



Comprehensive Conservation and Management Plan 2015

Supplemental Document 1

Clean Waters and Healthy Watersheds (WW) Theme

Implementation Actions 2015–2019

Summary Table. Clean Waters and Healthy Watersheds (WW) Implementation Actions

Implementation Actions (IAs) have been formulated to carry out the WW 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 Strategies Addressed
WW-1	Evaluate the impact of increasing human population, climate change and land use trends in the Long Island Sound watershed to determine nutrient and contaminant stressors on sewage loads from Wastewater Treatment Facilities (WWTFs)/Combined Sewer Overflows (CSOs) and decentralized/on-site wastewater treatment systems (OSWTS).	1-1a1, 1-1a2, 1-1a7
WW-2	Strategically plan for and implement capital improvements, BMPs, and improved operation and maintenance to mitigate CSO, stormwater, and nonpoint source loadings, taking into account the analysis of potential future changes in loading (WW-1).	1-1a1, 1-1a2
WW-3	Explore expansion of point source and nonpoint source nutrient trading programs for the Long Island Sound watershed.	1-1a2
WW-4	Pursue opportunities to further improve nitrogen removal, particularly low-cost retrofits, at WWTFs, throughout the watershed.	1-1a2
WW-5	Improve integrity of sewage collection infrastructure and institute sustainable asset management programs.	1-1a2, 1-1a6
WW-6	Enhance implementation of the 2000 Dissolved Oxygen TMDL and evaluate revision of the TMDL and allocations as needed to attain water quality standards.	1-1a3, 4-2a4, 4-3b2
WW-7	Improve the reporting requirements of MS4 communities for Dissolved Oxygen TMDL implementation tracking to better quantify the effectiveness of control measures.	1-1a4, 4-2a4
WW-8	Improve and enforce pesticide/herbicide/fertilizer regulations and other Best Management Practices (BMPs) for agriculture and urban turf.	1-1a5
WW-9	Develop a nonpoint source and stormwater tracking system tool for the Long Island Sound watershed.	1-1a6, 1-1a7, 4-2a4
WW-10	Develop improved policies for use and performance of decentralized and on-site wastewater treatment systems.	1-1a7, 4-2a4
WW-11	Improve understanding, management, and design of denitrifying decentralized and residential, on-site wastewater treatment systems.	1-1a7, 4-1a1, 4-2a4
WW-12	Improve efficiency and resiliency of existing/new waste treatment systems including septic, WWTF and stormwater infrastructure to accommodate sea level rise.	1-1a8, 3-4a1, 3-4b1, 3-4b2, 4-3a1

IA Number	Implementation Action Title	Major Strategies Addressed
WW-13	Develop watershed management plans for sub-watersheds, including urban areas, within the Connecticut and New York portions of the Long Island Sound watershed, and track their implementation and effectiveness.	1-1b1
WW-14	Promote establishment and protection of riparian corridors and wetland buffers at the municipal level through development of local ordinances and increased permanent land protection.	1-1b2, 2-1a2
WW-15	Support implementation of stormwater permit guidance requiring all new development and substantial redevelopment to capture and infiltrate runoff from the 90 th percentile storm, (generally a 0.8-1.3 inch storm).	1-1c1, 1-1a6, 1-1b2, 3-4a1, 3-4a2, 3-4b1, 3-4b2
WW-16	Improve environmental practices (boat wrap, bottom paint, pump out, etc.) at marinas.	1-2a1, 1-2a2
WW-17	Develop a Long Island Sound-specific marine debris reduction plan and implement actions to support trash-free waters.	1-2a2
WW-18	Support and promote pharmaceutical and prescription medicine take-back programs at the state and municipal level to inform the general public about the pathways and impacts of emerging contaminants entering the waters and sediments of Long Island Sound.	1-2b1
WW-19	Encourage state, and local health departments to adopt emerging rapid bacterial detection technologies that would allow shorter duration administrative beach/shellfish closings than those based on rainfall only.	1-2b2
WW-20	Evaluate challenges to implementation of bioextraction in Long Island Sound, including use conflicts, economic viability, permitting and testing requirements and potential environmental impacts, and make recommendations to overcome them.	1-2b3
WW-21	Improve the permitting and certification process for new aquaculture projects with products intended for human consumption, particularly those projects with a bioextraction focus.	1-2b3
WW-22	Estimate future phosphorus loading to Long Island Sound and its impact on Long Island Sound nutrient dynamics.	1-3a1
WW-23	Improve ability of models and/or studies to estimate contaminant and nutrient loads in critical areas and evaluate the effectiveness of remedial actions.	1-3a2, 4-1a1, 4-1c1
WW-24	Maintain and enhance the utility and efficiency of water quality monitoring of nutrient loads to Long Island Sound science and management efforts.	1-3b1, 4-1b4
WW-25	Develop and implement a water quality monitoring strategy for nitrogen in the upper basin states of Massachusetts, Vermont, and New Hampshire.	1-3b1, 4-1b3, 4-1b4, 4-2a4
WW-26	Assess and identify the impact of emerging (e.g., PBDE, pharmaceuticals) and legacy (e.g., heavy metals, PCBs) contaminants on the ecosystem services and biota of Long Island Sound.	1-3b2, 4-1a1

IA Number	Implementation Action Title	Major Strategies Addressed
WW-27	Develop water quality monitoring programs associated with coastal habitat restoration projects.	1-3b3, 4-1b3
WW-28	Determine the level of spatial and temporal sampling needed to assess Long Island Sound water quality as impacted by climate change drivers (SLR, warming, acidification).	1-3b3, 4-1b3, 4-1b4, 4-3a1
WW-29	Complete LISS Sentinel Monitoring for Climate Change pilot projects and evaluate results to guide strategy development and future implementation.	1-3b3, 4-3a1
WW-30	Conduct periodic (five year) review and revision of Sentinel Monitoring Strategy document.	1-3b3, 4-3a1
WW-31	Assess sources of nutrient and pathogen contamination to Long Island Sound embayments.	1-3b4, 1-3b1, 4-1b4
WW-32	Monitor and track occurrences and contributing factors of biotoxin and harmful algal blooms (HABs) outbreaks.	1-3b5
WW-33	Develop a regional partnership that will continue to support the implementation and advancement of the LISS Sentinel Monitoring for Climate Change Program and integrate it with regional and national efforts.	1-3c1, 4-1b3
WW-34	Continue to support, improve, and utilize the Sentinel Monitoring Data Citation Clearinghouse and other data synthesis, storage, and sharing efforts.	1-3c2, 4-1b3

Implementation Action: WW-1

Evaluate the impact of increasing human population, climate change and land use trends in the Long Island Sound watershed to determine nutrient and contaminant stressors on sewage loads from Wastewater Treatment Facilities (WWTFs)/Combined Sewer Overflows (CSOs) and decentralized/on-site wastewater treatment systems (OSWTS).

Theme	Clean Waters and Healthy Watersheds
Goal	Improve water quality by reducing contaminant and nutrient loads from the land and the waters impacting Long Island Sound.
Outcome	1-1: Contaminant and nutrient loads from land-based sources in the watershed of Long Island Sound are reduced.
Objective	1-1a: To reduce contaminant and nutrient loads from point and nonpoint sources.
Strategy	1-1a1: Continue mitigation of Combined Sewer Overflows (CSOs) and Municipal Separate Storm Sewer Systems (MS4s), incorporating climate change and sea level rise in planning, regulation, and BMPs. 1-1a2: Evaluate and improve the clean water infrastructure for wastewater treatment facilities (WWTFs), conveyance systems, and associated sewer lines. 1-1a6: Implement low-impact development and green infrastructure for new and existing development, and mitigate pollution from commercial and industrial sources.

Project Description/Background: Population increases, land development, and climate change will increase the demands on sewage treatment infrastructure, both centralized systems in urban areas and onsite treatment systems in suburban and rural areas. It is important to understand the impact of changes in demand over the lifespan of the infrastructure when designing and implementing upgrades. A population and land use study should be conducted that includes an analysis of how these changes will impact flows and nutrient loads and how municipalities and state agencies can mitigate this impact in the design and upgrades of WWTF, storm sewers, and onsite treatment systems. Trends in population, land development, and impervious cover are drivers of nitrogen loading from developed lands. The study should also take into consideration changes in precipitation and temperature patterns from present and anticipated future changes in climate that may affect runoff and groundwater infiltration rates. These data will enable state and municipal managers to reinforce the need for implementing BMPs to mitigate these nutrient stressors. The final report will be sent to all municipalities and stakeholders involved in WWTF/CSO upgrades.

Cooperators and Partners: State agencies of Connecticut, New York, Massachusetts, New Hampshire and Vermont and their respective state municipalities and health departments. Local water resource planning agencies.

Funding Sources: A combination of state and federal grants and loans primarily funded through each states' respective State Revolving Fund (SRF) loan and grant programs and through EPA Grants. Long Island Sound Futures Fund (LISFF), other local grants and private funds. Some limited amount of academic study/modeling could be grant funded (Possibly Enhancement grant or LISFF).

Funding Needs: \$\$

Expected Outputs:

- Report on impact of population change, land use, and climate on loadings.
- Data to enable state and municipal managers to reinforce need for and implement BMPs for mitigating nutrient stressors to surface and groundwater.

Performance Metric(s):

- Number of State and local policies and regulations that result from or cite data generated as part of this action.
- Recorded number of state municipalities incorporating special sewer districts and number of denitrifying decentralized treatment systems installed in the Long Island Sound watershed as a result of study findings.

Implementation Status: New

Expected Timeframe: Conduct study 2016–2018, issue analysis report in 2018–2019, and implement in 2020.

Implementation Action: WW-2

Strategically plan for and implement capital improvements, BMPs, and improved operation and maintenance to mitigate CSO, stormwater, and nonpoint source loadings, taking into account the analysis of potential future changes in loading (see WW-1).

Theme: Clean Waters and Healthy Watersheds
Goal: Improve water quality by reducing contaminant and nutrient loads from the land and the waters impacting Long Island Sound.
Outcome: 1-1: Contaminant and nutrient loads from land-based sources in the watershed of Long Island Sound are reduced.
Objective: 1-1a: To reduce contaminant and nutrient loads from point and nonpoint sources.
Strategy: 1-1a1: Continue mitigation of Combined Sewer Overflows (CSOs) and Municipal Separate Storm Sewer Systems (MS4s), incorporating climate change and sea level rise in planning, regulation, and BMPs. 1-1a2: Evaluate and improve the clean water infrastructure for wastewater treatment facilities (WWTFs), conveyance systems, and associated sewer lines.

Project Description/Background: BMPs consistent with those suggested by the report generated in WW-1 will help municipalities and towns to better plan future infrastructure repairs and upgrades. As the incremental cost of continued WWTF upgrades continues to increase, it is critical to aggressively combat other sources of nutrient and pathogen contamination to Long Island Sound, such as CSOs, stormwater runoff, agricultural infiltration and runoff, and septic systems. The state agencies will use a combination of tools and strategies, including 319 projects, MS4 plans, National Pollutant Discharge Elimination System (NPDES) permits, general permits and other Clean Water Act SRF programs to assist municipalities in reducing contaminant levels in stormwater systems. Collaboration with land developers will provide the capacity to incorporate BMPs into development plans.

Cooperators and Partners: The state agencies of Connecticut and New York, their respective state municipalities, and key developers or professional development organizations.

Funding Sources: A combination of state and federal grants and loans primarily funded through each states' respective SRF loan and grant programs and state and municipal budgets. LISFF, Enhancement grant or other partner grant funding.

Funding Needs: \$\$\$\$

Expected Outputs:

- Report on impact of population change on loadings

Performance Metric(s):

- Reports and analyses of population trends based on U.S. census results.
- Planning grants will include estimates of expected sewer use and population fluctuation as well as anticipated flow rates and nutrient levels.

Implementation Status: New

Expected Timeframe: 2015–2019 Initial implementation. Broad scale implementation in future cycles (2020–2035).

Implementation Action: WW-3

Explore expansion of point source and nonpoint source nutrient trading programs for the Long Island Sound watershed.

Theme: Clean Waters and Healthy Watersheds
Goal: Improve water quality by reducing contaminant and nutrient loads from the land and the waters impacting Long Island Sound.
Outcome: 1-1: Contaminant and nutrient loads from land-based sources in the watershed of Long Island Sound are reduced.
Objective: 1-1a: To reduce contaminant and nutrient loads from point and nonpoint sources.
Strategy: 1-1a2: Evaluate and improve the clean water infrastructure for wastewater treatment facilities (WWTFs), conveyance systems, and associated sewer lines.

Project Description/Background: Nutrient trading programs can assist in attaining water quality objectives by providing economic market-based incentives to support cost effective nutrient reduction strategies. State agencies will continue support of existing point source nutrient trading programs (such as Connecticut’s Nitrogen General Permit and Nitrogen Credit Exchange Program) and support expansion of potential new nonpoint source trading programs implemented at the municipal level throughout the Long Island Sound watershed as well.

Cooperators and Partners: The state environmental agencies of Connecticut and New York (as well as the upper basin states) and their respective state municipalities.

Funding Sources: A combination of state Clean Water SRF funding and local municipal and private funding sources.

Funding Needs: \$\$\$\$; Eventually could be self-sustaining by implementing a true trading program rather than marketplace.

Expected Outputs:

- Comprehensive review on effectiveness and recommendations for existing/future trading programs

Performance Metric(s):

- Number of municipalities participating in credit exchange.
- Number of credits exchanged.

Implementation Status: Underway; Connecticut Nitrogen General Permit and Nitrogen Trading program is underway as is the New York bubble permit program.

Expected Timeframe: 2015–2019 Maintain current point source trading and assess expansion to include other sources.

Implementation Action: WW-6

Enhance implementation of the 2000 Dissolved Oxygen TMDL and evaluate revision of the TMDL and allocations as needed to attain water quality standards.

Theme: Clean Waters and Healthy Watersheds
Goal: Improve water quality by reducing contaminant and nutrient loads from the land and the waters impacting Long Island Sound.
Outcome: 1-1: Contaminant and nutrient loads from land-based sources in the watershed of Long Island Sound are reduced.
Objective: 1-1a: To reduce contaminant and nutrient loads from point and nonpoint sources.
Strategy: 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. 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 LIS. 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)

Project Description/Background: A recent LISS evaluation of TMDL implementation (NEIWPC 2014) demonstrated areas of success and opportunities to improve nitrogen reduction. Since the 2000 TMDL highlighted the need for additional phases of action to attain water quality standards, there is a need to further enhance nitrogen reductions or alternatives to nitrogen reduction to attain water quality standards. Continued scientific and technical support will be needed to assess attainment of dissolved oxygen water quality standards from implementation of the 2000 TMDL and to assess additional actions needed. The states of Connecticut, New York, Massachusetts, New Hampshire and Vermont should continue to work with EPA to implement a tributary state WWTF permitting strategy, upgrade WWTFs, assess current stormwater and nonpoint source pollution control effectiveness, understand nitrogen loading to groundwater, and continue development of a feasible tracking system for NPS nitrogen reductions. The five-state workgroup will continue to assess the adequacy of the Long Island Sound TMDL nitrogen allocations in attaining water quality standards.

Cooperators and Partners: EPA, CTDEEP, NYSDEC, MassDEP, NHDES and VTDEC, and local government agencies

Funding Sources: Federal and state funding would likely be necessary, including Connecticut Clean Water Fund (CWF), SRF and other funding

Funding Needs: Technical support for TMDL revision—\$\$, Implementation to achieve revised TMDL—\$\$\$\$

Expected Outputs: Implementation of Long Island Sound TMDL and progress toward a 5-state TMDL revision.

Performance Metric(s):

- Attainment of 2000 TMDL waste load allocation.
- Completion of an evaluation of and plan for TMDL Revision

Implementation Status:

- Underway. The TMDL Work Group is developing enhancements to the existing TMDL.

Expected Timeframe: 2015–2017 achieve 2000 TMDL waste load allocation. Revise TMDL by 2020.

Implementation Action: WW-7

Improve the reporting requirements of MS4 communities for Dissolved Oxygen TMDL implementation tracking to better quantify the effectiveness of control measures

Theme: Clean Waters and Healthy Watersheds
Goal: Improve water quality by reducing contaminant and nutrient loads from the land and the waters impacting Long Island Sound.
Outcome: 1-1: Contaminant and nutrient loads from land-based sources in the watershed of Long Island Sound are reduced.
Objective: 1-1a: To reduce contaminant and nutrient loads from point and nonpoint sources.
Strategy: 1-1a4: Ensure cross-department collaboration and cooperation at the municipal level to implement MS4 BMPs (e.g., involve highway departments). 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 LIS.

Project Description/Background: MS4 communities are required to report actions taken to address the six minimum control measures for stormwater runoff and other actions to reduce pollutant loads to impaired waters. Current reporting does not provide sufficient information to determine the impact of these actions in controlling nitrogen discharges. Improved information from the regulated communities will allow the states and LISS to better assess and track the actions taken to address water quality and the relative success of each action. For example, current reporting requires only a listing of actions, but does not require an estimate of the improvement to the entire system. This action also encourages greater state oversight of MS4 permits/permittees. Also included will be the evaluation of the relative source contribution of nitrogen loading to groundwater, e.g., OSWTS, lawn fertilizer, agricultural, legacy land use, etc. LISS will offer guidance to improve tracking actions and reporting. Implementation action WW-9 will help to provide additional tracking and reporting mechanisms.

Cooperators and Partners: The states of New York, Connecticut, and Massachusetts and MS4 regulated municipalities. The state agencies plan on using a combination of tools and strategies, including 319, MS4, and other SRF programs to assist municipalities in reducing contaminant levels in stormwater systems.

Funding Sources: State agency funds would be required to implement revised requirements.

Funding Needs: \$\$; some costs may be incurred by municipalities to train personnel, collect additional data, and modify reporting systems.

Expected outputs:

- New reporting requirements.
- Better understanding of the relative success of control measures.

Performance Metric(s):

- Municipal tracking that reports actions in terms of percentage improvement of the entire stormwater collection/treatment system and volume of discharge treated.

Implementation Status: Underway. The MS4 programs in both states are currently fully implemented. This particular reporting task would not be a new action but improvements on the existing action. Tracking is now currently required under the MS4 regulations.

Expected Timeframe: 2015–2018 to develop and implement a new reporting system.

Implementation Action: WW-9

Develop a nonpoint source and stormwater tracking system tool for the Long Island Sound watershed.

Theme: Clean Waters and Healthy Watersheds
Goal: Improve water quality by reducing contaminant and nutrient loads from the land and the waters impacting Long Island Sound.
Outcome: 1-1: Contaminant and nutrient loads from land-based sources in the watershed of Long Island Sound are reduced.
Objective: 1-1a: To reduce contaminant and nutrient loads from point and nonpoint sources.
Strategy: 1-1a6: Implement low-impact development and green infrastructure for new and existing development, and mitigate pollution from commercial and industrial sources. 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 LIS.

Project Description/Background: The Long Island Sound TMDL and NPS and Watersheds Workgroups identified the need to develop a tracking system in order to account for on-the-ground activities related to reducing nitrogen from nonpoint sources and stormwater. The tool, once developed, will act as a database for tracking both qualitative and quantitative activities, allow for implementation planning through adjustments to scenarios, and permit a more quantitative evaluation of progress relative to the TMDL required nitrogen reductions.

Cooperators and Partners: EPA Region 1, EPA LISS, States of Connecticut, New York, Massachusetts, New Hampshire and Vermont. A contract with a qualified consultant to complete the required tasks will be necessary.

Funding Sources: LISS above-base funding.

Funding Needs: \$\$\$. Additional funds will likely be needed in order to obtain required data for the entire watershed once pilot project is complete.

Expected Outputs: A functional tracking and accountability system to store implementation activities related to reducing nitrogen and qualitatively track progress towards attainment of the TMDL. The Tracking system will establish consistency for data collection, implementation planning, and determining progress across the Long Island Sound watershed.

Performance Metric(s):

- Complete and adopt Tracking Tool, successfully implement pilot program.
- Improved municipal and watershed BMP tracking and reporting.

Implementation Status: Underway. Enhancement grant has already been awarded to a contractor to research and assist LISS in developing an NPS tracking tool.

Expected Timeframe: 2016–2019. One year to complete Request for Proposal (RFP) process and select contractor. Two years to complete the above two phases. Fully populating the Tracking System may fall into a future cycle (2020–2025).

Implementation Action: WW-10

Develop improved policies for use and performance of decentralized and on-site wastewater treatment systems.

Theme: Clean Waters and Healthy Watersheds
Goal: Improve water quality by reducing contaminant and nutrient loads from the land and the waters impacting Long Island Sound.
Outcome: 1-1: Contaminant and nutrient loads from land-based sources in the watershed of Long Island Sound are reduced.
Objective: 1-1a: To reduce contaminant and nutrient loads from point and nonpoint sources.
Strategy: 1-1a7: Improve comprehensive management and performance of decentralized wastewater treatment systems and residential, on-site wastewater treatment systems (OSWTSs). 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 LIS.

Project Description/Background: Decentralized wastewater treatment facilities are an increasing share of the nitrogen load to Long Island Sound. There is a need to develop and implement nutrient reducing practices at on-site/decentralized wastewater systems for domestic/residential wastewater to restore and protect waters affecting coastal water bodies and habitats. The Connecticut Department of Public Health (CTDPH), New York State Department of Health, and Suffolk County should develop state and county regulations, policies and programs to manage and regulate these facilities. Training and resources should be provided to health and watershed management organizations, septic system inspectors and planning agencies for developing improved policies and implementing best available nutrient and microbial reducing technologies, including, for example, upgrades consistent with Suffolk County Department of Health Services (SCDHS) 2014 Comprehensive Water Resources Management Plan. Connecticut and New York should identify nutrient threatened and sensitive resources needing innovative and alternative technologies and implement the management components of the EPA's *Voluntary National Guidelines for Management of Onsite and Clustered (Decentralized) Wastewater Treatment Systems* (2003). Localities should develop, implement, and/or enforce local laws and ordinances that promote and/or govern comprehensive management of on-site and decentralized wastewater treatment systems.

Cooperators and Partners: The state, county and municipal agencies of Connecticut and New York. A contract/research study may be necessary to facilitate and support regulatory and policy development.

Funding Sources: A combination of state and federal grants and loans primarily funded through each states' respective SRF loan and grant programs and through EPA Grants. Possible LISFF, other local grants or private funds could be used for studies or pilot projects.

Funding Needs: \$\$\$

Expected Outputs:

- Strategy/Plan to advocate for state and county resources to support and develop necessary regulations and policies. Improved and adopted regulations policies requiring current advanced nutrient reducing package and on-site septic systems in both states.

Performance Metric(s):

- Recorded number of states and municipalities incorporating special sewer districts to facilitate installation of denitrifying decentralized and residential onsite systems. Adopted state and county regulations.

Implementation Status: New

Expected Timeframe: 2016–2019. Two to three years to solicit and implement study. Broad scale implementation in 2020–2030 time range.

Implementation Action: WW-11

Improve understanding, management, and design of denitrifying decentralized and residential, on-site wastewater treatment systems.

Theme: Clean Waters and Healthy Watersheds
Goal: Improve water quality by reducing contaminant and nutrient loads from the land and the waters impacting Long Island Sound.
Outcome: 1-1: Contaminant and nutrient loads from land-based sources in the watershed of Long Island Sound are reduced.
Objective: 1-1a: To reduce contaminant and nutrient loads from point and nonpoint sources.
Strategy: 1-1a7: Improve comprehensive management and performance of decentralized wastewater treatment systems and residential, on-site wastewater treatment systems (OSWTSs). 4-1a1: Identify science activities needed to transparently link outcomes and objectives to strategies and actions, setting priorities based on management relevance and scientific merits. 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 LIS.

Project Description/Background: Substantial effort has been invested in increasing WWTF infrastructure to remove nitrogen. More attention needs to be paid to other sources of nitrogen, and of these, sewage effluent nitrogen from unsewered areas, particularly those near surface waters and the coast, is among the largest remaining contributors. Approximately half of the homes and businesses in the watershed have conventional OSWTS that do little to remove nitrogen. The innovative and alternative technology exists to remove significant amounts of N from these sources, but it is still expensive, rarely required by law, and in some cases, still under development. This action will focus on developing an understanding and guidance on how best to utilize these systems, when to require their installation, and how much of an impact they can have on the nutrient budget of Long Island Sound and its embayments.

Cooperators and Partners: Research would likely be conducted by academic or consulting agency partners. New OSWTS regulations at the state or county level are needed to improve oversight and guidance on the use and application, and permitting of nutrient reducing technologies. Planning and zoning by regional planning agencies should ensure that upgrades to decentralized and residential onsite systems do not lead to increased development density and thus no net reduction in nitrogen load. LISS will assist with logistics, outreach and possibly some funding.

Funding Sources: Planning grants could target LISFF. Implementation would require external sources of funding or state/municipal budgets.

Funding Needs: Feasibility study \$\$\$, Implementation \$\$\$\$\$. Individual upgrades to a nitrogen removing septic system can cost \$20–50K depending on size, lot constraints, etc. which would require external funding for state or local subsidized loan programs or other homeowner financing programs and mechanisms.

Expected Outputs:

- Planning/research reports on nitrogen removing OSWTS.
- Improvement and economies of scale in OSWTS nitrogen removal technologies.
- Eventual N load reductions resulting from implementation.

Performance Metric(s):

- Number of nitrogen removing septic systems installed and consequent nitrogen load reduction.

Implementation Status: Underway/New. Efforts to understand the impact of OSWTS are underway nationally and regionally.

Expected Timeframe: 2015–2019 to assess new technology, policy and legislative options, and begin long-term implementation over future cycles.

Implementation Action: WW-12

Improve efficiency and resiliency of existing/new waste treatment systems including septic, WWTF and stormwater infrastructure to accommodate sea level rise.

Theme: Clean Waters and Healthy Watersheds
Goal: Improve water quality by reducing contaminant and nutrient loads from the land and the waters impacting Long Island Sound.
Outcome: 1-1: Contaminant and nutrient loads from land-based sources in the watershed of Long Island Sound are reduced.
Objective: 1-1a: To reduce contaminant and nutrient loads from point and nonpoint sources.
Strategy: 1-1a8: Incorporate climate change and sea level rise in planning, regulation, and BMPs for stormwater and wastewater treatment. 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. 4-3a1: Include important environmental drivers (e.g., climate change) in all relevant management planning initiatives.

Project Description/Background: To minimize and prevent flood-induced discharges of untreated or partially treated sewage containing excess nutrients and pollutants, EPA and state agencies need to work with municipalities to improve and protect wastewater treatment plants and storm sewer infrastructure operations and efficiencies. Activities include promoting the Climate Ready Utilities Program and the Climate Resilient Evaluation and Awareness tool (CREAT) to water utilities and municipalities, and support utilities in modifying treatment plants to withstand future storm surge. Criteria should also be developed for use of State Revolving Fund (SRF) infrastructure investments for building resiliency to climate change impacts. Studies should be conducted to identify where improvements are necessary and the costs associated with those improvements. This would be followed by assistance to municipalities in applying for funding for projects to upgrade infrastructure for pollution control equipment and facilities. Onsite wastewater treatment infrastructure located within coastal flood zones or in areas with minimal or no separation from groundwater are also at risk for flooding and potential operation failure. State and county Health and environmental agencies should provide training and resources to shoreline municipalities and planning agencies for developing and implementing coastal adaptation and resiliency strategies for decentralized treatment plants and on-site sewage systems located within the coastal flood zones of the Long Island Sound municipalities. This includes implementing strategies to deal with depth to groundwater changes as a result of climate change, and its impacts on septic system use and siting. State Health and environmental agencies will need to work with the municipalities to oversee and implement regulations for decentralized treatment plants and on-site septic systems.

Cooperators and Partners: State and local agencies in Connecticut and New York, including the CTDEEP and CTDPH, NYSDEC (for OSWT systems over 1000gpd), NYSDOH (for systems 1000 gpd or less), and Suffolk County.

Funding Sources: Initial study could be LISFF funded. Implementation would be a combination of state and federal grants and loans primarily funded through each state's respective SRF loan and grant programs, to seek funding for NPS infrastructure upgrades

Funding Needs: \$ to \$\$\$\$

Expected Outputs:

- Report on changes necessary to incorporate sea level rise (SLR) into existing policies.
- List of plants and systems that will require upgrades to accommodate SLR.

Performance Metric(s):

- Number of municipalities that incorporate coastal adaptation and resiliency strategies for wastewater treatment infrastructure into their resiliency plans.

Implementation Status: New

Expected Timeframe: 2015–2019. Report by an outside consultant should take one year and be funded within two to three years. Implementation of report recommendations would be in the 2020–2030 timeframe.

Implementation Action: WW-19

Encourage state and local health departments to adopt emerging rapid bacterial detection technologies that would allow shorter duration administrative beach/shellfish closings than those based on rainfall only.

Theme:	Clean Waters and Healthy Watersheds
Goal:	Improve water quality by reducing contaminant and nutrient loads from the land and the waters impacting Long Island Sound.
Outcome:	1-2: The negative impacts of contaminants and nutrients in the waters and sediments of Long Island Sound and tributaries/embayments are reduced.
Objective:	1-2b: To mitigate impacts of nutrients and contaminants to human health and to the biota and ecosystem of Long Island Sound.
Strategy:	1-2b2: Reduce human health risks through increased or targeted pathogen beach and embayment monitoring and fish and shellfish contaminant testing.

Project Description/Background: While temporary beach and shellfish closures based on rainfall criteria only are an important management tool to avoid bacterial contamination and illness, emerging technologies such as rapid bacterial detection could increase human health protection and reduce resource use impairments. Rapid testing techniques, including QPCR and other DNA based technologies for detecting *E.coli* and fecal coliform are becoming less expensive and a reliable method for more accurately determining when beaches need to close, and when they can re-open. As the feasibility of these technologies are demonstrated, state and local health departments should adopt them in their testing programs.

Cooperators and Partners: Individual municipalities would ultimately be responsible. LISS could provide logistical and planning assistance and possibly some funding for pilot programs in association with state shellfish and beach safety programs. In Connecticut, the State Department of Public Health would oversee monitoring detections technologies for bathing beach monitoring programs and the State Department of Agriculture, Division of Shellfish and Aquaculture would oversee for detection monitoring of shellfish areas.

Funding Sources: LISFF could fund pilot studies, feasibility analysis, etc. Other assessment funding would come from interested municipalities, which already generally do some monitoring.

Funding Needs: \$\$

Expected Outputs:

- Reduced beach and shellfish closures
- Better science informing management decisions.

Performance Metric(s):

- If a method can be shown to be effective, fewer beach/shellfish bed closure days compared to rainfall based criteria only.

Implementation Status: New

Expected Timeframe: 2016–2019 for pilot scale/feasibility studies. If shown effective, wide scale implementation would take an additional two to five years.

Implementation Action: WW-24

Maintain and enhance the utility and efficiency of water quality monitoring of nutrient loads to Long Island Sound science and management efforts.

Theme: Clean Waters and Healthy Watersheds
Goal: Improve water quality by reducing contaminant and nutrient loads from the land and the waters impacting Long Island Sound.
Outcome: 1-3: Research, monitoring, and modeling to support attainment of water quality objectives is maintained and improved.
Objective: 1-3b: To research, monitor and assess water quality and factors that contribute to water quality change.
Strategy: 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.
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: The Long Island Sound Study has a long-standing commitment to water quality monitoring. With the recent expenditures by Connecticut and New York towards reducing nutrient loading and hypoxia, it is critical to maintain a comprehensive, but efficient monitoring program, and to invest in new technologies that will improve the efficiency and/or resolution of our monitoring as we strive to manage adaptively in response to these changes. Rapid advancements in automation and miniaturization have fueled the development of new instruments and sensors that can greatly reduce lab and field sample analysis times. It is critical for LISS to invest in these technologies as soon as they are proven to be robust and reliable, as the long term cost savings could be substantial. Pilot studies for two such technologies (*in situ* primary productivity via fast repetition rate fluorometry and *in situ* nutrient analysis) are currently ongoing. This action will involve a systematic review of the Long Island Sound water quality monitoring program. Review findings will be used to further improve the program.

Cooperators and Partners: CTDEEP and IEC/New England Interstate Water Pollution Control Commission (NEIWPCC) presently conduct the LISS funded monitoring program. USGS and UCONN as well as many smaller agencies have other extant monitoring programs. LISS research and monitoring partners (DEEP, IEC, NOAA, UCONN, etc.). LISS could provide logistical support and possibly funding through the Water Quality working group.

Funding Sources: Approximately \$1M of the LISS program funds support water quality monitoring, with additional funds (approximately \$200k) coming from the state and from EPA 604(b) funding.

Funding Needs: \$--\$.

Expected Outputs:

- Workshop in spring 2015.
- Assessment of ongoing pilot study using fast repetition rate fluorometry for primary production rate measurements and NERACOOS funded pilot study of *in situ* nutrient analyzers.
- Systematic review of long-term water quality monitoring dataset. Regular review and updates to monitoring technologies.

Performance Metric(s): N/A

Implementation Status: Underway

Expected Timeframe: 2015–2019. Assessments are ongoing with a workshop to be held in spring 2015. Future assessments may recommend substantial infrastructure investment to improve spatial and/or temporal resolution (e.g., increasing number of buoys and/or outfitting with *in situ* nutrient sensors).

Implementation Action WW-31

Assess sources of nutrient and pathogen contamination to Long Island Sound embayments.

Theme: Waters and Watersheds
Goal: Improve water quality by reducing contaminant and nutrient loads from the land and the waters impacting Long Island Sound.
Outcome: 1-2: The negative impacts of contaminants and nutrients in the waters and sediments of Long Island Sound and tributaries/embayments are reduced.
Objective: 1-2b: To mitigate impacts of nutrients and contaminants to human health and to the biota and ecosystem of Long Island Sound.
Strategy: 1-3b4: Research, monitor, and assess pathogens, their sources and their impacts on water quality.
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. 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: Embayments and near-shore area are in close proximity to sources of contamination from point and nonpoint sources and in many cases are hydrographically distinct from the main body of the sound. While steps have been taken to reduce overall loading to Long Island Sound, Sound wide reductions are often insufficient to address localized embayment level concerns. Pathogen contamination causes beach and shellfish closures and excess nutrients have the potential to affect wetlands and other resources and cause blooms of macroalgae and phytoplankton, including HABs, which can impact human health. This effort is currently underway in New York. A three-year project beginning in April 2015 will categorize Long Island embayments into “like groups” and then a representative from each category will be selected for a detailed analysis of the pathogen and nitrogen loads to those representative embayments from all sources. Once the loads from the representative embayments are determined, relative contributions from each source will be applied to estimate the pollutant loads within each of the embayments of a “like group”. The Long Island Embayment project could act as a template for looking at embayments in other areas of Long Island Sound.

It is necessary to evaluate the relative contribution of sources of pathogens and nutrients to Long Island Sound embayments through sampling and modeling as a first step in the development of TMDLs or other management plans to protect resources and human use.

Cooperators and Partners: NYSDEC, CTDEEP, local governments, academic researchers

Funding Sources: States of New York and Connecticut and local governments, nonprofits and citizen action groups

Funding Needs: \$\$\$

Expected Output:

- Enumeration and/or estimation of pathogen and nutrient loads from point and nonpoint sources to embayments

Performance Metrics: N/A

Implementation Status: Underway. A LISS research project (Vaudrey et. al) is measuring and modeling nutrients in embayments and New York State will be evaluating embayment pathogen and nutrient sources. Connecticut is developing TMDLs.

Expected Timeframe: 2015–2019.