Stony Brook University scientist Mike Doall and a graduate student displaying the kelp grown for their bioextraction project at Cedar Beach in Mt. Sinai, NY.

to the CTWM. The data collected through this effort are quality assured and made publicly available through the EPA Water Quality Portal and the USGS National Water Information System. The photo on page 8 is an example of field sampling undertaken as part of this work.

The planning phase of the CTWM also included the development of a Quality Assurance Project Plan and modeling plan. CT DEEP will continue to collaborate with USGS to incorporate refined groundwater flow and nutrient budgets in the development and application phases of the CTWM. Output from the CTWM will be used to provide nutrient loading to site-specific embayment studies.

## Looking Ahead

Previous modeling and monitoring initiatives focused on evaluating pollution from land-based sources. Recent LISS-funded research identified the potential to further mitigate nitrogen pollution through in-waterbody bioextraction, a process in which the harvest of cultured shellfish and seaweed removes nutrients and improves water quality. The LISS invested in pilot projects that evaluated the use of seaweed as a fertilizer amendment and developed an online mapping tool to identify suitable areas for bioextraction. The LISS plans to continue efforts focused on bioextraction research, as well as planning and implementation of nonpoint source and stormwater controls through various practices including nature-based solutions.

# 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.

## Figure 5.

**Ecosystem Target Funding Allocation**
Millions of Dollars, 2020 — 2021
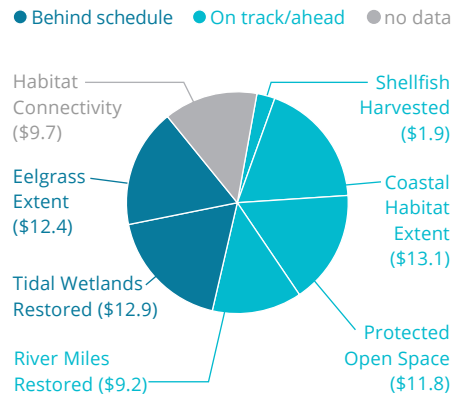
● Behind schedule  ● On track/ahead  ● no data



Habitat Connectivity ($9.7)
Shellfish Harvested ($1.9)
Eelgrass Extent ($12.4)
Coastal Habitat Extent ($13.1)
Tidal Wetlands Restored ($12.9)
River Miles Restored ($9.2)
Protected Open Space ($11.8)

*This chart includes projects initiated at the beginning of the 2015 CCMP that continued to draw down funds during 2020 and 2021. The size of the slice represents the total amount of dollars spent during fiscal years 2020 and 2021 to achieve each ecosystem target.*

## Ecosystem Target Progress

The LISS continues to make great strides toward achieving the targets for restoring coastal habitat extent, protecting open space, and restoring river miles for fish passage. Approximately 48 percent of the funding allocated to this theme is directed to work supporting these targets (Figure 5).

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 2020 to 2021, the partnership protected 1,007 acres of natural habitat from development (Figure 6). Conserving these properties supports ecosystem health, reduces potential water quality impacts to the Sound, protects habitat for wildlife and fish, and provides opportunities for recreation. To date, the LISS and its partners have achieved 66 percent of the 2035 goal for habitat protection. Notable, large-scale acquisitions include the Atkinson/Dirlam Preserve (230 acres) and the Niantic River Headwaters Community Forest Preserve (200 acres) in CT, and the Carman Property (93 acres) in NY. The Protecting Open Space target was driven by the priority IA to protect high-priority coastal habitat from development (HW-9).

Four of the seven targets within this theme are ahead or on schedule (Figure 1). While Eelgrass Extent and Tidal Wetlands Restored Ecosystem Targets are behind schedule, the LISS is investing 25 percent of the funding directed to this theme toward projects that address these two targets. Because data is lacking to accurately report on Habitat Connectivity, the LISS funded a project in 2021 to identify appropriate metrics to track this target and 14 percent of current allocations for this theme support projects to increase connectivity.

## Figure 6.

**Protected Open Space**
Acres Protected, 2006-2021    ● CT  ● NY
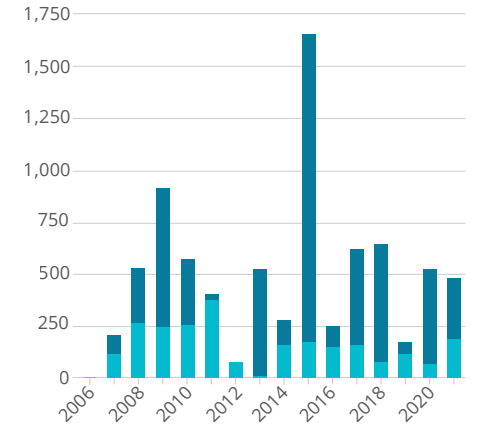


## Implementation Action (IA) Investments

The LISS invested nearly $15.4 million toward implementing the 10 highest funded IAs in the Thriving Habitats and Abundant Wildlife theme during 2020 and 2021 (Table 1). The three highest funded IAs, HW-1, HW-9 and HW-3, support progress in the Coastal Habitat Extent, Protected Open Space, and River Miles Restored ecosystem targets, all of which are meeting or ahead of schedule in achieving LISS goals. During 2020 to 2021, specific projects funded with the $4.9 million under HW-1 included the Flax Pond habitat restoration project in Old

Field, NY and restoration of the Sluice Creek and Leetes Island Tidal Marshes in Guilford, CT. The dam removal at Merwin Meadows Park in Wilton, CT received part of the $2.7 million in funding under HW-3. Other significant investments included mapping the status and trends in Long Island Sound eelgrass (HW-25) and land acquisition and open space protection in NY (HW-9). While these projects support targets that are currently on-track, some also address Eelgrass Extent and Tidal Marshes Restored, targets currently behind schedule.

## SUCCESS STORIES
### Developing Conservation Plans for NY's Marsh Complexes

Tidal marshes benefit Long Island Sound coastal communities by providing recreational opportunities, buffering storm surge, and improving water quality by filtering nutrients and trapping sediments. Healthy wetlands are also a vital habitat for fish and wildlife. As sea levels rise due to climate change, marshes must migrate upland or vertically accumulate more sediment to survive. To assist communities and conservation groups with planning for marsh migration and coastal resiliency, the LISS supported development of an easy-to-use Marsh Migration Viewer for

| | Table 2. The theme's ten highest funded 2020—2024 Implementation Actions. | |
|---|---|---|
| HW-1 | Complete projects that result in restoration of coastal habitat. | $4,933,705 |
| HW-9 | Equitably protect high-priority coastal habitat from development through property acquisition and other means, support sustainable use of these properties, without discouraging wildlife use, and create a registry of protected areas in Connecticut and New York, which encompasses both existing protected properties and future acquisitions. | $4,070,654 |
| HW-3 | Complete projects that restore or maintain habitat connectivity (i.e., river miles reconnected and/or contiguous acres of coastal habitat protected or restored). Generate supporting Geographic Information System data to help measure extent of connectivity enhanced. | $2,747,042 |
| HW-16 | Collect and analyze data on, and restore habitat for, listed and forage species. | $1,310,206 |
| HW-22 | Engage local communities in design, development, implementation, and promotion of habitat restoration, stewardship and monitoring projects. | $685,857 |
| HW-11 | In lieu of hard armoring, develop and promote the use of living shoreline habitat protection methods (dunes, shorelines, coastal marshes) and standardized living shoreline monitoring protocols while considering the habitat needs of Species of Greatest Conservation Need, including forage species, and reducing wildlife conflicts. | $513,403 |
| HW-5 | Use remote sensing, mapping tools, modeling, and field verification to determine sites that are likely to be impacted by sea level rise, and which sites are ideal for habitat migration. | $366,364 |
| HW-10 | Promote management practices that limit human disturbance and protect functional availability of coastal and marine habitats for Species of Greatest Conservation Need, including forage species and other wildlife. | $315,293 |
| HW-13 | Promote directed volunteer-driven invasive species reconnaissance and removal work. | $310,186 |
| HW-25 | Continue Long Island Sound eelgrass abundance surveys and promote eelgrass management. | $113,140 |

Tidal marsh in Blind Brook in Rye included in conservation plan.

20 of the largest marsh complexes in New York's Long Island Sound watershed. Using the output from the Sea Level Affecting Marshes Model (SLAMM), the viewer depicts potential marsh migration over time on a parcel-by-parcel basis under various sea level rise scenarios. In addition, the project prepared detailed fact sheets for each marsh and held virtual training workshops for stakeholders across the watershed. As a result of these workshops, the project identified two locations, Westchester County and Mattituck Creek in Suffolk County, for the development of marsh conservation plans. The final plans have already been used to justify land protection efforts in the Town of Mamaroneck and restoration project proposals for Mattituck Creek. The viewer, fact sheets, and conservation plans allow stakeholders to make informed decisions regarding habitat restoration and land conservation for their communities in preparation for sea level rise and marsh migration.

## Restoration and Protection of the Hepburn Preserve in Old Saybrook, CT

Healthy barrier beaches and dunes provide numerous benefits to both human and wildlife communities, including many



Photo looking west with dune (right) and living shoreline under construction. Existing healthy saltmarsh can be seen in the foreground.

species of birds that rely on them for nesting, foraging, and shelter, as well as rare plant species that cannot grow anywhere else. Barrier beaches and dunes act as storm buffers to protect both wildlife habitat, such as tidal marshes, and the residential neighborhoods bordering the coast. The functions and values of degraded beaches and dunes are diminished and the

risks to the habitats they protect increase significantly. The beach at the Hepburn Preserve in Old Saybrook was recently observed migrating landward at an alarming rate, which led to a significant reduction in dune height and width at the site. Stone groins to the west and a large breakwater to the east trapped sand, starving the beach and causing

Looking east nearing project completion. Rock sills with cobblestone are centered between the restored dune planted with American beachgrass (background, left) and tidal marsh restoration site in the foreground, which was planted with smooth cordgrass shortly afterwards.

its degradation. An attempt to restore this dune about 10 years ago included soft armoring with coir logs and buried geo-tubes filled with sand. A decade of nor'easters and tropical storms, however, took their toll. Water breached the dune and pushed a large volume of sand into the tidal marsh behind it, blocking Crab Creek, which feeds Hepburn's Pond – a brackish tidal pond that is home to rare plant species. Realizing the soft approach would not protect against the bigger coastal storms that regularly strike, project partners (Connecticut River Conservancy, Lynde Point Land Trust, Borough of Fenwick, CT DEEP, and more) decided on a harder, yet environmentally friendly, approach.

This relatively large-scale habitat restoration and protection project included several components. While the project was in design and permitting, a temporary pipe was placed into Crab Creek to sustain flow and prevent loss of the rare plants growing along the edges of Hepburn's Pond. A staggered array of nine rock sills were installed in the intertidal area just offshore of where the dune had breached. The sills are tall enough to be topped by water only during the highest tides of the year and have enough space between them to allow water to pass, preventing rip currents and scour. Sediments were placed landward of the sills and planted with smooth cordgrass, *Spartina alterniflora*, restoring some of the lost tidal marsh habitat. Sand was imported to rebuild the dune's height and width, and planted with beach grass, *Ammophila breviligulata*. The lower end of Crab Creek was moved north, away from the dune, to prevent it filling up with sand again at the next big coastal storm. The steps taken at this site will reduce the risk of storm damage to already impacted dune and marsh habitat, making the site more resilient to climate change and sea level rise.

## Looking Ahead

Over the next two years, the LISS and its partners will continue to prioritize increasing coastal habitat acres restored, increasing acres of land protected, increasing river miles reconnected, advancing research on tidal marshes, identifying eelgrass restoration opportunities, supporting and advancing living shorelines, identifying areas for invasive species management, and supporting adaptive management of priority habitat and restoration sites. To accomplish these goals, the LISS will work to connect partners and encourage them to apply for available sources of environmental and resiliency funds.

# Sustainable & Resilient Communities

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

**Figure 7.**

**Ecosystem Target Funding Allocation**
Millions of Dollars, 2020 — 2021
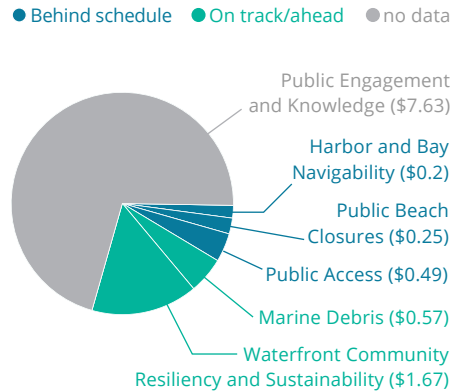
● Behind schedule ● On track/ahead ● no data



Public Engagement and Knowledge ($7.63)

Harbor and Bay Navigability ($0.2)

Public Beach Closures ($0.25)

Public Access ($0.49)

Marine Debris ($0.57)

Waterfront Community Resiliency and Sustainability ($1.67)

This chart includes projects initiated at the beginning of the 2015 CCMP that continued to draw down funds during 2020 and 2021. The size of the slice represents the total amount of dollars spent during fiscal years 2020 and 2021 to achieve each ecosystem target.

## Ecosystem Target Progress

The ecosystem target to decrease the mass of marine debris in Long Island Sound appears to be on track (Figure 7). Annual International Coastal Cleanup (ICC) events held in the Sound indicate the number of pounds of debris collected per mile have been reduced. The five-year running average (2017-2021) is 141 pounds per mile, representing a 70 percent decrease from the baseline (2009-2013) of 475 pounds per mile (Figure 8). In addition, data

from the Ocean Conservancy's Trash Information and Data for Education and Solutions database reveals a significant decrease in the number of plastic bags collected over the past five years. This decline coincides with implementation of several municipal plastic bag bans in NY, followed by adoption of state policies in 2020 and 2021 in both CT and NY. In 2021, a total of 7.9 plastic bags per mile (2,369 bags) were collected compared to 106.4 plastic bags per mile (8,454 bags) in 2013, indicating a 93 percent decrease.

While these measures are encouraging, many variables influence the weight of debris per mile collected each year. These include the type of debris collected, the number of volunteers collecting debris, weather conditions, and cleanups conducted prior to the ICC.

In 2021 and 2022, the CT and NY Sea Grant programs, with support from National Oceanic and Atmospheric Administration, developed a Long Island Sound Marine Debris Action Plan. One of its recommendations is to conduct a gap analysis of tracking data using the ICC databases and other sources to document trends in marine debris. The

**Figure 8.**

**Coastal Cleanup Marine Debris Collected**
Pounds per Miles of Beach, 1998-2021



Five-year Running Average
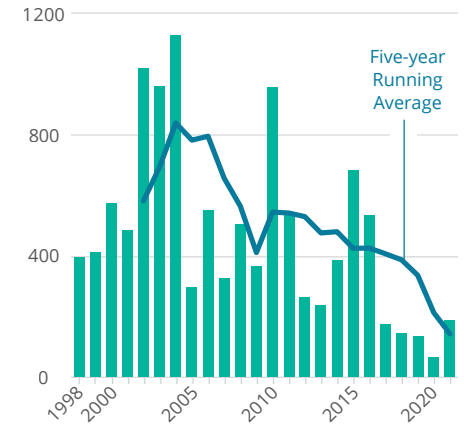
analysis will help identify at-risk areas most affected by marine debris and pollution, develop new partnerships, and provide tools and resources to support and increase the number of annual cleanups.

Additionally, the Long Island Sound Futures Fund (LISFF) supported eight projects by community organizations to reduce marine debris. The projects included volunteer cleanups, installation of a trash skimmer in the water, and promotion of reusable bags and bottles. The LISS also held a #DontTrashLISound campaign to raise awareness through social media.

Two of seven Sustainable and Resilient Communities (SRC) ecosystem targets are on-track or ahead of schedule (Figure 7). To address data gaps in measuring success of the targets behind schedule, the LISS will be developing new research tools, including a public perception survey to measure public engagement and knowledge, and a new methodology to track municipal efforts to develop and implement coastal sustainability plans.

## Implementation Action (IA) Investments

The LISS invested over $5.6 million toward implementing the 10 highest funded IAs in the SRC theme during 2020 and 2021 (Table 3). The 32 IAs under the SRC theme support outcomes in two categories: 1) increasing knowledge and appreciation of the Sound through education, public engagement, and access, and 2) enhancing community sustainability and resiliency. Nine of the top 10 funded IAs support the CCMP's education, public engagement, and access outcomes. Many of these projects are funded through the LISFF. Specific projects included the development of a five-year coordinated Communications, Outreach

| Table 3. The theme's ten highest funded 2020–2024 Implementation Actions. | | |
|---|---|---|
| SC-7 | Produce informational materials that can be distributed through multiple formats to encourage stewardship and increase the public's understanding of the ecological, cultural, and recreational value of Long Island Sound. | $1,744,720 |
| SC-19 | Support programs and opportunities that promote in-the-field and hands-on learning through classroom and informal activities. | $833,755 |
| SC-6 | By 2024, develop and implement a 5-year coordinated communications plan that engages multiple audiences (e.g., elected officials and municipalities) in ongoing efforts to improve the health and resilience of Long Island Sound. | $765,464 |
| SC-20 | Provide support to municipalities on low-impact development and green infrastructure. | $481,720 |
| SC-1 | Support festivals, celebrations, events, campaigns and materials that reach priority audiences through multiple communication channels to promote education and encourage appreciation, responsible use, and stewardship of the Sound's natural, cultural, historical and maritime resources. | $446,941 |
| SC-9 | Raise awareness through various media formats about the Sound's water quality conditions that could impact human health. | $323,891 |
| SC-4 | Support federal, state and local environmental justice initiatives that promote equitable access, appreciation, and understanding of the Long Island Sound. | $307,286 |
| SC-11 | Support local volunteer organizations that are working toward the ecological restoration of the Sound and its tributaries. | $239,117 |
| SC-8 | Develop projects with the Long Island Sound National Estuarine Research Reserve and other partners to disseminate knowledge and results from Long Island Sound monitoring and research. | $230,639 |
| SC-10 | Expand efforts, through the LISS website and social media channels, to educate the public about the impacts of climate change on Long Island Sound and in Long Island Sound Stewardship Areas. | $227,677 |

The Elmhurst Campus schoolyard in Queens with its colorful sports areas, outdoor classroom, native plant gardens, and turf field.

and Engagement Plan for Long Island Sound (SC-6), the *Bright Green Hartford* project that provided residents with free green tools such as downspout diverters and rain barrels (SC-7, SC-20), National Audubon Society's *Share the Shore with Shorebirds* program (SC-19, SC-4), and the *Long Island Sound Student Action Plan*, an educational and mentorship program for students to develop research and conservation projects (SC-19, SC-7, SC-4). In 2020 and 2021, the LISS also supported the development of an SRC Work Group and work plan focusing on sustainability and resiliency outcomes.

## SUCCESS STORIES
### By Students and for Students: Green Infrastructure Schoolyard in Elmhurst, Queens

Support from the LISFF helped students from four Queens schools work together to design a unique green infrastructure project that will capture over 1.7 million gallons of stormwater each year. The project brings green spaces to an area with high needs. Elmhurst ranks in the bottom 15 percent for communities with available public spaces and the school campus serves a population where nearly 40 percent of families fall below the federal poverty level. The new playground is on the Elmhurst Campus where the Pan American International High School, Civic Leadership Academy, VOYAGES Preparatory High School, and Queens Transition Center are all located within a 10-minute walk, the site serves nearly 45,000 residents. The area was developed on a low-lying wetland and is heavily impacted by flooding, most recently during Hurricane Ida in 2021.

The playground features an outdoor classroom, a green-roof gazebo, and native plants for students and the community to enjoy. The combination of permeable surfaces and water retention reduce neighborhood flooding as well as improve the health of nearby Flushing Bay and Long Island Sound.

The schoolyard also created employment opportunities through Youth-Build, an organization that hires high school students and former students. YouthBuild staff built garden beds with recycled lumber and participated in the installation of the permeable turf field and green infrastructure.

Project collaborators included The Trust for Public Land, in partnership with New York City's Department of Environmental Protection, EPA, and the National Fish and Wildlife Foundation.

### Planning and Planting for a Resilient Coastal Forest in Southeastern Connecticut, Stonington

Through funding from the LISFF, the Avalonia Land Conservancy partnered with CT Sea Grant to develop and implement a coastal forest resilience management plan for the Hoffman Evergreen Preserve in Stonington, CT. The management plan uses climate

Volunteer planting a black oak (*Quercus velutina*) during a work party at the Hoffman Preserve on May 26, 2021.

projections for Southeastern CT for the year 2050. Researchers identified trees and shrubs native to the state as well as those from states south of CT that do well in current and future climate conditions to plant within the Hoffman Evergreen Preserve. The Hoffman Preserve is a coastal forest located approximately six miles from the shore and within the Long Island Sound coastal boundary. Coastal forests are one of the 12 habitat types targeted for restoration by the LISS.

Roughly 60 acres of the nearly 200-acre preserve were targeted for vegetative management (including invasive species control) to develop a healthy and resilient forest. Volunteers spread seed mix and planted over 600 bareroot and potted saplings during three plantings held in 2021. Additional plantings are scheduled for 2022. The location of tree and shrub plantings were recorded to facilitate monitoring of their ongoing health. Project leaders actively engaged Avalonia Land Conservancy members, municipal representatives, community members, and natural resource managers during the planning and implementation phases. An educational webinar series was held in 2021 discussing topics such as climate change and forests, carbon sequestration and forest ecosystems, and a forest demonstration project in Rhode Island as well as the Hoffman Evergreen Preserve. Additionally, the US Forest Service and the Northern Institute of Applied Science led a four-part workshop series in 2021. The combined webinar and workshop series attracted more than 450 participants.

This innovative project at the Hoffman Evergreen Preserve will ensure this coastal forest continues to provide critical habitat, opportunities for safe public access and recreation, and vital ecosystem services for water filtration to Long Island Sound (reducing contaminant, nutrient, and sediment loads) into the future.

## Looking Ahead

Following completion of a five-year work plan by the SRC Work Group in March 2021, the CT and NY Sea Grant programs hired five extension professionals in November 2021. Over the next two years, these extension professionals will work with coastal Long Island Sound communities to build a coordinated regional response to current and future climate change impacts, empower better trained and informed community decision-makers, and increase implementation of sustainability and resilience projects throughout the region. In addition, a work group focused on outreach and engagement is set to regroup and begin implementation of the newly developed five-year Communications, Outreach, and Engagement Plan for Long Island Sound.

# Sound Science & Inclusive Management

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

## Implementation Action (IA) Investments

The LISS invested over $15.3 million toward implementing the 10 highest funded IAs in the Sound Science and Inclusive Management theme during 2020 and 2021 (Table 1). The three highest funded, SM-11, SM-1, and SM-13, support systemwide modeling, identifying and addressing science needs, and staffing the Management Conference.

Funding of more than $6 million was allocated to the New York City Department of Environmental Protection to develop a new computer model of the region's coastal waters (SM-11), including Long Island Sound, New York Harbor, and New York-New Jersey Bight (the waters extending from Cape May in New Jersey to Montauk Point on the eastern tip of Long Island). The model, which will replace an outdated modeling framework, includes state-of-the art hydrodynamic, water quality, and visualization components.

Almost $3 million was allocated to LISS science needs related to management objectives and the 20 ecosystem targets (SM-1). The LISS Research Grant Program funded projects related to current science needs in support of SM-1. In 2020 and 2021, the LISS partners worked to update the Science Needs document, which was posted on the LISS website in April 2022. Additional funding continued collaboration with the EPA National Coastal Condi-

tion Assessment (SM-7) and helped to develop a new web application to measure hypoxic area and volume (SM-6).

The LISS allocated over $2 million to continue support to the Management Conference (SM-13). In 2020, the Management Conference identified environmental justice, climate resiliency, and sustainability as top priority focus areas of the program. As a result, the LISS expanded the work in these key areas through the creation of two new work groups.

## SUCCESS STORIES
## Documenting Successful Water Quality Improvements

Over 20 years ago, CT and NY jointly agreed with EPA to reduce nitrogen inputs to Long Island Sound by nearly 60 percent from the early 1990s baseline of 213,150 pounds of nitrogen per day in order to decrease the total area of hypoxia (low dissolved oxygen). This agreement resulted in setting the 2000 Dissolved Oxygen Total Maximum Daily Load (TMDL) for nitrogen inputs to the Sound. This nitrogen reduction was achieved by 2016, but questions remained about whether the Sound's water quality was improving as a



Captain Pete and University of Connecticut doctoral candidate, Lauren Barrett, haul in the rosette sampler during a water cast.

result. In January 2021, two scientists from the University of Connecticut, Drs. Michael Whitney and Penny Vlahos, published a peer-reviewed paper in the distinguished American Chemical Society's journal, Environmental Science and Technology, documenting a significant

reduction in Long Island Sound hypoxic area due to decreased nitrogen loading. In May 2021, EPA issued a press release about this research paper, highlighting its significance. As detailed in the press release, the reduction in the cumulative amount of nitrogen discharged to Long Island Sound each year by 47 million pounds has decreased the area of hypoxia from an average of 205 square miles from 1987 to 2000 (before the TMDL) to a five-year average of 94 square miles. This is one of the few successful hypoxia reductions globally and was documented by the LISS-supported monitoring program. However, this research paper also warned that the increase in Long Island Sound water temperatures due to climate change will reduce the future capacity to hold oxygen. Therefore, further decreases in nitrogen loading must be made to maintain the observed reduction in total hypoxic area.

In early June 2021, *Newsday*, a prominent newspaper on Long Island, published a news story followed by an editorial detailing the findings, praising the success, and noting that it took "time, money, and perseverance." The editorial stated that "This achievement

| | Table 4. The theme's ten highest funded 2020–2024 Implementation Actions. | |
|---|---|---|
| SM-11 | By 2024, complete the Integrated Systemwide Modeling Tool to support nitrogen management and Dissolved Oxygen TMDL assessment. | $6,101,278 |
| SM-1 | Regularly update and refine the high-priority science needs relating to the understanding and attainment of management objectives and ecosystem targets. | $2,943,604 |
| SM-13 | Continue program administrative, financial, and technical assistance support to Management Conference. | $2,368,315 |
| SM-28 | Evaluate the potential limitation of primary productivity, modification of species composition, and other impacts by nutrients other than nitrogen in embayments and the main Sound; as well as the ratios of these nutrients to nitrogen. | $759,242 |
| SM-7 | Continue National Coastal Assessment monitoring of Long Island Sound. | $734,002 |
| SM-6 | Re-interpolate aerial estimates of hypoxia, from 1991 to present, using both CT DEEP and Interstate Environmental Commission data. | $706,436 |
| SM-8 | Coordinate and leverage community water quality monitoring programs, enhancing the utility and application of data. | $676,201 |
| SM-14 | Continue state program coordination and involvement in the Management Conference. | $406,867 |
| SM-12 | Link watershed and groundwater nutrient loading models to Long Island Sound water quality models to better elucidate the sources and contributions of nitrogen and support their management. | $363,821 |
| SM-3 | Refine and expand the data supporting coastal and marine spatial planning under the Blue Plan for Long Island Sound. | $281,636 |

**Problem**

Lack of representation and inclusion of underserved communities and their needs in LISS decision-making and implementation.

**Goals**

To improve **DEIJ (Diversity, Equity, Inclusion, and Justice)** literacy among existing partners or ensure an inclusive work environment and to effectively view projects through a DEIJ lens.

To meaningfully engage disadvantaged and underserved groups in LISS decision-making processes.

To ensure all EJ needs within the watershed are fully identified and addressed.

**Objectives**

Identify barriers to LISS representation and access to resources.

Examine LISS implementation projects and develop a process to hold the program accountable to EJ priorities.

Set aside funds for EJ engagement and implementation.

Establish meaningful strong working relationships with diverse and underrepresented groups.

Create mechanisms, resources, programs, etc as necessary to support the meaningful involvement of new partners in LISS work groups (WGs) and communities.

**Tasks**

FY 2022    FY 2023    FY 2024    FY 2025

**1.** Engagement starting with 3-5 areas per state

**2.** EJ needs assessment

**3.** Internal assessment

**4.** DEIJ trainings

**5.** LISS community impact fund

**6.** Exploration or EJ commitee

**7.** Conversations with LISS WG (EJ Lens Exploration)

**Outputs/Results**

Community needs and barriers participation identified (**1,2,6**)

New collaboration and connections with local groups (**1,5,6**)

Programmatic gaps, barriers, and needs identified and needed trainings/changes initiated (**3,4,6,7**)

Some EJ needs addressed locally (**5,6**)

More stakeholders have access to LISS resources (**5,6,7**)

Progress towards representative decicion-making (**1,2,3,4,5,6,7**)

LISS EJ WG Integration (IAs, evaluation criteria etc). (**6,7**)
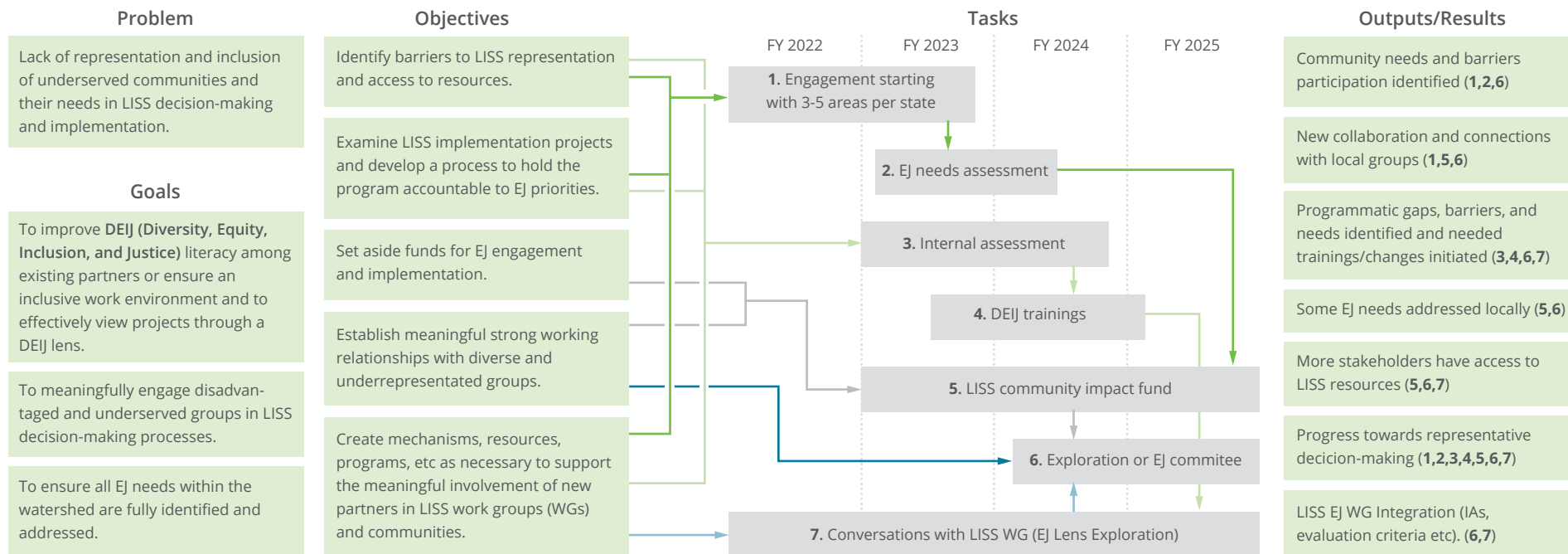
Figure 9. The LISS Environmental Justice Work Group has outlined program goals, objectives, tasks, and outputs.

resulted from nearly three decades of work, oodles of cash, adherence to science, and relentless focus by government at all levels, buoyed by public support for the environment."

## Integrating Environmental Justice into Management

The LISS created the Environmental Justice Work Group (EJWG) to specifically drive progress in this cross-cutting principle. The work group kicked off a year-long planning process in autumn 2020.

The EJWG, chaired by staff from EPA and NY Sea Grant, developed a work plan defining goals and objectives and the tasks and outputs to complete over the next five years (Figure 9). Work group tasks focus on expanding EJ considerations within the LISS partnership, meaningfully engaging underserved and underrepresented groups in decision-making processes (SM-17), and working to address EJ needs within the watershed (SC-4).

The work group has started

to promote the integration of EJ throughout many of the LISS programs and processes. Work group members are creating strategies to expand the program's outreach to new communities and partners to diversify the perspectives and participants in the program. The focus of this work group to advance EJ goals represents a new initiative to achieve more inclusive management in terms of the people involved in decision-making and the principles advanced through the LISS.

LISS in partnership with Bronx Children's Museum helped to host Sound Stewards programs at Pelham Bay Park and Orchard Beach. Students participated in collecting and studying water quality parameters (temperature, salinity, and pH) while simulating the field component of our Unified Water Study. Most of the excitement stemmed from close encounters with a diversity of aquatic life, including horseshoe crabs and fish.

Dedicated work group members across non-profit, government, and academic sectors contributed their knowledge and experiences to develop the work plan and remain engaged in work group meetings and implementation activities.

## New Web Application to Measure Hypoxic Area and Volume Reinforces Their Decline

The severity of hypoxia has for many years been characterized by estimating the area of Long Island Sound bottom waters with less than three milligrams of oxygen per liter. In 2021, CT DEEP and Dr. James O'Donnell of the University of Connecticut unveiled a new web application to make exploring those data easier for users. Funded by the LISS, the tool allows users to calculate Long Island Sound hypoxic area and volume using a variety of dissolved oxygen threshold values. Hypoxic volume is important because it describes the extent of hypoxia not only in bottom waters, but throughout the water column, which is more useful in determining the impact of low oxygen on the biota. Using the tool to evaluate 26 years of data, the researchers concluded that despite the annual variability in the area and volume of hypoxia, there is convincing evidence that both hypoxic area and volume have declined over time due to the decrease in nitrogen loading, further supporting the evidence documented in the research paper described in the first success story. This is important because it shows that the 60 percent reduction in nitrogen loading that was achieved in 2016 has reduced the area of waters unhealthy for fish. Hypoxia has always been a primary concern in Long Island Sound, and this is one of the limited documented examples of widespread hypoxia reduction in a coastal estuary.

## Looking Ahead

The LISS will continue to support applied research, monitoring, and modeling to understand and solve the environmental challenges facing Long Island Sound, as detailed in the April 2022 Science Needs document. The LISS Research Grant Program involves the region's academic community in applying new techniques and approaches to problems, longstanding and new. This research, along with other science efforts supported by the program, contributes new insights that inform management decisions to protect and restore the Sound.

As the LISS monitoring and modeling efforts have increased, the program has a growing need for improved data access, management, integration, and visualization. Numerous efforts are underway by LISS partners to ensure that data is preserved and protected, and ultimately turned into accessible information to guide improved management.
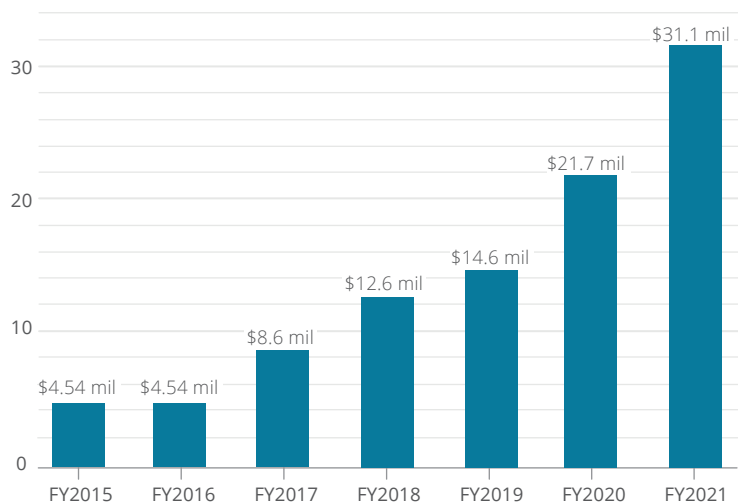
# Funding

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 (through 2023) to the LISS under Section 119. Funding for the LISS has increased since 2015, reaching $31.1 million in 2021. The increased funding has resulted in many more implementation projects on the ground, and therefore enhanced improvements in Long Island Sound. Each year, the LISS Management Conference develops a work plan to implement projects based on appropriations approved by Congress. Grant recipients 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 LISS and its partners, are available at *longislandsoundstudy.net* in the Reports section.
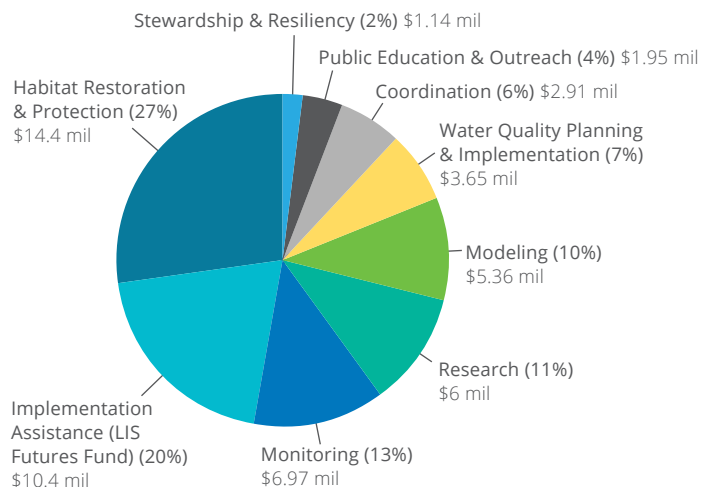
**Importantly, for every federal dollar appropriated to the program from 2020 to 2021, LISS partners leveraged an additional $8 to implement projects,** more than $447 million in total, demonstrating a great return on investment and reflecting the broader regional commitment to restore and protect the Sound.
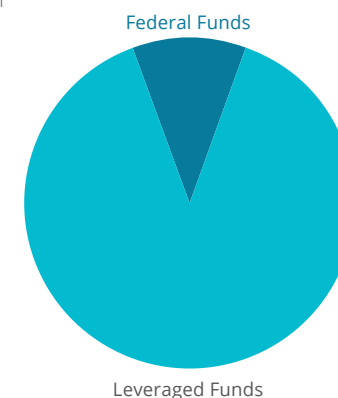
**Long Island Sound Study Funding**

Total Enacted Funding per Federal Fiscal Year (Millions of Dollars)



**Total Budget by Program Element**

Average Percent of Budget FY 2020 – 2021



Stewardship & Resiliency (2%) $1.14 mil
Public Education & Outreach (4%) $1.95 mil
Coordination (6%) $2.91 mil
Water Quality Planning & Implementation (7%) $3.65 mil
Modeling (10%) $5.36 mil
Research (11%) $6 mil
Monitoring (13%) $6.97 mil
Implementation Assistance (LIS Futures Fund) (20%) $10.4 mil
Habitat Restoration & Protection (27%) $14.4 mil

**Leveraged Ratio of Federal Funds**

8:1 Leveraging Ratio



Federal Funds

Leveraged Funds

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