Comprehensive Conservation and Management Plan 2020

Supplemental Document 4

Sound Science and Inclusive Management (SM) Theme

Implementation Actions 2020–2024

Summary Table. Sound Science and Inclusive Management (SM) Implementation Actions

Implementation Actions (IAs) have been formulated to carry out the SM strategies. The IAs are listed in the table with highest priority actions shaded in **bold blue**. The major strategies addressed by the action are also listed in the table.

IA Number	Implementation Action Title	Major Strategy Addressed
SM-1	**Regularly update and refine the high-priority science needs relating to the understanding and attainment of management objectives and ecosystem targets.**	**4-1a1, 1-1a7, 1-3a2, 2-4a4**
SM-2	Complete seafloor mapping conducted under the Sound Cable Fund, and use results to guide additional mapping.	4-1b1
SM-3	Refine and expand the data supporting coastal and marine spatial planning under the Blue Plan for Long Island Sound.	4-1b2
SM-4	Develop metadata for major monitoring programs relevant to LISS Ecosystem Targets for use in an Integrated Data Management Plan including community science.	4-1b3, 1-3b1, 1-3b3, 1-3c1, 1-3c2
SM-5	Develop an Integrated Data Management Plan considering local, regional, and national observing initiatives.	4-1b3, 1-3b1, 1-3b3, 1-3c1, 1-3c2
SM-6	Re-interpolate aerial estimates of hypoxia, from 1991 to present, using both CTDEEP and IEC data.	4-1b3
SM-7	Continue National Coastal Condition Assessment monitoring of Long Island Sound.	4-1b3
SM-8	**Coordinate and leverage community water quality monitoring programs, enhancing the utility and application of data.**	**4-1b4**
SM-9	Assess options for establishing a secure, long-term Long Island Sound data portal, such as LIQWIDS, that can access other data systems, including WQX.	4-1b5
SM-10	Ensure all geospatial data needed for LISS Ecosystem Targets is formatted and has sufficient metadata to be interoperable among common GIS applications.	4-1b5
SM-11	**By 2024, complete the Integrated Systemwide Modeling Tool to support nitrogen management and Dissolved Oxygen TMDL assessment.**	**4-1c1, 1-3a2**
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.**	**4-1c1, 1-3a2**
SM-13	Continue program administrative, financial, and technical assistance support to Management Conference.	4-2a1

IA Number	Implementation Action Title	Major Strategy Addressed
SM-14	Continue state program coordination and involvement in the Management Conference.	4-2a1
SM-15	Optimize structure and function of the Management Conference with a focus on implementation of the revised CCMP.	4-2a1
SM-16	Reauthorize Clean Water Act sections 119 and 320 in 2024.	4-2a1
SM-17	**Establish and implement practices to effectively engage underrepresented stakeholders and communities in CCMP implementation and LISS Management Conference decision-making.**	**4-2a1**
SM-18	**Convene senior EPA and State management to help direct, inform, and coordinate policy relevant to Long Island Sound.**	**4-2a3**
SM-19	Foster continued involvement of the tributary states in Management Conference activities relating to nutrient science and management.	4-2a4, 1-1a3, 1-1a4, 1-1a7, 1-3b1
SM-20	**Support the refinement and application of the Long Island Sound Blue Plan to more comprehensively manage Long Island Sound resources.**	**4-2a5**
SM-21	**Conduct primary valuations of the critical ecosystem goods and services supported by Long Island Sound and its coastal habitats.**	**4-2b1**
SM-22	Conduct return-on investment analysis for Long Island Sound restoration and preservation strategies to inform priority-setting for implementation of the CCMP.	4-2b1
SM-23	Capitalize Connecticut Clean Water Fund and New York State Revolving Fund adequately to finance Clean Water infrastructure needs.	4-2b2
SM-24	**Research and develop innovative, locally appropriate funding mechanisms to provide sustained, reliable sources of investment capital to restore and protect ecosystem services.**	**4-2b2**
SM-25	Coordinate, collaborate and leverage funding opportunities with the Long Island Sound National Estuarine Research Reserve for implementation and restoration, science, and public involvement and education projects.	4-2b2, 1-3c1, 3-1b1, 4-1b3
SM-26	Incorporate climate change-driven factors such as temperature, acidification, and sea level rise in model applications to assess factors that can influence future attainment of water quality standards and habitat protection and restoration goals.	4-3a1, 1-1a8, 1-3b3
SM-27	Determine how climate change will impact attainment of CCMP Ecosystem Targets, goals and objectives using LISS vulnerability assessment and other resources.	4-3a1
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.	4-3a1, 1-3a1

IA Number	Implementation Action Title	Major Strategy Addressed
SM-29	Continue collaboration with Connecticut Institute for Resiliency and Climate Adaption (CIRCA).	4-3a2
SM-30	**Refine the ecosystem metrics and targets based on the underlying science of the Long Island Sound ecosystem to clearly identify the characteristics of a "restored" Long Island Sound.**	**4-3b1**
SM-31	Incorporate bioextraction analyses in Dissolved Oxygen TMDL assessments on the assimilative capacity of Long Island Sound to process nutrients without loss of designated uses.	4-3b2, 1-1a3
SM-32	By 2024, update the CCMP tracking system to address GAO recommendations and communicate progress to the public.	4-3b3
SM-33	Continue to issue "report cards" on water quality conditions in Long Island Sound that are easily understood by the public and scientifically defensible.	4-3b3
SM-34	Refine and communicate information on the Long Island Sound ecosystem and watershed using environmental indicators (drivers, pressures, conditions, and response indicators).	4-3b3
SM-35	Develop annual Long Island Sound Study work plans that consider progress made and recommendations for improving implementation to achieve desired outcomes.	4-3b4
SM-36	**Every five years develop a comprehensive, specific, target-oriented implementation plan engaging all Long Island Sound partners.**	**4-3b4**
SM-37	**In 2021, develop a Sustainable and Resilient Communities five-year plan that identifies specific actions, which, when approved by the Management Conference, will be added to the 2020 CCMP update.**	**4-3b4, 3-4a1, 3-4b1, 3-4b2, 1-1a6, 1-1a8, 1-1c1, 1-1b2**

Implementation Action: SM-1

Regularly update and refine the high-priority science needs relating to the understanding and attainment of management objectives and ecosystem targets.

Theme: Sound Science and Inclusive Management
Goal: Manage Long Island Sound using sound science and cross-jurisdictional governance that is inclusive, adaptive, innovative, and accountable.
Outcome: 4-1: The scientific understanding of Long Island Sound to support management is increased through strengthened research, monitoring, assessment, mapping, and modeling.
Objective: 4-1a: To enhance the research portfolio to answer questions relevant to Long Island Sound management.
Strategy: 4-1a1: Identify and support science activities needed to transparently link outcomes and objectives to strategies and actions, setting priorities based on management relevance and scientific merits. 1-1a7: Improve comprehensive management and performance of decentralized wastewater treatment systems, and residential, on-site wastewater treatments systems (OSWTSs). 1-3a2: Better understand eutrophication dynamics, effects, and mechanisms and continue support for modeling and synthesis efforts and their application to management scenarios. 2-4a4: Identify water quality conditions necessary to support priority habitats and use suitability models to evaluate appropriate restoration priorities through pollution controls.

Project Description/Background: Science is an integral element of integrated management of the ecosystem. This action will regularly update and refine the high-priority science needs relating to the understanding and attainment of management objectives and ecosystem targets. The science needs assessment will build upon the *Long Island Sound: Prospects for the Urban Sea* (Latimer et. al., 2014) synthesis book to identify the science needed to support the attainment of management objectives and ecosystem targets in the CCMP update. The Long Island Sound Study (LISS) will annually consider elements of science needs that are a high-priority. Accurate and timely scientific information is necessary to support optimal management options to protect and restore Long Island Sound. The LISS has supported Biennial solicitations for scientific research that over the past 20 years has resulted in 40 investigations, numerous publications, and improved knowledge upon which to base management of Long Island Sound. The Connecticut and New York Sea Grant Programs also conduct biennial research competitions that can provide support for Long Island Sound research.

Cooperators and Partners: LISS MC, LISS STAC, NYSG, and CTSG.

Funding Sources: LISS program funds.

Funding Needs: $ for staff time, website development, and possible consultant support.

Expected Outputs:
- A searchable database and website collating all past funded scientific projects (including associated final reports and publications appended)
- Continually updated Science Needs Assessment (i.e., research, monitoring, assessment, and modeling) to support the attainment of management objectives and ecosystem targets
- Research results published in peer-reviewed scientific journals
- New knowledge that supports the attainment of CCMP goals and objectives

Performance Metric(s):
- A fully functional website of past scientific projects (searchable, with research products)
- A fully functional website/report with enumerated scientific priorities for the subsequent five years tied to CCMP goals and objectives

Expected Timeframe: Ongoing; 2020-2024.

Implementation Action: SM-2

Complete Seafloor Mapping conducted under the Sound Cable Fund, and use results to guide additional mapping.

Theme: Sound Science and Inclusive Management
Goal: Manage Long Island Sound using sound science and cross-jurisdictional governance that is inclusive, adaptive, innovative, and accountable.
Outcome: 4-1: The scientific understanding of Long Island Sound to support management is increased through strengthened research, monitoring, assessment, mapping, and modeling.
Objective: 4-1b: To maintain and enhance monitoring and assessment programs to increase understanding of Long Island Sound and assess progress toward management outcomes.
Strategy: 4-1b1: Characterize, inventory, and map open and shallow water habitats to support resource management and marine spatial planning.

Project Description/Background: As a condition for permitting an underwater cable in Long Island Sound, a 2004 settlement between the states of Connecticut and New York, two power companies, and a cable company provided funding for a Long Island Sound Research and Restoration Fund. CTDEEP, NYSDEC, and EPA directed that the fund be used to map the seafloor of Long Island Sound to provide sound science in support of future review of proposed projects. A Sound Cable Fund Steering Committee is overseeing the mapping effort being conducted by a consortium of federal and university scientists. In an effort to better understand, describe, and analyze these seafloor (or "benthic") environments federal and state agencies, regional organizations, and academic institutions use high resolution underwater imaging techniques to characterize and map specific geographic locations. In 2012, three areas of the Long Island Sound were identified to develop a multi-phased benthic mapping effort. In 2014, Phase I of the Long Island Sound Cable Fund Habitat Mapping Initiative was completed, where data collection, analysis, data organization, and product development tasks were conducted in the central Sound, designated as the Phase I Pilot Area. This phase evaluated the entire process needed to comprehensively map the seafloor habitats and develop desired products on a subset of the larger Long Island Sound project area. In 2017, Phase II of the Cable Fund Habitat Mapping Initiative began, where the eastern Sound, from west of Connecticut River to Fishers Island Sound, was focused on. Planning for Phase III of the Initiative is in the initial stages. This action will complete the Seafloor Mapping Initiative and use results to guide additional mapping.

Cooperators and Partners: Cable Fund Steering Committee (i.e., EPA Region 1 and Region 2, NYSDEC, CTDEEP, CTSG, NYSG).

Funding Sources: Lawsuit settlement.

Funding Needs: $$$$. Approximately $7M was made available through the settlement fund. As products are completed, the cost of obtaining additional spatial coverage or detail will be assessed.

Expected Outputs:
- Completed digital maps of Long Island Sound seafloor environment including: acoustic intensity and seafloor topography, sediment texture and grain size distribution, sedimentary environment and chemistry, benthic habitats and ecological processes, and physical oceanographic characterization
- Increased understanding of the general physical, chemical, and biologic nature of the Long Island Sound seafloor

Performance Metric(s):
- Percent of Long Island Sound mapped
- Products used in support of infrastructure planning
- Demarcation of species and habitats

Expected Timeframe: Discrete; 2020-2024.

Implementation Action: SM-3

Refine and expand the data supporting coastal and marine spatial planning under the Blue Plan for Long Island Sound.

Theme: Sound Science and Inclusive Management
Goal: Manage Long Island Sound using sound science and cross-jurisdictional governance that is inclusive, adaptive, innovative, and accountable.
Outcome: 4-1: The scientific understanding of Long Island Sound to support management is increased through strengthened research, monitoring, assessment, mapping, and modeling.
Objective: 4-1b: To maintain and enhance monitoring and assessment programs to increase understanding of Long Island Sound and assess progress toward management outcomes.
Strategy: 4-1b2: Characterize, inventory, and map human uses, both recreational and commercial, of open and shallow water habitats to support resource management and marine spatial planning.

Project Description/Background: Coastal and Marine Spatial Planning (CMSP) is a process that brings together multiple users of the ocean—including energy, industry, government, conservation, and recreation—to make informed and coordinated decisions about how to use marine resources sustainably. CMSP generally uses maps to create a more comprehensive picture of a marine area—identifying where and how an ocean area is being used and what natural resources and habitats exist. It is similar to land-use planning, but for marine waters. This action will refine and expand the data supporting CMSP under the Long Island Sound Blue Plan (https://portal.ct.gov/-/media/DEEP/coastal-resources/LIS_blue_plan/blueplanfinaldraftversion12september2019pdf.pdf). The ultimate purpose of the Blue Plan is to facilitate a transparent, science-based decision-making process for the preservation of the Sound's ecosystems and resources, while protecting its traditional uses. The plan provides an inventory of the Sound's natural resources and uses and establishes a spatial plan to guide future use of the waters and submerged lands.

Cooperators and Partners: CTDEEP, Long Island Sound Resource and Use Inventory and Blue Plan Advisory Committee.

Funding Sources: LISS; Sound Cable Fund; In-kind services for identification of data, multiple potential sources for data collection.

Funding Needs: $$

Expected Outputs:
- Increased coordination and collaboration among partners and stakeholders
- Increased meaningful public participation

Performance Metric(s):
- Number of projects resulting in data supporting coastal and marine spatial planning

Expected Timeframe: Discrete; 2020-2024.

Implementation Action: SM-4

Develop metadata for major monitoring programs relevant to LISS Ecosystem Targets for use in an Integrated Data Management Plan including community science.

Theme: Sound Science and Inclusive Management
Goal: Manage Long Island Sound using sound science and cross-jurisdictional governance that is inclusive, adaptive, innovative, and accountable.
Outcome: 4-1: The scientific understanding of Long Island Sound to support management is increased through strengthened research, monitoring, assessment, mapping, and modeling.
Objective: 4-1b: To maintain and enhance monitoring and assessment programs to increase understanding of Long Island Sound and assess progress toward management outcomes.
Strategy: 4-1b3: Evaluate, enhance, integrate, and coordinate ongoing monitoring programs. 1-3b1: Improve identification and source tracking of nonpoint sources (e.g., watershed, groundwater, atmospheric deposition) and sinks of nutrients and their impacts on water and habitat quality. 1-3b3: Improve understanding of climate change (e.g., acidification, sea level rise, temperature) on Long Island Sound water and habitat quality and biota, and their interaction with other water quality issues (e.g., eutrophication). 1-3c1: Support collaboration between Long Island Sound Study (LISS) partner organizations including upper basin agencies/partners (USGS, CTDEEP, CTDOA, NYSDEC, MassDEP, SCDHS, etc.) to improve utility of monitoring data and the sentinel monitoring program. 1-3c2: Implement improved data storage and sharing solutions to support collaboration and incorporation of data into management decisions.

Project Description/Background: Assessing the status and trends of the condition of Long Island Sound requires regular measurements of important ecological variables. The LISS has funded water quality monitoring since 1987, adding elements over time and supporting survey of important habitats. Many different partners are involved in this data collection, and there is a need for a metadata index to be developed, and then synthesized and stored in a centralized location. This action will help develop metadata for major monitoring programs relevant to the LISS Ecosystem Targets for use in an Integrated Monitoring Data Management Plan (LIS-IMP) including community science. The plan will include an upgrade and integration assessment of the collection and analysis methods of the multiple agencies that currently comprise the program. Planning should consider offshore monitoring objectives related to assessment of wind energy activities and essential fish habitats, as well as focus on local embayment monitoring.

Cooperators and Partners: EPA, NOAA, USGS, NYSDEC, CTDEEP, IEC, LISS STAC.

Funding Sources: LISS program funds.

Funding Needs: $$

Expected Outputs:
- Documented metadata for major monitoring programs
- Compilation of metadata in a centralized location

Performance Metric(s):
- Modifications in the monitoring program incorporating metadata

Expected Timeframe: Discrete; 2020-2024.

Implementation Action: SM-5

Develop an Integrated Data Management Plan considering local, regional, and national observing initiatives.

Theme: Sound Science and Inclusive Management
Goal: Manage Long Island Sound using sound science and cross-jurisdictional governance that is inclusive, adaptive, innovative, and accountable.
Outcome: 4-1: The scientific understanding of Long Island Sound to support management is increased through strengthened research, monitoring, assessment, mapping, and modeling.
Objective: 4-1b: To maintain and enhance monitoring and assessment programs to increase understanding of Long Island Sound and assess progress toward management outcomes.
Strategy: 4-1b3: Evaluate, enhance, integrate, and coordinate ongoing monitoring programs. 1-3b1: Improve identification and source tracking of nonpoint sources (e.g., watershed, groundwater, atmospheric deposition) and sinks of nutrients and their impacts on water and habitat quality. 1-3b3: Improve understanding of climate change (e.g., acidification, sea level rise, temperature) on Long Island Sound water and habitat quality and biota, and their interaction with other water quality issues (e.g., eutrophication). 1-3c1: Support collaboration between Long Island Sound Study (LISS) partner organizations including upper basin agencies/partners (USGS, CTDEEP, CTDOA, NYSDEC, MassDEP, SCDHS, etc.) to improve utility of monitoring data and the sentinel monitoring program. 1-3c2: Implement improved data storage and sharing solutions to support collaboration and incorporation of data into management decisions.

Project Description/Background: The LISS has funded water quality monitoring since 1987, adding elements over time and supporting survey of important habitats. This program involves multiple agencies and sources. There is a need to develop a holistic framework to provide data users with an efficient means to access, download, evaluate, or otherwise utilize the data from these multiple sources. In addition, there are significant historical data that need to be rescued and included into a digital form that is usable by the scientific community. A Long Island Sound Integrated Data Management Plan (LIS-IDP) should be able to serve the multiple needs of the Long Island Sound community while also allowing seamless access to regional and national observing systems. The plan will incorporate completed and ongoing efforts including the thought process that went into the development of LIQWIDS, a water-quality data collaboration system; the development of a community science database and data visualization tools; and the outputs from the Integrated Systemwide Eutrophication Modeling.

Cooperators and Partners: EPA, NOAA, USGS, NYSDEC, CTDEEP, IEC, LISS STAC.

Funding Sources: LISS program funds.

Funding Needs: $$

Expected Outputs:
- Adopted guidelines and systems to store, manage, and access data
- A Long Island Sound Integrated Data Management Plan

Performance Metric(s):
- Improved identification and access of historical and current data from multiple sources

Expected Timeframe: Discrete; 2020-2024.

Implementation Action: SM-6

Re-interpolate aerial estimates of hypoxia, from 1991 to present, using both CTDEEP and IEC data.

Theme: Sound Science and Inclusive Management
Goal: Manage Long Island Sound using sound science and cross-jurisdictional governance that is inclusive, adaptive, innovative, and accountable.
Outcome: 4-1: The scientific understanding of Long Island Sound to support management is increased through strengthened research, monitoring, assessment, mapping, and modeling.
Objective: 4-1b: To maintain and enhance monitoring and assessment programs to increase understanding of Long Island Sound and assess progress toward management outcomes.
Strategy: 4-1b3: Evaluate, enhance, integrate, and coordinate ongoing monitoring programs.

Project Description/Background: Assessing the status and trends of the condition of Long Island Sound requires regular measurements of important ecological variables. Since 1991, CTDEEP has been providing monitoring support for the measurement of hypoxia related environmental variables in Long Island Sound. In addition, IEC has been providing similar monitoring support for the western-most areas of Long Island Sound. The action will re-interpolate aerial estimates of hypoxia, from 1991 to present, using both the CTDEEP and IEC monitoring data.

Cooperators and Partners: EPA, NYSDEC, CTDEEP, IEC, LISS STAC through a water quality monitoring work group.

Funding Sources: LISS program funds.

Funding Needs: $; Most of the work is being performed in-house through the work group.

Expected Outputs:
- A modified aerial estimates of hypoxia using CTDEEP and IEC data

Performance Metric(s):
- Incorporation IEC data in the Sound-wide data analysis and representation

Expected Timeframe: Discrete; 2020-2024.

Implementation Action: SM-7

Continue National Coastal Condition Assessment monitoring of Long Island Sound.

Theme: Sound Science and Inclusive Management
Goal: Manage Long Island Sound using sound science and cross-jurisdictional governance that is inclusive, adaptive, innovative, and accountable.
Outcome: 4-1: The scientific understanding of Long Island Sound to support management is increased through strengthened research, monitoring, assessment, mapping, and modeling.
Objective: 4-1b: To maintain and enhance monitoring and assessment programs to increase understanding of Long Island Sound and assess progress toward management outcomes.
Strategy: 4-1b3: Evaluate, enhance, integrate, and coordinate ongoing monitoring programs.

Project Description/Background: To address questions about national coastal condition, the EPA participates in a multi-agency effort to assess the condition of the nation's coastal resources. The agency chose to assess condition using nationally consistent monitoring surveys to minimize the problems created by compiling data collected using multiple approaches. The results of these assessments are compiled periodically into a National Coastal Condition Assessment (NCCA). This series of reports contains one of the most comprehensive ecological assessments of the condition of our nation's coastal bays and estuaries (EPA, 2012). In 2015 and 2020, CTDEEP conducted a field program under the NCCA Program to characterize nutrients, sediments, and benthic macroinvertebrate communities at 23 open water sites of the Long Island Sound. In addition, LISS has provided $500,000 of FY2020 funds to extend this effort to 60 sites in Long Island Sound embayments, where the NCCA will also be implemented. By continuing these efforts, the health of Long Island Sound harbor and bays will be assessed, in which those assessments will be linked to human pressures, and subsequently improve and protect water quality, habitat, and biological and ecological diversity in the Sound and its embayments.

Cooperators and Partners: EPA, CTDEEP, and research institutions.

Funding Sources: EPA.

Funding Needs: $$$

Expected Outputs:
- Field data incorporated into the EPA National Coastal Condition Assessment

Performance Metric(s):
- Field work conducted
- Environmental indicators using the data are updated

Expected Timeframe: Ongoing; 2020-2024.

Reference: EPA, 2012. National Coastal Condition Report IV. U. S. Environmental Protection Agency, Office of Research and Development, Office of Water, Washington, D. C., EPA-842-R-10-003, 368 pp.

Implementation Action: SM-8

Coordinate and leverage community water quality monitoring programs, enhancing the utility and application of data.

Theme: Sound Science and Inclusive Management
Goal: Manage Long Island Sound using sound science and cross-jurisdictional governance that is inclusive, adaptive, innovative, and accountable.
Outcome: 4-1: The scientific understanding of Long Island Sound to support management is increased through strengthened research, monitoring, assessment, mapping, and modeling.
Objective: 4-1b: To maintain and enhance monitoring and assessment programs to increase understanding of Long Island Sound and assess progress toward management outcomes.
Strategy: 4-1b4: Strengthen monitoring of conditions in embayments and near-shore waters, and integrate the resulting data and assessments into open water monitoring programs.

Project Description/Background: In order to gage the effectiveness of management and restoration projects, it is necessary to have near-shore water quality and other data available. From the funded LISS analysis aimed to evaluate the feasibility of developing a framework for coordinating community-based water quality monitoring groups around the Sound, the Unified Water Study (UWS) was formed in 2017. By 2020, the UWS has expanded to include 23 groups monitoring 40 embayments. The UWS educates and encourages residents to take an active role in their community and be responsible stewards for their environment. This action will continue to coordinate, leverage, and expand these water quality monitoring programs. Additionally, to further enhance the utility and application of these collected data, efforts are underway to advance data management, in which, through the development of a database and data visualization tools used by community scientists and others monitoring the waters and natural resources of Long Island Sound.

Cooperators and Partners: LISS, Save the Sound.

Funding Sources: LISS program funds.

Funding Needs: $$$

Expected Outputs:
- Continue to support community water quality monitoring programs, including the UWS
- Development of a database and data visualization tools

Performance Metric(s):
- Number of water quality monitoring programs
- Number of community scientists or groups involved in programs
- Number of embayments sampled

Expected Timeframe: Ongoing; 2020-2024.

Implementation Action: SM-9

Assess options for establishing a secure, long-term Long Island Sound data portal, such as LIQWIDS, that can access other data systems, including WQX.

Theme: Sound Science and Inclusive Management
Goal: Manage Long Island Sound using sound science and cross-jurisdictional governance that is inclusive, adaptive, innovative, and accountable.
Outcome: 4-1: The scientific understanding of Long Island Sound to support management is increased through strengthened research, monitoring, assessment, mapping, and modeling.
Objective: 4-1b: To maintain and enhance monitoring and assessment programs to increase understanding of Long Island Sound and assess progress toward management outcomes.
Strategy: 4-1b5: Improve regional identification, storage, and sharing of spatial and temporal data.

Project Description/Background: Over the past few years significant support has been growing for integration of LISS monitoring data/programs with regional data collection initiatives. This action will assess options for establishing a secure, long-term Long Island Sound data portal, such as the Long Island Water Quality Integrated Data System (LIQWIDS), that can access other data systems, including Water Quality Exchange (WQX). LIQWIDS is a water-quality collaboration system which allows users, such as, NYSDEC, Long Island Regional Planning Council, officials from Nassau and Suffolk Counties, and other stakeholders to access a data portal with a map-based user interface to share ambient monitoring data. The WQX is the mechanism for data partners to submit water monitoring data to EPA. The development of a Long Island Sound data portal that accesses other data systems, like WQX, will better integrate monitoring data from a variety of partners.

Cooperators and Partners: LISS MC and STAC, federal and state agencies.

Funding Sources: LISS program funds.

Funding Needs: $

Expected Outputs:
- Development of a strategic plan outlining steps and resources needed to establish a secure, long-term Long Island Sound data portal

Performance Metric(s):
- Strategic plan in coordination with STAC
- Submission of strategic plan to LISS MC

Expected Timeframe: Discrete; 2020-2024.

Implementation Action: SM-10

Ensure all geospatial data needed for LISS Ecosystem Targets is formatted and has sufficient metadata to be interoperable among common GIS applications.

Theme: Sound Science and Inclusive Management
Goal: Manage Long Island Sound using sound science and cross-jurisdictional governance that is inclusive, adaptive, innovative, and accountable.
Outcome: 4-1: The scientific understanding of Long Island Sound to support management is increased through strengthened research, monitoring, assessment, mapping, and modeling.
Objective: 4-1b: To maintain and enhance monitoring and assessment programs to increase understanding of Long Island Sound and assess progress toward management outcomes.
Strategy: 4-1b5: Improve regional identification, storage, and sharing of spatial and temporal data.

Project Description/Background: In 2012, LISS secured a consultant, Corbel Analytics, to aid in the development of a comprehensive Geographic Information Systems (GIS) needs assessment to serve the needs of all of the LISS partners. The report, completed in 2013, recommended a number of steps that could improve the use and application of Long Island Sound data through regional GIS. This action will ensure all geospatial data needed for LISS Ecosystem Targets is formatted and has sufficient metadata to be interoperable among common GIS applications.

Cooperators and Partners: LISS.

Funding Sources: LISS program funds.

Funding Needs: $$ - Implementation costs/year; In-house staff evaluation.

Expected Outputs:
- Funded projects with geospatial data have sufficient metadata

Performance Metric(s):
- Number of geospatial applications

Expected Timeframe: Ongoing; 2020-2024.

Implementation Action: SM-11

By 2024, complete the Integrated Systemwide Modeling Tool to support nitrogen management and Dissolved Oxygen TMDL assessment.

Theme: Sound Science and Inclusive Management
Goal: Manage Long Island Sound using sound science and cross-jurisdictional governance that is inclusive, adaptive, innovative, and accountable.
Outcome: 4-1: The scientific understanding of Long Island Sound to support management is increased through strengthened research, monitoring, assessment, mapping, and modeling.
Objective: 4-1c: To develop and improve modeling capabilities to provide predictive assessments of resources, physical dynamics, and water quality.
Strategy: 4-1c1: Transition existing and new models to a community modeling framework that provides open source access to facilitate external collaboration, assessments, and enhancements. 1-3a2: Better understand eutrophication dynamics, effects, and mechanisms and continue support for modeling and synthesis efforts and their application to management scenarios.

Project Description/Background: The System Wide Eutrophication Model (SWEM) is a simulation model that has been used to relate nutrient loadings to water quality impairments in Long Island Sound and the New York/New Jersey Harbor. With LISS funding, UCONN, assisted by HDR, Inc., a) recalibrated the model in 2014 after making a series of technical improvements to its formulation; and b) took steps to advance the open-source accessibility of the model. The model is now more consistent with scientific observations in Long Island Sound of mixing, circulation, primary productivity, and respiration. However, the model fails to predict the observed minimums in dissolved oxygen. Therefore, this action, by 2024, will complete the Integrated Systemwide Modeling Tool to support nitrogen management and Dissolved Oxygen TMDL assessment. The Integrated Systemwide Modeling Tool will better describe dissolved oxygen concentrations, and also address new challenges such as warming temperatures, increasing precipitation and more development that can threaten progress that has been made. Under an agreement with EPA, the NYCDEP was funded in 2017, 2018, and 2019 to design a model that integrates physical and biochemical components, such as, water circulation, water mixing, sediment flux of nutrients, dissolved oxygen levels, water quality, and ecological conditions affecting seagrass, tidal marshes, and fish. The model will allow researchers to forecast how Long Island Sound may respond to changes in human (e.g., pollution), and natural (e.g., weather) drivers that impact the system. Additionally, the model will enable managers to evaluate potential impacts of point and nonpoint source discharges, and sediment fluxes on water quality. In 2020, to implement this action, NYCDEP has awarded a contract to HDR, Inc. to develop the new Integrated Systemwide Modeling Tool. One key recommendation is to increase the spatial resolution of modeling to better represent wind-driven, cross-Sound water transport. Modeling should also support linkage or nesting of finer scale models of nearshore areas where effects of waves, shoreline evolution, eutrophication, and water quality can be integrated.

Cooperators and Partners: LISS, NYCDEP, academic community, consultants, state and municipalities.

Funding Sources: LISS program funds.

Funding Needs: $$$

Expected Outputs:
- Development of a nitrogen management model, which can include further enhancements to SWEM or the development of alternate modeling tools
- Strengthen management and guide investments in pollution control
- Support compliance with regulatory goals (e.g., municipal stormwater, combined sewer overflows controls, TMDLs) at multiple scales
- Completion of the Integrated Systemwide Modeling Tool

Performance Metric(s):
- Improved calibration of model-predicted versus measured parameters

Expected Timeframe: Ongoing; 2020-2024.

Implementation Action: 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.

Theme: Sound Science and Inclusive Management
Goal: Manage Long Island Sound using sound science and cross-jurisdictional governance that is inclusive, adaptive, innovative, and accountable.
Outcome: 4-1: The scientific understanding of Long Island Sound to support management is increased through strengthened research, monitoring, assessment, mapping, and modeling.
Objective: 4-1c: To develop and improve modeling capabilities to provide predictive assessments of resources, physical dynamics, and water quality.
Strategy: 4-1c1: Transition existing and new models to a community modeling framework that provides open source access to facilitate external collaboration, assessments, and enhancements. 1-3a2: Better understand eutrophication dynamics, effects, and mechanisms and continue support for modeling and synthesis efforts and their application to management scenarios.

Project Description/Background: Coastal nitrogen source loading from surface and groundwater runoff are estimated using a variety of approaches. Eutrophication modeling would benefit from more refined estimates of this loading, both for individual embayment planning and Long Island Sound-wide planning. A number of efforts are underway, including estimates of nitrogen loads by embayment using the N-Load model, modeling the nitrogen load from regulated MS4 sources on Long Island, and researching groundwater fluxes of nitrogen. It is important to develop these individual system models, focusing on watersheds, groundwater, embayments and open water; however, to greatly improve the understanding of nutrient pollution impacts of the entire Long Island Sound system, these models need to be connected. This action will 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. LISS is supporting this action by using FY2020 funds to conduct multiple modeling projects. For example, CTDEEP and USGS were funded $260,000 to better understand locally important source of nutrients to coastal embayments, specifically determining the residence-time context for coastal groundwater flow systems and related effects on management scenarios that have an impact on nitrogen in the Long Island Sound. Additionally, NYSDEC was awarded $300,000 to develop a Solute Transport Model to facilitate informed decision-making on the local, state and regional level through insight into how nitrogen discharge will likely change in response to nitrogen mitigation efforts within the watershed.

Cooperators and Partners: LISS STAC/NEIWPCC, NYSDEC, CTDEEP, USGS.

Funding Sources: LISS program funds.

Funding Needs: $$$

Expected Outputs:
- Improved estimates of coastal nitrogen source loading from surface and groundwater runoff

Performance Metric(s):
- Number of embayments with source-specific loading estimates
- Characterization of relative importance of contributing sources (e.g., septic, turf fertilizer, etc.) to groundwater or surface runoff of nitrogen
- Improved Long Island Sound water quality model estimates of nutrient loads from surface and groundwater sources

Expected Timeframe: Ongoing; 2020-2024.

Implementation Action: SM-13

Continue program administrative, financial, and technical assistance support to Management Conference.

Theme: Sound Science and Inclusive Management
Goal: Manage Long Island Sound using sound science and cross-jurisdictional governance that is inclusive, adaptive, innovative, and accountable.
Outcome: 4-2: Actions are implemented through coordinated strategies by all levels of government and diverse stakeholders.
Objective: 4-2a: To increase communication, coordination, and reduce institutional barriers to cooperation on an ecosystem level among all levels of government, stakeholder groups, and the general public.
Strategy: 4-2a1: Maintain and enhance the Long Island Sound Management Conference as the coordinating entity to implement the CCMP, and expand opportunities for local government involvement.

Project Description/Background: EPA should continue to provide lead agency support, including program administrative, financial, and technical assistance, to the Management Conference consistent with the policies and requirements of Clean Water Act sections 119 and 320. This support has been centrally coordinated by an EPA Long Island Sound Office located in Stamford, CT since 1992.

Cooperators and Partners: EPA lead, with support from CTDEEP and NYSDEC.

Funding Sources: EPA.

Funding Needs: $$$/year for core program staff and functions.

Expected Outputs:
- Core LISS products and functions defined in annual work plans

Performance Metric(s):
- Completion of annual work plan products and activities

Expected Timeframe: Ongoing; 2020-2024.

Implementation Action: SM-14

Continue state program coordination and involvement in the Management Conference.

Theme: Sound Science and Inclusive Management
Goal: Manage Long Island Sound using sound science and cross-jurisdictional governance that is inclusive, adaptive, innovative, and accountable.
Outcome: 4-2: Actions are implemented through coordinated strategies by all levels of government and diverse stakeholders.
Objective: 4-2a: To increase communication, coordination, and reduce institutional barriers to cooperation on an ecosystem level among all levels of government, stakeholder groups, and the general public.
Strategy: 4-2a1: Maintain and enhance the Long Island Sound Management Conference as the coordinating entity to implement the CCMP, and expand opportunities for local government involvement.

Project Description/Background: The involvement of Connecticut and New York is critical to the successful management of Long Island Sound. State coordinators have worked to involve and integrate diverse state programs into Long Island Sound-focused management. In addition to the lead state agencies, CTDEEP and NYSDEC, involvement and coordination with sister state agencies (e.g., CTDPH, CTDOA, NYSDOS, NYSOPRHP, etc.) on issues relating to the management of Long Island Sound is vital. This action will continue state program coordination and involvement in the Management Conference.

Cooperators and Partners: CTDEEP and NYSDEC lead with financial support from EPA.

Funding Sources: EPA through Long Island Sound funding.

Funding Needs: $$/year for core program staff and functions.

Expected Outputs:
- Core LISS products and functions defined in annual work plans

Performance Metric(s):
- State staff participation in program projects and initiatives

Expected Timeframe: Ongoing; 2020-2024.

Implementation Action: SM-15

Optimize structure and function of the Management Conference with a focus on implementation of the revised CCMP.

Theme: Sound Science and Inclusive Management
Goal: Manage Long Island Sound using sound science and cross-jurisdictional governance that is inclusive, adaptive, innovative, and accountable.
Outcome: 4-2: Actions are implemented through coordinated strategies by all levels of government and diverse stakeholders.
Objective: 4-2a: To increase communication, coordination, and reduce institutional barriers to cooperation on an ecosystem level among all levels of government, stakeholder groups, and the general public.
Strategy: 4-2a1: Maintain and enhance the Long Island Sound Management Conference as the coordinating entity to implement the CCMP, and expand opportunities for local government involvement.

Project Description/Background: The Management Conference structure and function (committees, work groups, and advisory committees) must support the attainment of the CCMP goals and outcomes. To support this action, LISS has awarded Connecticut and New York Sea Grant $50,000, of FY2020 funds, to support the development of the new LISS Sustainable and Resilient Communities Working Group. The Group will undergo a year-long process to develop a focused and strategic five-year work plan to ultimately enhance the progress on the CCMP Sustainable and Resilient Communities theme.

Cooperators and Partners: LISS Management Committee lead, with support from advisory committees; NY and CT Sea Grant Leads the Sustainable and Resilient Communities Working Group.

Funding Sources: LISS program funds.

Funding Needs: $$

Expected Outputs:
- LISS Management Conference restructured as appropriate
- Development of a Sustainable and Resilient Communities strategic five-year work plan

Performance Metric(s):
- New structure communicated and implemented among program partners
- An engaged Sustainable and Resilient Communities Working Group meeting regularly to make progress on the five-year work plan

Expected Timeframe: Discrete; 2020-2024.

Implementation Action: SM-16

Reauthorize Clean Water Act sections 119 and 320 in 2024.

Theme: Sound Science and Inclusive Management
Goal: Manage Long Island Sound using sound science and cross-jurisdictional governance that is inclusive, adaptive, innovative, and accountable.
Outcome: 4-2: Actions are implemented through coordinated strategies by all levels of government and diverse stakeholders.
Objective: 4-2a: To increase communication, coordination, and reduce institutional barriers to cooperation on an ecosystem level among all levels of government, stakeholder groups, and the general public.
Strategy: 4-2a1: Maintain and enhance the Long Island Sound Management Conference as the coordinating entity to implement the CCMP, and expand opportunities for local government involvement.

Project Description/Background: Clean Water Act Sections 320 and 119 set the purpose and authority of the Long Island Sound Management Conference. Appropriations for Clean Water Act §119 – Long Island Sound Restoration Act of $40M annually were authorized through FY2023 under America's Water Infrastructure Act (AWIA) of 2018. For §119 – Long Island Sound Stewardship Act, appropriations of $25M annually were authorized through FY2023 under AWIA of 2018. For §320 – National Estuary Program (NEP), annual appropriations for the 28 estuary programs of $27M through FY2020 were authorized.

Cooperators and Partners: Congress lead with support from stakeholders.

Funding Sources: N/A

Funding Needs: $

Expected Outputs:
- Reauthorized Clean Water Act sections 119 and 320

Performance Metric(s):
- Sponsored legislation introduced and passed by Congress

Expected Timeframe: Discrete; 2020-2024.

Implementation Action: SM-17

Establish and implement practices to effectively engage underrepresented stakeholders and communities in CCMP implementation and LISS Management Conference decision-making.

Theme: Sound Science and Inclusive Management
Goal: Manage Long Island Sound using sound science and cross-jurisdictional governance that is inclusive, adaptive, innovative, and accountable.
Outcome: 4-2: Actions are implemented through coordinated strategies by all levels of government and diverse stakeholders.
Objective: 4-2a: To increase communication, coordination, and reduce institutional barriers to cooperation on an ecosystem level among all levels of government, stakeholder groups, and the general public.
Strategy: 4-2a1: Maintain and enhance the Long Island Sound Management Conference as the coordinating entity to implement the CCMP, and expand opportunities for local government involvement.

Project Description/Background: There is a need to broaden the conversation on environmental protection. The involvement and support of traditionally underrepresented groups is an important element of Environmental Justice (EJ) and can strengthen efforts to protect and restore Long Island Sound. This action will establish and implement practices to effectively engage underrepresented stakeholders and communities in CCMP implementation and LISS Management Conference decision-making. Activities to carry out this action can include inviting individuals, communities, or organizations to participate in LISS committee and work group meetings. The main focus over the next five years will be improving LISS engagement practices and increasing inclusion. There will be a priority on learning and sharing lessons learned with other agencies and NGOs. The goal is not to burden underrepresented communities with LISS engagement priorities but to expand the LISS' engagement practices and inclusion. Building relationships with new individuals and groups will be key. To help implement this action, LISS will conduct a needs assessment (see SC-4) which will actively engage EJ leaders, communities and young people in identifying needs, barriers and opportunities. The findings from the needs assessment will be incorporated into future Long Island Sound decision-making. Additionally, LISS may conduct a stakeholder mapping exercise to better understand gaps in the program's existing outreach efforts and identify groups that LISS is not currently reaching. The LISS Environmental Justice Work Group will recommend projects, programs, and initiatives to make progress on this action.

Cooperators and Partners: The LISS and participating organizations.

Funding Sources: LISS and agencies existing funding.

Funding Needs: $-$$

Expected Outputs:
- Members of organizations traditionally underrepresented in environmental policy development are involved in the LISS
- Stakeholder maps or other tools to understand gaps in representation
- Increase in new EJ communities and organizations engaged with LISS over multiple years (i.e., successful sustained engagement by LISS)

Performance Metric(s):
- Number of barriers to meetings reduced
- Number of new communities or organizations engaged
- Number of EJ communities engaged
- Number of internal trainings held
- Number of underrepresented groups to receive LISS support for CCMP implementation projects

Expected Timeframe: Ongoing; 2020-2024.

Implementation Action: SM-18

Convene senior EPA and State management to help direct, inform, and coordinate policy relevant to Long Island Sound.

Theme: Sound Science and Inclusive Management
Goal: Manage Long Island Sound using sound science and cross-jurisdictional governance that is inclusive, adaptive, innovative, and accountable.
Outcome: 4-2: Actions are implemented through coordinated strategies by all levels of government and diverse stakeholders.
Objective: 4-2a: To increase communication, coordination, and reduce institutional barriers to cooperation on an ecosystem level among all levels of government, stakeholder groups, and the general public.
Strategy: 4-2a3: Maintain EPA, NYSDEC, and CTDEEP support of the Management Conference to provide leadership and accountability.

Project Description/Background: The Long Island Sound Management Conference is led by a Policy Committee comprised of the Regional Administrators of EPA Regions 1 and 2, and the Commissioners of the CTDEEP, and NYSDEC. An Executive Steering Committee of division directors provides more frequent policy level input on Long Island Sound management.

Cooperators and Partners: EPA, CTDEEP, NYSDEC.

Funding Sources: LISS and agency existing funding.

Funding Needs: $; In kind work from existing staff.

Expected Outputs:
- Improved integration of federal and state programs priorities into Long Island Sound program activities

Performance Metric(s):
- Number of Policy Committee (one/year) and Executive Steering Committee meetings (three/year)

Expected Timeframe: Discrete; 2020-2024.

Implementation Action: SM-19

Foster continued involvement of the tributary states in Management Conference activities relating to nutrient science and management.

Theme: Sound Science and Inclusive Management
Goal: Manage Long Island Sound using sound science and cross-jurisdictional governance that is inclusive, adaptive, innovative, and accountable.
Outcome: 4-2: Actions are implemented through coordinated strategies by all levels of government and diverse stakeholders.
Objective: 4-2a: To increase communication, coordination, and reduce institutional barriers to cooperation on an ecosystem level among all levels of government, stakeholder groups, and the general public.
Strategy: 4-2a4: Enhance opportunities for cooperation and involvement of the tributary states of Massachusetts, New Hampshire, Rhode Island, and Vermont to address stressors that contribute to downstream effects on Long Island Sound. 1-1a3: Enhance implementation of the existing 2000 Dissolved Oxygen Total Maximum Daily Load throughout the watershed; and adapt and revise it based on monitoring, modeling, research, and how climate change may affect attainment of water quality standards in the future. 1-1a4: Ensure cross-department collaboration and cooperation at the municipal level to implement MS4 BMPs (e.g., involve highway departments). 1-1a7: Improve comprehensive management and performance of decentralized wastewater treatment systems, and residential, on-site wastewater treatments systems (OSWTSs). 1-3b1: Improve identification and source tracking of nonpoint sources (e.g., watershed, groundwater, atmospheric deposition) and sinks of nutrients and their impacts on water and habitat quality.

Project Description/Background: This action will foster continued involvement of the tributary states in the Management Conference activities relating to nutrient science and management. Massachusetts Department of Environmental Protection (MassDEP) now has a seat on the Management Committee. While distance and travel limitations may preclude regular, in-person attendance of staff from all the tributary states in Long Island Sound planning, there are opportunities to use technology to foster remote involvement. In 2017, the Technical Stakeholder Review Group was formed to actively involve all tributary states in the Nitrogen Reduction Strategy, which is a strategy to aggressively continue progress on nitrogen reductions, in parallel with State's continued implementation of the 2000 TMDL, and achieve water quality standards throughout the Long Island Sound and its embayments.

Cooperators and Partners: EPA, CTDEEP, NYSDEC, MassDEP, NHDES, VTDEP.

Funding Sources: LISS and agency existing resources.

Funding Needs: $$/year

Expected Outputs:
- Improved integration of federal and state programs priorities into Long Island Sound TMDL activities

Performance Metric(s):
- Nitrogen reductions from all watershed states

Expected Timeframe: Discrete; 2020-2024.

Implementation Action: SM-20

Support the refinement and application of the Long Island Sound Blue Plan to more comprehensively manage Long Island Sound resources.

Theme: Sound Science and Inclusive Management
Goal: Manage Long Island Sound using sound science and cross-jurisdictional governance that is inclusive, adaptive, innovative, and accountable.
Outcome: 4-2: Actions are implemented through coordinated strategies by all levels of government and diverse stakeholders.
Objective: 4-2a: To increase communication, coordination, and reduce institutional barriers to cooperation on an ecosystem level among all levels of government, stakeholder groups, and the general public.
Strategy: 4-2a5: Through Marine Spatial Planning, facilitate the management of multiple human uses of the Sound compatible with the conservation of natural resources and habitats.

Project Description/Background: Coastal and Marine Spatial Planning (CMSP) is a process that brings together multiple users of the ocean—including energy, industry, commercial fishing, government, conservation, and recreation—to make informed and coordinated decisions about how to use marine resources sustainably. CMSP generally uses maps to create a more comprehensive picture of a marine area—identifying where and how an ocean area is being used and what natural resources and habitat exist. It is similar to land-use planning, but for marine waters. This action will support the refinement and application of the Long Island Sound Blue Plan spatial plan to more comprehensively manage Long Island Sound resources. The ultimate purpose of the Long Island Sound Blue Plan is to facilitate a transparent, science-based decision-making process for the preservation of the Sound's ecosystems and resources, while protecting its traditional uses. The plan provides an inventory of the Sound's natural resources and uses, and establishes a spatial plan to guide future use of the waters and submerged lands (https://portal.ct.gov/DEEP/Coastal-Resources/LIS-Blue-Plan/Long-Island-Sound-Blue-Plan-Home).

Cooperators and Partners: LISS, CTDEEP.

Funding Sources: LISS, CTDEEP, CT Sea Grant.

Funding Needs: $$

Expected Outputs:
- Increased coordination and collaboration among partners and stakeholders
- Increased meaningful public participation
- Application of the Long Island Sound Blue Plan

Performance Metric(s):
- Number of projects resulting in data supporting coastal and marine spatial planning

Expected Timeframe: Discrete; 2020-2024.

Implementation Action: SM-21

Conduct primary valuations of the critical ecosystem goods and services supported by Long Island Sound and its coastal habitats.

Theme: Sound Science and Inclusive Management
Goal: Manage Long Island Sound using sound science and cross-jurisdictional governance that is inclusive, adaptive, innovative, and accountable.
Outcome: 4-2: Actions are implemented through coordinated strategies by all levels of government and diverse stakeholders.
Objective: 4-2b: To maintain and enhance efficient public investments in restoration and management.
Strategy: 4-2b1: Apply concepts of economic valuations of the natural capital of LIS and its watershed (i.e., the value of the goods and services supported by natural ecosystems) to inform and sustain investment in protecting and restoring those assets.

Project Description/Background: The financial value of goods and services provided to the region's economy by the natural ecosystems in Long Island Sound and on the lands whose waters drain to it ranges between $17 billion and $37 billion annually (Kocian et al. 2014). Treated as a capital asset with a lifespan of 100 years, the value of these natural systems is $690 billion to $1.3 trillion. Unlike built systems that depreciate, however, natural assets often accumulate value over time, particularly if they are protected and restored. In addition, an estimated 191,000 direct and indirect jobs in the region result from the healthy function of these natural systems, and associated stewardship work. A recommendation for future research of primary ecosystem service valuations is first and foremost to fill in key gaps. The greatest limitation to this analysis is the gaps of primary valuation studies representing all of the ecosystem goods and services provided in the Long Island Sound Basin. Granularity on valuation is lacking for more specific land covers, such as some of LISS's priority habitats: intertidal flats, cliffs and bluffs, and rocky intertidal zones.

Cooperators and Partners: Multiple research funders and economists.

Funding Sources: Research funds.

Funding Needs: $$

Expected Outputs:
- Studies that identify Long Island Sound-specific valuations

Performance Metric(s):
- Key data gaps identified, research conducted, products published resulting in increased confidence in ecosystem service valuations

Expected Timeframe: Discrete; 2020-2024.

Reference: Kocian, M., Fletcher, A., Schundler, G., Batker, D., Schwartz, A., Briceno, T., 2014. The Trillion Dollar Asset: The Economic Value of the Long Island Sound Basin. Earth Economics, Tacoma, WA, 76 pp.

Implementation Action: SM-22

Conduct return-on investment analysis for Long Island Sound restoration and preservation strategies to inform priority-setting for implementation of the CCMP.

Theme: Sound Science and Inclusive Management
Goal: Manage Long Island Sound using sound science and cross-jurisdictional governance that is inclusive, adaptive, innovative, and accountable.
Outcome: 4-2: Actions are implemented through coordinated strategies by all levels of government and diverse stakeholders.
Objective: 4-2b: To maintain and enhance efficient public investments in restoration and management.
Strategy: 4-2b1: Apply concepts of economic valuations of the natural capital of LIS and its watershed (i.e., the value of the goods and services supported by natural ecosystems) to inform and sustain investment in protecting and restoring those assets.

Project Description/Background: The financial value of goods and services provided to the region's economy by the natural ecosystems in Long Island Sound and on the lands whose waters drain to it ranges between $17 billion and $37 billion annually (Kocian et al. 2014). Treated as a capital asset with a lifespan of 100 years, the value of these natural systems is $690 billion to $1.3 trillion. Unlike built systems that depreciate, however, natural assets often accumulate value over time, particularly if they are protected and restored. In addition, an estimated 191,000 direct and indirect jobs in the region result from the healthy function of these natural systems, and associated stewardship work. Private or public understanding of the rate of return on investments is essential to allocating capital efficiently to generate significant and real returns. Understanding the size of assets and the relative returns on investments in those assets provides robust information for deciding the scale of and potential returns from investment. By utilizing metrics that incorporate ecosystem services, the true value of investments can be understood. The measurement of Return-on-Investment (ROI) has been proven to be superior to other decision-making tools for ensuring cost-efficiency and the maximization of benefits. This action will conduct a return-on investment analysis for Long Island Sound restoration and preservation strategies to inform priority setting for implementation of the CCMP.

Cooperators and Partners: LISS and contractor.

Funding Sources: In-kind services.

Funding Needs: $; in-house staff support, through a workgroup to develop a scope of work to be done by a contractor, contractor cost

Expected Outputs:
- A return on investment calculator that can be scaled from small to large protection and, or restoration activities throughout the Sound

Performance Metric(s):
- Meetings of work group; SOW for contract; contractor selection and oversight

Expected Timeframe: Discrete; 2020-2024.

Reference: Kocian, M., Fletcher, A., Schundler, G., Batker, D., Schwartz, A., Briceno, T., 2014. The Trillion Dollar Asset: The Economic Value of the Long Island Sound Basin. Earth Economics, Tacoma, WA, 76 pp.

Implementation Action: SM-23

Capitalize Connecticut Clean Water Fund and New York State Revolving Fund adequately to finance Clean Water infrastructure needs.

Theme: Sound Science and Inclusive Management
Goal: Manage Long Island Sound using sound science and cross-jurisdictional governance that is inclusive, adaptive, innovative, and accountable.
Outcome: 4-2: Actions are implemented through coordinated strategies by all levels of government and diverse stakeholders.
Objective: 4-2b: To maintain and enhance efficient public investments in restoration and management.
Strategy: 4-2b2: Identify critical funding needs for protection and restoration projects, science, education, and involvement, and relate these needs to available or new funding sources.

Project Description/Background: EPA provides capitalization grants, Connecticut Clean Water Fund and New York State Revolving Fund, to the states that are matched by state monies to create loan funds to finance clean water infrastructure projects. The 20-year need for capital upgrades to water infrastructure that considers climate change adaptation must be identified and met. EPA has been encouraging states to re-evaluate their programs to ensure decentralized sewage needs are adequately determined and sufficiently funded. This is particularly important for Long Island Sound since on-site wastewater treatment systems represent an unmanaged source of nitrogen.

Cooperators and Partners: EPA, CTDEEP, NYSDEC, NYS Environmental Facilities Corporation (NYEFC).

Funding Sources: EPA, CTDEEP, NYEFC.

Funding Needs: $$$/year needed in bonding to support infrastructure work.

Expected Outputs:
- Clean Water implementation projects

Performance Metric(s):
- Federal appropriations for the State Revolving Fund and leveraged state matching funds

Expected Timeframe: Ongoing; 2020-2024.

Implementation Action: SM-24

Research and develop innovative, locally appropriate funding mechanisms to provide sustained, reliable sources of investment capital to restore and protect ecosystem services.

Theme: Sound Science and Inclusive Management
Goal: Manage Long Island Sound using sound science and cross-jurisdictional governance that is inclusive, adaptive, innovative, and accountable.
Outcome: 4-2: Actions are implemented through coordinated strategies by all levels of government and diverse stakeholders.
Objective: 4-2b: To maintain and enhance efficient public investments in restoration and management.
Strategy: 4-2b2: Identify critical funding needs for protection and restoration projects, science, education, and involvement, and relate these needs to available or new funding sources.

Project Description/Background: The financial value of goods and services provided to the region's economy by the natural ecosystems in Long Island Sound and on the lands whose waters drain to it ranges between $17 billion and $37 billion annually (Kocian et al. 2014). Treated as a capital asset with a lifespan of 100 years, the value of these natural systems is $690 billion to $1.3 trillion. Unlike built systems that depreciate, however, natural assets often accumulate value over time, particularly if they are protected and restored. In addition, an estimated 191,000 direct and indirect jobs in the region result from the healthy function of these natural systems, and associated stewardship work.

Funding mechanisms refer to creative ways to meet financial needs for protecting and managing community assets (including natural capital). They include market mechanisms designed to obtain a desired value from community assets by providing incentives and disincentives for practices that protect or degrade them while also creating a revenue base to invest in their management. The utility and efficiency of funding mechanisms will become more apparent in coming years as new market opportunities develop for habitat, climate control, temperature, and water quality. Current funding mechanisms have limitations. Those benefiting from many aspects of the Long Island Sound Basin (property values, storm protection, and drinking water) might be willing to further contribute to investments that improve those assets. Those harming natural assets (e.g. through pollution) would benefit from a system that internalizes those costs and more efficiently allocates funds to mitigate damages or repair natural assets. NYSDEC's Municipal Sewage System Asset Management Guide, published in 2015, provides knowledge for wastewater to be funded correctly which results in technical support to municipalities in developing asset management plans (https://www.dec.ny.gov/docs/water_pdf/mssamguide.pdf). Further research and development of the full range of innovative, locally appropriate funding mechanisms could provide a sustained, reliable source of investment capital to restore and protect ecosystem services.

Cooperators and Partners: LISS, NFWF, LISS Citizens Advisory Committee. This action could be accomplished through an independent consultant or supported through a regional taskforce to evaluate options for establishing new funding tools to generate the financial resources needed to sustain investment in Long Island Sound's natural assets.

Funding Sources: Varied government and private funding sources.

Funding Needs: $$

Expected Outputs:
- A strategic planning document elucidating potential mechanisms for funding
- A prospectus for private/public sector parties to inform investment

Performance Metric(s):
- A plan with funding mechanisms
- A fund, administered by the appropriate agency, to apply investment funds to restore as well as track progress

Expected Timeframe: Discrete; 2020-2024.

Reference: Kocian, M., Fletcher, A., Schundler, G., Batker, D., Schwartz, A., Briceno, T., 2014. The Trillion Dollar Asset: The Economic Value of the Long Island Sound Basin. Earth Economics, Tacoma, WA, 76 pp.

Implementation Action: SM-25

Coordinate, collaborate and leverage funding opportunities with the Long Island Sound National Estuarine Research Reserve for implementation and restoration, science, and public involvement and education projects.

Theme: Sound Science and Inclusive Management
Goal: Manage Long Island Sound using sound science and cross-jurisdictional governance that is inclusive, adaptive, innovative, and accountable.
Outcome: 4-2: Actions are implemented through coordinated strategies by all levels of government and diverse stakeholders.
Objective: 4-2b: To maintain and enhance efficient public investments in restoration and management.
Strategy: 4-2b2: Identify critical funding needs for protection and restoration projects, science, education, and involvement, and relate these needs to available or new funding sources. 1-3c1: Support collaboration between Long Island Sound Study (LISS) partner organizations including upper basin agencies/partners (USGS, CTDEEP, CTDOA, NYSDEC, MassDEP, SCDHS, etc.) to improve utility of monitoring data and the sentinel monitoring program. 3-1b1: Provide information products that educate communities about the health of Long Island Sound and about the collaborative efforts to restore and protect the Sound. 4-1b3: Evaluate, enhance, integrate, and coordinate ongoing monitoring programs.

Project Description/Background: The Long Island Sound provides countless natural resources and services, and therefore contributes an estimated $7 billion annually to the regional economy; however, it is constantly threatened by development, pollution, invasive species, and climate change implications. To help provide information to decision-makers to further protect and conserve the Sound, the implementation of a National Estuarine Research Reserve (NERR) in Connecticut is essential. The NERR program would complement and extend the activities of programs currently conducted through the addition of funding, resources, and expertise. Connecticut is one of only two marine coastal state without a NERR. This action will coordinate, collaborate and leverage funding opportunities with the Long Island Sound NERR for implementation and restoration, science, and public involvement and education projects. The implementation of this action will also support WW-39 and SC-8, in which through increased funding opportunities, collaboration between partners and development of projects will be heighted. Multiple sources of funding exist on the federal, state, local, and non-governmental levels.

Cooperators and Partners: EPA and other federal agencies, CTDEEP, NYSDEC, CTSG, NYSG, foundations, Norwalk River Watershed Initiative, Harbor Watch and other watershed organizations in the region, etc.

Funding Sources: EPA and other federal agencies, CTDEEP, NYSDEC, CTSG, NYSG, foundations, etc.

Funding Needs: $$ to assist agencies and institutions in sharing facilities and research infrastructure resources, $$ to provide financial support to share resources and equipment, and coordination through existing staff and organizations to better direct available resources.

Expected Outputs:
- Projects that implement the CCMP
- Increased funding opportunities

Performance Metric(s):
- Number of projects
- Quantitative progress toward implementation metrics
- Funding level

Expected Timeframe: Ongoing; 2020-2024.

Implementation Action: SM-26

Incorporate climate change-driven factors such as temperature, acidification, and sea level rise in model applications to assess factors that can influence future attainment of water quality standards and habitat protection and restoration goals.

Theme: Sound Science and Inclusive Management
Goal: Manage Long Island Sound using sound science and cross-jurisdictional governance that is inclusive, adaptive, innovative, and accountable.
Outcome: 4-3: Implementation is adapted and improved through the application of new information and knowledge.
Objective: 4-3a: To frame sustainability, adaptation, and resilience in relation to the drivers of ecosystem change.
Strategy: 4-3a1: Include important environmental drivers (e.g., climate change) in all relevant management planning initiatives. 1-1a8: Incorporate climate change and sea level rise in planning, regulation, and BMPs for stormwater and wastewater treatment. 1-3b3: Improve understanding of climate change (e.g., acidification, sea level rise, temperature) on Long Island Sound water and habitat quality and biota, and their interaction with other water quality issues (e.g., eutrophication).

Project Description/Background: Physical factors can affect the susceptibility of Long Island Sound to impairments in water and habitat quality. Scenarios for future attainment of dissolved oxygen water quality standards or habitat protection and restoration goals must evaluate plausible alterations to the physical environment due to climate change (e.g., increased temperature, acidification, and sea level rise implications). Using FY2020, under an agreement with EPA, NYCDEP has awarded a contract to HDR, Inc. to develop the new Integrated Systemwide Eutrophication Modeling Tool. The tool will integrate physical, biogeochemical, and ecological components to forecast how the Sound may respond to changes in human (e.g., pollution) and natural (e.g., weather) drivers that impact the system. Additionally, the tool will simulate future environmental conditions, including climate change and sea level rise scenarios. This effort will address this action to incorporate climate-change driven factors in model applications to assess factors that can influence water quality standards and habitat protection and restoration goals.

Cooperators and Partners: LISS modeling management advisory group, NYCDEP, HDR, Inc., EPA.

Funding Sources: LISS program funds.

Funding Needs: $$

Expected Outputs:
- Model scenarios for water quality attainment that incorporate future physical conditions driven by climate change
- Completion of the Integrated Systemwide Eutrophication Modeling Tool

Performance Metric(s):
- Updated modeling scenarios

Expected Timeframe: Ongoing; 2020-2024.

Implementation Action: SM-27

Determine how climate change will impact attainment of CCMP Ecosystem Targets, goals and objectives using LISS vulnerability assessment and other resources.

Theme: Sound Science and Inclusive Management
Goal: Manage Long Island Sound using sound science and cross-jurisdictional governance that is inclusive, adaptive, innovative, and accountable.
Outcome: 4-3: Implementation is adapted and improved through the application of new information and knowledge.
Objective: 4-3a: To frame sustainability, adaptation, and resilience in relation to the drivers of ecosystem change.
Strategy: 4-3a1: Include important environmental drivers (e.g., climate change) in all relevant management planning initiatives.

Project Description/Background: Federal agency and EPA-specific policies now direct EPA programs to promote smarter, more climate-resilient Federal investments in the face of increased risks from climate change stressors such as sea level rise and ocean acidification. EPA's National Estuary Program is working to implement those policies by providing technical assistance and funding support to the 28 National Estuary Programs funded under §320 of the Clean Water Act for risk-based vulnerability assessments. The LISS Vulnerability Assessment was completed in 2019 and should be used to inform future investments in CCMP implementation, i.e., that actions to implement a CCMP will result in their intended estuary protection and restoration benefits through time regardless of reasonably-anticipated climate changes. The Assessment obtained and summarized feedback from local experts on the scoping reports developed on climate change vulnerabilities for EPA's NEP in the northeast from Marine to New York (https://longislandsoundstudy.net/wp-content/uploads/2019/09/LISS-VA-Final-Report-Appendices-A-C-and-E.pdf).

Cooperators and Partners: EPA, LISS, CTDEEP, NYSDEC and all Long Island Sound partners.

Funding Sources: Resources permitting, in FY2020 and in each of the following three fiscal years, EPA will provide technical assistance and funding to help ensure that §320-funded implementation of CCMP goals and of annual work plan activities is not at risk from near- and long-term climate change impacts.

Funding Needs: $

Expected Outputs:
- Integrate vulnerability assessment findings and planned response approaches into a CCMP appendix or supplemental document
- Implement specific response activities via annual work plans as necessary
- Engaged and strong partnerships and information sharing at all levels of government
- Develop or continue to develop, implement, and update comprehensive plans that integrate consideration of climate change into agency operations and overall mission objectives

Performance Metric(s):
- Number of CCMP Ecosystem Target Assessments incorporating information on climate change effects

Expected Time frame: Discrete; 2020-2024.

Implementation Action: 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.

Theme: Sound Science and Inclusive Management
Goal: Manage Long Island Sound using sound science and cross-jurisdictional governance that is inclusive, adaptive, innovative, and accountable.
Outcome: 4-3: Implementation is adapted and improved through the application of new information and knowledge.
Objective: 4-3a: To frame sustainability, adaptation, and resilience in relation to the drivers of ecosystem change.
Strategy: 4-3a1: Include important environmental drivers (e.g., climate change) in all relevant management planning initiatives 1-3a1: Understand the effects that nutrient ratios (nitrogen, phosphrous, carbon) have on ecosystem structure and function in freshwaters, embayments, and in Long Island Sound and consider them in setting nutrient control policies.

Project Description/Background: The available information on Long Island Sound suggests that primary productivity is mostly nitrogen-limited. However, other nutrients, such as phosphorus and silica, could influence phytoplankton species composition or potentially limit productivity in certain situations, as sometimes occurs in other estuaries. There is currently no evidence for such impacts in the Sound, except for potential silica limitation in the spring in the western Sound. The influence of non-nitrogenous nutrients is probably most likely in the Sound's embayments where local nutrient loading differs from the general pattern. New research would be required to document such effects.

Cooperators and Partners: EPA, LISS, NY and CT Sea Grant, research institutions, NOAA.

Funding Sources: LISS research program, and other federal/state sources.

Funding Needs: $$

Expected Outputs:
- Better understanding of non-nitrogenous nutrient impacts in the Sound and its embayments

Performance Metric(s):
- Number of projects investigating non-nitrogenous nutrient impacts, as well as the ratios of these nutrients to nitrogen

Expected Timeframe: Ongoing; 2020-2024.

Implementation Action: SM-29

Continue collaboration with Connecticut Institute for Resiliency and Climate Adaptation (CIRCA).

Theme: Sound Science and Inclusive Management
Goal: Manage Long Island Sound using sound science and cross-jurisdictional governance that is inclusive, adaptive, innovative, and accountable.
Outcome: 4-3: Implementation is adapted and improved through the application of new information and knowledge.
Objective: 4-3a: To frame sustainability, adaptation, and resilience in relation to the drivers of ecosystem change.
Strategy: 4-3a2: Consider the spectrum of desired ecosystem outcomes when planning and implementing resiliency of both built and natural systems.

Project Description/Background: The Connecticut Institute for Resiliency and Climate Adaptation (CIRCA) is designed to increase the resilience and sustainability of vulnerable communities and individuals along Connecticut's coast and inland waterways as they are affected by the growing impact of climate change on the environment. By bringing together experts in a wide range of academic disciplines, developing cutting-edge research to solve practical problems, and collaborating with local, regional, and national partners, the institute will facilitate development of strategic plans for protecting the state's coastal region. CIRCA has completed and continues to conduct numerous research projects focusing on coastal flooding and waves, inland flooding, sea level rise, critical infrastructure resilience, living shorelines, and policy and planning. More specifically, CIRCA is collecting data and resources to assist municipalities in developing climate resilience tools, strategies, and plans in their communities, in which they track and maintain data on these completed plans and strategies. This data enables LISS to track Connecticut's progress in the Waterfront Community Resiliency and Sustainability Ecosystem Target. By continuing collaboration with CIRCA, LISS is able to assess the status of sustainable and resilient targets.

Cooperators and Partners: UConn, CTDEEP, NOAA.

Funding Sources: Initial funding for the Institute, in the amount of $2.5 million, comes from a plea agreement approved by the U.S. Attorney's Office in a suit the State brought against Conopco Inc., for clean water violations related to wastewater treatment. Additional funding includes $610,000 from the Connecticut Sea Grant Coastal Storm Awareness program and federal funding of $425,000 from a grant to enhance coastal resilience in Connecticut.

Funding Needs: $$$-$$$$

Expected Outputs:
- Improved scientific understanding of the changing climate and its local impacts communities
- Developed and deployed best practices for climate resilience
- Resilient and sustainable communities
- Enhanced resilience of critical infrastructure (e.g. power, water, communications)
- Reduced loss of life and property, ecological damage, and social disruption from storms
- A more climate-literate public

Performance Metric(s):
- Number of pilot projects to improve coastal resilience and sustainability

Expected Timeframe: Ongoing; 2020-2024.

Implementation Action: SM-30

Refine the ecosystem metrics and targets based on the underlying science of the Long Island Sound ecosystem to clearly identify the characteristics of a "restored" Long Island Sound.

Theme: Sound Science and Inclusive Management
Goal: Manage Long Island Sound using sound science and cross-jurisdictional governance that is inclusive, adaptive, innovative, and accountable.
Outcome: 4-3: Implementation is adapted and improved through the application of new information and knowledge.
Objective: 4-3b: To apply an adaptive management framework, when warranted by the level of uncertainty in the underlying science, to implementation.
Strategy: 4-3b1: Establish baselines of historical or pre-historical conditions of ecosystem attributes and magnitudes of change to help provide a basis for setting restoration goals.

Project Description/Background: The CCMP includes ecosystem targets for restoration to be tracked through measurable indicators. Progress toward attaining the ecosystem target conditions will be evaluated on an annual basis. The ecosystem targets will also be assessed for refinement and the inclusion of new targets. This action will refine the ecosystem metrics and targets based on the underlying science of the Long Island Sound ecosystem to clearly identify the characteristics of a "restored" Long Island Sound.

Cooperators and Partners: LISS.

Funding Sources: LISS program funds.

Funding Needs: $; Part of the base LISS staff program activities.

Expected Outputs:
- Assessments of progress toward ecosystem characteristics

Performance Metric(s):
- Annual updates of environmental indicators
- Published reports on progress toward attainment of targets

Expected Timeframe: Discrete; 2020-2024.

Implementation Action: SM-31

Incorporate bioextraction analyses in Dissolved Oxygen TMDL assessments on the assimilative capacity of Long Island Sound to process nutrients without loss of designated uses.

Theme: Sound Science and Inclusive Management
Goal: Manage Long Island Sound using sound science and cross-jurisdictional governance that is inclusive, adaptive, innovative, and accountable.
Outcome: 4-3: Implementation is adapted and improved through the application of new information and knowledge.
Objective: 4-3b: To apply an adaptive management framework, when warranted by the level of uncertainty in the underlying science, to implementation.
Strategy: 4-3b2: Utilize and learn from cutting-edge approaches and methods to improve management options for pollution mitigation and ecosystem protection (e.g., marine spatial planning, innovative source reduction technologies, and in situ extractive technologies). 1-1a3: Enhance implementation of the existing 2000 Dissolved Oxygen Total Maximum Daily Load throughout the watershed; and adapt and revise it based on monitoring, modeling, research, and how climate change may affect attainment of water quality standards in the future.

Project Description/Background: Bioextraction of nutrients through shellfish and seaweed aquaculture harvests can increase the nutrient assimilative capacity of Long Island Sound, thereby increasing dissolved oxygen levels and improving water quality. These efforts will support the implementation of the Long Island Sound 2000 Dissolved Oxygen TMDL to reduce hypoxic areas and achieve water quality standards. LISS has provided funds to facilitate this action in various ways, including, hiring a bioextraction coordinator to implement a Bioextraction Initiative, providing incentives to conduct pilot projects, and reducing barriers for future commercial operation. With FY2020 funds, $381,051 was awarded to NYSDEC to conduct a Nutrient Bioextraction Pilot using Sugar Kelp and Ribbed Mussels, in which will inform regulators and nutrient resource managers on uptake rates of nutrients. LISS will incorporate the information learned through these projects in the Integrated Systemwide Eutrophication Modeling Tool, a tool being developed that integrates physical, biogeochemical, and ecological components to better understand impacts of point and nonpoint source discharges and sediment fluxes on water quality, to include bioextraction analyses and the associated benefits of bioextraction to improve water quality. The tool will include the bioextraction analyses and the associated benefits of bioextraction to improve water quality.

Cooperators and Partners: LISS, TMDL Work Group.

Funding Sources: LISS program funds.

Funding Needs: $$$

Expected Outputs:
- Implementation of the Bioextraction Initiative
- Estimates of potential areal application of bioextraction aquaculture
- Increased dissemination of pilot study results to regulators and nutrient resource managers
- Completion of the Nutrient Bioextraction Pilot

Performance Metric(s):
- Number of studies to estimate bioextraction potential of farm-scale operations
- Update to the Integrated Systemwide Eutrophication Modeling Tool

Expected Timeframe: Discrete; 2020-2024.

Implementation Action: SM-32

By 2024, update the CCMP tracking system to address GAO recommendations and communicate progress to the public.

Theme: Sound Science and Inclusive Management
Goal: Manage Long Island Sound using sound science and cross-jurisdictional governance that is inclusive, adaptive, innovative, and accountable.
Outcome: 4-3: Implementation is adapted and improved through the application of new information and knowledge.
Objective: 4-3b: To apply an adaptive management framework, when warranted by the level of uncertainty in the underlying science, to implementation.
Strategy: 4-3b3: Prepare periodic progress reports on the health of the Sound and on implementation progress.

Project Description/Background: In 2018, the Government Accountability Office (GAO) reported on the evaluation of the LISS (GAO-18-140). The report includes what is known about the progress made toward achieving the 1994 CCMP; how the LISS intends to measure and report on progress toward achieving the 2015 CCMP; and the estimated costs of restoration. Specific recommendations include: 1) Incorporate leading practices of performance reporting which are i) evaluating the performance compared to goals set out by a plan; ii) reviewing past performance toward meeting the goals, measured as baseline and trend data for ecological indicators; and iii) evaluating actions for unachieved goals to understand how and why they haven't been met, and what management adjustments are needed; 2) Develop cost estimates that include analysis of uncertainties for each of the ecosystem targets in the 2015 Plan; and 3) Estimate the range of potential costs for all implementation actions and include the estimates in future supplements to the 2015 Plan. In response, LISS hired the Horsley Witten Group and FB Environmental to evaluate LISS' current reporting framework through the lens of the GAO leading practices, research on reporting practices from other estuary programs, and a cost analysis to generate ecosystem target cost estimates, determine areas where LISS can improve in implementation, and further identify steps for implementation (https://longislandsoundstudy.net/2019/11/addressing-gaos-recommendations-liss-performance-reporting-and-cost-estimating/). Additionally, LISS is working with the Resource Management Branch to develop a database to track the progress and implementation of the 2020-2024 IAs included in the 2020 CCMP.

Cooperators and Partners: LISS, Federal and state implementer agencies.

Funding Sources: LISS program funds.

Funding Needs: $$/year

Expected Outputs:
- Implementation tracking report

Performance Metric(s):
- Number of agencies reporting on implementation progress

Expected Timeframe: Discrete; 2020-2024.

Implementation Action: SM-33

Continue to issue "report cards" on water quality conditions in Long Island Sound that are easily understood by the public and scientifically defensible.

Theme: Sound Science and Inclusive Management
Goal: Manage Long Island Sound using sound science and cross-jurisdictional governance that is inclusive, adaptive, innovative, and accountable.
Outcome: 4-3: Implementation is adapted and improved through the application of new information and knowledge.
Objective: 4-3b: To apply an adaptive management framework, when warranted by the level of uncertainty in the underlying science, to implementation.
Strategy: 4-3b3: Prepare periodic progress reports on the health of the Sound and on implementation progress.

Project Description/Background: Report cards can integrate diverse data into an easily understandable form to communicate to the public and build support for actions for improve assessments. Critical to the report card success is the scientific credibility of its underlying assumptions. In 2016, Save the Sound developed the Long Island Sound Report Card to track and publicize the ecological health of the Sound. Every other year, the report card is administered in which Save the Sound assembles water monitoring data (e.g., dissolved oxygen, water clarity, chlorophyll *a*, and dissolved organic carbon) and, using an assessment methodology, scores water quality in five regions of the Long Island Sound. This action will facilitate the continuation to "issue" a report card on water quality based on the science-based approaches developed elsewhere, but applied specifically to Long Island Sound.

Cooperators and Partners: Save the Sound, LISS, Science and Technical Advisory Committee.

Funding Sources: LISS program funds, Long Island Sound Funders Cooperative.

Funding Needs: $$/year to maintain and publish report cards

Expected Outputs:
- Biennial published report card

Performance Metric(s):
- Development of science-based matrices for translating water quality conditions into grades
- Incorporates external technical advisory input

Expected Timeframe: Discrete; 2020-2024.

Implementation Action: SM-34

Refine and communicate information on the Long Island Sound ecosystem and watershed using environmental indicators (drivers, pressures, conditions, and response indicators).

Theme: Sound Science and Inclusive Management
Goal: Manage Long Island Sound using sound science and cross-jurisdictional governance that is inclusive, adaptive, innovative, and accountable.
Outcome: 4-3: Implementation is adapted and improved through the application of new information and knowledge.
Objective: 4-3b: To apply an adaptive management framework, when warranted by the level of uncertainty in the underlying science, to implementation.
Strategy: 4-3b3: Prepare periodic progress reports on the health of the Sound and on implementation progress.

Project Description/Background: Indicators are quantitative or qualitative measures that provide information about the status of or changes in natural, cultural, and economic aspects of an ecosystem. The LISS has been developing and reporting on the environmental drivers, pressures, conditions, and response indicators of the Long Island Sound ecosystem since the late 1990s. There is a need to maintain a robust environmental indicators program on the status and trends of Long Island Sound's water quality, habitats, and marine and coastal animal populations, and develop new climate change and socioeconomic indicators. LISS has developed Ecosystem Targets and Supporting Indicators for each of the CCMP themes, in which the Ecosystem Indicators use data to measure the health of the Sound, and the Ecosystem Targets are indicators that include performance targets to help inform and drive progress toward meeting management goals (https://longislandsoundstudy.net/research-monitoring/liss-ecosystem-targets-and-supporting-indicators/). Reporting on the health of Long Island Sound is one of the elements required under legislation for reporting to Congress. This action will refine and communication information of the Long Island Sound ecosystem and watershed using environmental indicators.

Cooperators and Partners: LISS.

Funding Sources: LISS program funds.

Funding Needs: $

Expected Outputs:
- Maintained LISS environmental indicators website

Performance Metric(s):
- Latest data regularly incorporated into environmental indicators

Expected Timeframe: Ongoing; 2020-2024.

Implementation Action: SM-35

Develop annual Long Island Sound Study work plans that consider progress made and recommendations for improving implementation to achieve desired outcomes.

Theme: Sound Science and Inclusive Management
Goal: Manage Long Island Sound using sound science and cross-jurisdictional governance that is inclusive, adaptive, innovative, and accountable.
Outcome: 4-3: Implementation is adapted and improved through the application of new information and knowledge.
Objective: 4-3b: To apply an adaptive management framework, when warranted by the level of uncertainty in the underlying science, to implementation.
Strategy: 4-3b4: At five-year intervals refine implementation actions and priorities by incorporating and integrating new information (including emerging issues) relating to science and management.

Project Description/Background: LISS develops annual work plans that document the desired outputs and outcomes from each funded task, while also providing an update from the activities funded in the prior year. The outputs and outcomes of the annual work plan should reflect the goals and objectives of the CCMP (https://longislandsoundstudy.net/category/media-center/annual-work-plans-2/).

Cooperators and Partners: LISS Management Committee.

Funding Sources: LISS program funds.

Funding Needs: $; work conducted by core LISS staff with no additional costs.

Expected Outputs:
- An annual work plan that clearly documents who will produce what, by when, to support a specified outcome

Performance Metric(s):
- Proposed annual work tasks that are reviewed for how they support attainment of desired outcomes. Management Committee meetings to review and approve the work plans

Expected Timeframe: Ongoing; 2020-2024.

Implementation Action: SM-36

Every five years develop a comprehensive, specific, target-oriented implementation plan engaging all Long Island Sound partners.

Theme: Sound Science and Inclusive Management
Goal: Manage Long Island Sound using sound science and cross-jurisdictional governance that is inclusive, adaptive, innovative, and accountable.
Outcome: 4-3: Implementation is adapted and improved through the application of new information and knowledge.
Objective: 4-3b: To apply an adaptive management framework, when warranted by the level of uncertainty in the underlying science, to implementation.
Strategy: 4-3b4: At five-year intervals refine implementation actions and priorities by incorporating and integrating new information (including emerging issues) relating to science and management.

Project Description/Background: The implementation actions included in this revision of the CCMP cover a period of five years. Every five years a new set of implementation actions will be developed considering success and challenges in implementation, changes in the health of Long Island Sound, and new science on the Sound. Under this action, LISS has developed a 2020-2024 Action Plan that updates the 2015 CCMP.

Cooperators and Partners: LISS and partner agencies.

Funding Sources: LISS program funds.

Funding Needs: $; Developed by LISS core staff.

Expected Outputs:
- Five-year implementation plan covering the period 2020-2024

Performance Metric(s):
- Evaluation of the implementation tracking report and assessment of innovations and new information
- Assessments of environmental indicators, and review of research and monitoring data to consider science gains

Expected Timeframe: Discrete; 2020.

Implementation Action: SM-37

In 2021, develop a Sustainable and Resilient Communities five-year plan that identifies specific actions, which, when approved by the Management Conference, will be added to the 2020 CCMP update.

Theme: Sound Science and Inclusive Management
Goal: Manage Long Island Sound using sound science and cross-jurisdictional governance that is inclusive, adaptive, innovative, and accountable.
Outcome: 4-3: Implementation is adapted and improved through the application of new information and knowledge.
Objective: 4-3b: To apply an adaptive management framework, when warranted by the level of uncertainty in the underlying science, to implementation.
Strategy: 4-3b4: At five-year intervals refine implementation actions and priorities by incorporating and integrating new information (including emerging issues) relating to science and management. 3-4a1: Provide support to municipalities to facilitate the development and updating of sustainability, and resiliency plans that incorporate current concepts on these topics. 3-4b1: Revise zoning, permitting, and related regulations to ensure that future development and redevelopment conform to sustainability, mitigation, and resiliency plans. 3-4b2: Provide technical assistance and training for homeowners, municipal officials, developers, engineers, and consultants on sustainability, adaptation, and resiliency concepts and opportunities for implementation. 1-1a6: Implement low-impact development and green infrastructure for new and existing residential development and mitigate pollution from commercial and industrial sources. 1-1a8: Incorporate climate change and sea level rise in planning, regulation, and BMPs for stormwater and wastewater treatment. 1-1c1: Preserve hydrologic function (e.g. flooding, buffer zones, resiliency, groundwater, etc.) in developing watersheds and restore in impaired watersheds. 1-1b2: Protect wetlands, healthy watersheds, riparian buffers, and open land to minimize land disturbance and impervious cover through land protection, sustainable development and green infrastructure.

Project Description/Background: In response to the lack of progress in the Sustainable and Resilient Communities CCMP theme, Connecticut and New York Sea Grant developed the new LISS Sustainable and Resilient Communities Working Group. LISS, using FY2020 funds, awarded $50,000 for this project to support a year-long process to develop a focused and strategic five-year work plan. This will result in a focused set of activities that will be identifiable to LISS efforts and directly quantifiably contribute to CCMP goals, actions and strategies. The process will include convening the working group in a series of online workshops to inventory ongoing efforts in sustainability and resilience, hear all opinions on potential projects moving forward, select work plan priorities, present a draft work plan and receive feedback, finalize a workplan and prepare an implementation strategy with associated budget request for LISS. The process will also engage one or two graduate/undergraduate interns to follow up on issues identified and help shepherd the project. The deliverables of this working group include a LISS Sustainable and Resilient Communities Working Group five-year work plan and implementation strategy, developed by 2021 and implemented by 2024, with accompanying LISS budget request, and an engaged Sustainable and Resilient Communities Working Group ready to implement the work plan. The implementation of this action will further the progress of other CCMP IAs, including to support community development, adoption, and implementation of new or updated Municipal Sustainability Plans and Coastal Resiliency Plans (SC-24). Once the five-year plan's identified actions are approved by the Management Conference, the actions will be added to the 2020 CCMP update.

Cooperators and Partners: Connecticut Sea Grant, New York Sea Grant, LISS.

Funding Sources: LISS program funds.

Funding Needs: $$

Expected Outputs:
- A Sustainable and Resilient Communication five-year plan

Performance Metric(s):
- An engaged Sustainable and Resilient Communities Working Group meeting regularly to make progress on the five-year plan
- Increased progress and implementation in the Sustainable and Resilient Communities CCMP Theme

Expected Timeframe: Discrete; 2020-2024.