APPENDICES

APPENDIX A

LISS AND PARTNER KEY ACCOMPLISHMENTS, 1994–2014

The LISS has assessed and documented the progress the many partners have made in restoring and protecting the Sound through a series of reports available online at www.longislandsoundstudy.net. Some regional accomplishments stand out.

IMPROVED WATER QUALITY

- Developed an innovative, bi-state plan to reduce nitrogen pollution comprehensively to Long Island Sound.
  - Reduced nearly 40 million pounds per year the amount of nitrogen discharged from 106 wastewater treatment facilities in Connecticut and New York.
  - Reduced atmospheric deposition of nitrogen due to air emission controls.
  - Reduced severity of hypoxia (or low dissolved oxygen levels).
  - Increased the area of eelgrass beds, a rooted underwater plant sensitive to water quality conditions, by 4.5 percent between 2009 and 2012 and 29 percent between 2002 and 2012.
- Established all of Long Island Sound waters as a No Discharge Zone for marine boat pump out waste.
- Decreased releases of toxic contaminants in the Long Island Sound watershed by 86 percent from 1988 to 2010 (from 16.5 million pounds to 2.3 million pounds).
  - Declining concentrations of many contaminants observed in sediment on the seafloor.
  - Decreased PCB concentrations in striped bass by 82 percent between 1987 and 2007.
  - Decreased concentrations of many contaminants in seafloor marine life as measured by the NOAA National Status and Trends program.
- Adopted an action plan in 2007 to address sources of mercury to the region, with New York and Connecticut joining with other New England States.

◀ **A COMMON TERN** within the Oyster Bay Long Island Sound Stewardship Area, Lattingtown, NY (Photo by Lisa Franceski)

- Expanded community involvement in local watershed protection.
  - Created the Nonpoint Education for Municipal Officials (NEMO) program, which developed into a national program to educate municipal officials about local land use decision-making and nonpoint sources of pollution.
  - Developed watershed management plans for more than half of the sub-watersheds in the bi-state watershed.
  - Established Advanced Master Gardener Coastal Certificate program to focus on sustainable landscaping—alternatives to nutrient, chemical, and water intensive landscaping—for clean waters, engaging cooperative extension volunteers in over 600 hours of outreach and an estimated public audience of over 5,000.
  - Established an organic lawn care certification program for lawn professionals, providing alternatives to nutrient and chemical intensive landscaping to 160 service providers who attended workshops in 2013 and 2014.

RESTORED AND PROTECTED HABITAT

- Restored a total of 1,650 acres of habitat from 1998 to 2014, 83 percent of the goal to restore at least 2,000 acres of habitat by 2020.
- Reopened 317 miles of river and stream corridors to fish passage from 1998 to 2014 by removing dams and obstructions or creating bypasses and fish ladders in selected reaches.
- Developed the Long Island Sound Stewardship Initiative, which identified 33 areas that warrant special protection due to outstanding or exemplary scientific, recreational, or ecological value.

- Protected a total of 2,850 acres in the Long Island Sound Study Area since 1998 through easements and land acquisitions. Of that total, 2,675 have been protected since 2006, when the Long Island Sound Stewardship Act of 2006 was enacted.

PLANNED FOR CLIMATE CHANGE RESILIENCY

- Anticipated the need for information about climate change to support adaptation by creating the Long Island Sound Sentinel Monitoring program in 2008. The program identified six key flora/fauna native to the Sound as indicators of change, created a database of climate change science, and piloted projects to observe and document change over time.
- Installed 79 individual Surface Elevation Tables in 16 different tidal marsh areas to measure elevation changes in the marsh surface.
- Supported Groton, CT in developing a model process for municipalities to identify climate change vulnerabilities and prepare for them.

SUPPORTED SCIENCE AND RESEARCH

- Developed and published a synthesis of available scientific information, *Long Island Sound: Prospects for the Urban Sea*, (Latimer et al. 2014).
- Developed, funded and maintained a 28-year record of water quality monitoring data in Long Island Sound at fixed stations (one of the longest-term water quality monitoring datasets available nationally) and expanded the network to include fixed real-time buoy data.
- Piloted innovative bioextraction projects to evaluate the potential for aquaculture expansion to improve water quality and support local community jobs.
- Expanded support for scientific research.
  - Partnered with the New York and Connecticut Sea Grant College Programs to administer and manage the Long Island Sound Study Research Grant program that through 2013 funded 33 investigations, resulting in numerous scientific publications, and improved knowledge upon which to base management of the Sound.
  - Coordinated a multi-partner effort to map the seafloor of Long Island Sound through the collection of high-resolution geophysical data. This information will aid management of marine resources and comprehensive marine spatial planning.

ENGAGED PARTNERS, LEVERAGED RESOURCES

- Created and revitalized the Long Island Sound Science and Technical Advisory Committee (STAC) composed of scientists and engineers to synthesize science and identify research priorities.
- Established and administered the LIS Futures Fund (LISFF)—a collaborative grant program with the National Fish and Wildlife Foundation that funds on-the-ground projects in communities around the Sound to help restore the Sound. Since 2005, the Futures Fund has invested $11.7 million in 285 projects in communities surrounding the Sound. With grantee match of $24 million, LISFF has generated a total of almost $36 million for projects in both states.
- Leveraged more than $3.2 billion in other federal, state and local funding from 2006-2013, a ratio of $84 leveraged for every EPA Long Island Sound dollar in funding for the Management Conference.

EDUCATED AND ENGAGED THE PUBLIC INCLUDING DISADVANTAGED COMMUNITIES

- Created and supported a robust and active Citizens Advisory Committee to provide public input and advice to the Management Conference on program direction, priorities, and funding needs.
- Convened an annual Citizens Summit to increase awareness of efforts being made to protect and restore the health of the Sound.
- Developed and supported a bi-state Mentor Teacher Program for K-12 educators who attended 37 training sessions and are certified as "train-the-trainers" mentors in their school district, with more than 350 educators trained, reaching 25,000 students in New York and Connecticut through 2013.
- Included Environmental Justice (EJ) as a priority topic in the LISFF annual request for proposals for CCMP implementation projects.
- Involved students from EJ communities into community-based water and habitat improvement projects.
- Built local partnerships to capitalize on federal EJ initiatives (such as USFWS Urban Wildlife Refuge Program and the EPA Urban Waters Program).
- Integrated involvement from underserved communities in new initiatives, building grassroots support for their expansion.
  - Involved youth from underserved communities in projects that demonstrated effectiveness of aquaculture to bioextract nitrogen from LIS waters.

APPENDIX B

TECHNICAL EXPLANATION OF ECOSYSTEM TARGETS

The following section provides a technical background and explanation of the quantitative ecosystem targets in the CCMP. Explanation is provided for each target on how and why the given metric and specific target were chosen and how progress toward the target will be measured (e.g., what the baseline value is, clarification of specific terms, what datasets will be used, etc.).

CLEAN WATERS AND HEALTHY WATERSHEDS

EXTENT OF HYPOXIA

Measurably reduce the area of hypoxia in Long Island Sound from pre-2000 Dissolved Oxygen TMDL averages to increase attainment of water quality standards for dissolved oxygen by 2035, as measured by the five-year running average size of the zone.

The average size of the maximum summertime extent of hypoxia (DO ≤ 3.0 mg/L) from 1987–2000 was 208 square miles. Based on the last 20 years of interannual variability, a 28 percent reduction would be necessary to achieve a "measurable reduction," defined as the ability to statistically differentiate (either by regression or by ANOVA) that a change has occurred with 95 percent confidence after 20 years (in 2035). We chose areal extent from the available hypoxia metrics tracked by LISS (areal extent, duration) because this metric is most closely correlated to the severity of impact and is the least environmentally variable of the metrics.

NITROGEN LOADING

Attain WWTF nitrogen loading at the recommended 2000 Dissolved Oxygen TMDL allocation level by 2017 and maintain the loading cap. Have all practices and measures installed to attain the allocations for stormwater and nonpoint source inputs from the entire watershed by 2025.

Discharges from wastewater treatment facilities are tracked for compliance with permit limits consistent with the LIS Dissolved Oxygen TMDL for nitrogen (CTDEEP, NYSDEC 2000). This target is to attain the TMDL allocation for wastewater treatment facilities (in trade equalized pounds per day) by 2017 and maintain compliance with that cap into the future. The allocations for nonpoint sources in the LIS TMDL require implementation of a variety of best management practices to control nonpoint source pollution. This target is to have all the necessary practices to attain the TMDL nonpoint source allocation in place by 2025. Because it is difficult to directly monitor nonpoint source nutrient loads, a BMP tracking and modeling approach will be used to assess attainment of the TMDL stormwater and nonpoint source allocations. This approach will produce quantitative estimates of nitrogen load controlled as a result of those practices. The estimation of nitrogen load controlled will be used to measure attainment of the TMDL targets to reduce nitrogen loading from stormwater and nonpoint sources.

WATER CLARITY

Improve water clarity by 2035 to support healthy eelgrass communities and attainment of the eelgrass extent target.

Water clarity is one of the major factors affecting eelgrass health and therefore extent. For most of LIS water clarity is correlated with phytoplankton levels and measured using standard light penetration techniques (e.g., Secchi disk, photosynthetically active radiation sensors). For the purposes of this goal, "improved" is defined as an increase in the overall numeric criterion for water clarity in the Long Island Sound water quality report card (under development) by at least half letter grade (e.g., B to B+) between the initial 2015 report card evaluation and the evaluation conducted in 2035.

IMPERVIOUS COVER

Through green infrastructure, low impact development, and stormwater disconnections, decrease by 10 percent the effective area of impervious cover in the Connecticut and New York portions of the watershed by 2035 relative to 2010 baseline.

The degree of impervious cover, particularly near waterbodies, has been shown to be associated with degradation of water quality in rivers and streams. The analysis is based on UCONN Center for Land Use Education And Research (CLEAR) Land use data (http://clear.uconn.edu/publications/research/Statewide_riparian_final.pdf) (Wilson and Arnold 2008) and can be tracked using the CLEAR estimate of impervious cover. Low impact development projects (e.g., green roofs, permeable parking lots) logged in the CLEAR Low Impact Development Atlas would be considered pervious for the purpose of this analysis. The 2010 baseline is 296,000 acres (463 square miles) of impervious cover in the LISS Study area. The study area is defined by the TMDL, and the study area boundary can be found here: http://longislandsoundstudy.net/wp-content/uploads/2010/01/LISSHabMap02.pdf.

RIPARIAN BUFFER EXTENT

Increase the percent area of natural vegetation within 300 feet of any stream or lake in the Connecticut and New York portions of the Long Island Sound watershed to 75 percent by 2035 from 2010 baseline of 65 percent.

Naturally vegetated zones around the shorelines of all waterbodies provide a buffer that has been shown to be effective in removing contaminants from groundwater before it enters into receiving waters. The target is to have 75 percent of areas within 300 feet of a stream or lake within the Connecticut and New York portions of the LIS watershed naturally vegetated by 2035, based on UCONN CLEAR land use data (http://clear.uconn.edu/projects/riparian_buffer/results/CLEAR_%20Summary_021508.pdf). Naturally vegetated includes forest, grassland, shrub, and wetland land use categories, but not turf grass or agriculture field classes. This target is based on analysis of land use and water quality in CT (Goetz, 2003; Wilson and Arnold 2008).

APPROVED SHELLFISH AREAS

Upgrade 5 percent of the acreage currently restricted or closed for shellfishing by 2035 from 2014 baseline.

Each state has designated areas for safe shellfishing; the "growing waters" designation is common to both CT and NY. Currently Connecticut has approximately 128,000 approved acres, 248,000 acres of conditionally approved or restricted beds, and 23,500 acres prohibited, while New York has 412,000 acres certified 1,613 acres seasonally certified (restricted), and 75,500 acres uncertified. Thus, to meet this target, 17,400 of the 349,000 closed or conditionally closed acres would need to be upgraded. This metric is reported by the states and tracked by the Long Island Sound Study Indicators program.

SEDIMENT QUALITY IMPROVEMENT

Reduce the area of impaired sediment in Long Island Sound by 20 percent by 2035 from 2006 baseline.

Sediment quality is determined by EPA's National Coastal Assessment Sediment Quality Index. This index is based on concentrations of 28 contaminants, characterized as "good," "fair," or "poor" for each station based on the number and severity of exceedances, and weighted by the portion of the Sound represented by each station. Our target is to reduce the net area that is impaired (rated as fair or poor) in Long Island Sound by 20 percent.

In 2006, 34 stations had data sufficient to establish a rating, and of those, 15 scored good, 11 fair, and eight poor. Spatially weighted (because sampling density is higher further west in LIS), 51.5 percent of LIS scores "good," 30 percent "fair," and 18.5 percent "poor." By this definition, 48.5 percent of LIS is considered impaired. To accomplish the goal of reducing this impairment by 20 percent we need to see net improvement in 10 percent (48 %*0.2 = 9.6%) of the area weighted stations.

We define "improvement" to be upgrading from "poor" to "fair" or from "fair" to "good," and net improvement to be the area of stations improving minus the area of stations regressing (from "good" to "fair" or "fair" to "poor"). By this definition, our goal can be accomplished by reducing the percentage of LIS scoring poor from 18.5 percent to less than 8.5 percent (as long as the percentage scoring "fair" does not increase to more than 40 percent) or by increasing the percentage scoring "good" from 51.5 percent to more than 61.5 percent, or a combination of both (e.g., 57% good, 33% fair, 10% poor = 5.5% increase in good + 8.5% decrease in poor = 13.5% of LIS area improved = 27% decrease in impairment).

THRIVING HABITATS AND ABUNDANT WILDLIFE

COASTAL HABITAT EXTENT

Restore 350 acres of coastal habitat by 2020 and a total of 3,000 acres by 2035 from a 2014 baseline.

Between 1998 and 2014, LISS partners have restored 1,650 acres of coastal habitat. The interim goal is to restore an additional 350 acres by 2020, for a cumulative total of 2,000 acres. The final goal is to restore an additional 2,550 acres between 2021 and 2035, bringing the cumulative total of acres restored since 1998 to 4,550 acres. The target for the coastal habitat extent includes restoration in any of the 12 targeted habitat types, including eelgrass and tidal wetlands. While separate and specific restoration targets are set for these two habitat types, gains in these two areas can be used to reach the total coastal habitat restoration targets. The Habitat Restoration Work Group tracks coastal habitat restoration projects that are in progress within the watershed by various partners and reports the total acres restored annually.

Eelgrass extent

Restore and maintain an additional 2,000 acres of eelgrass by 2035 from a 2012 baseline of 2,061 acres.

The 2012 eelgrass baseline comes from a 2012 USFWS survey that found 2,061 acres of eelgrass in the Eastern Basin of the Long Island Sound. While the survey was only conducted in the Eastern Basin, eelgrass experts believe that eelgrass beds in the Central Basin are small or nonexistent while beds are absent from the Western Basin. Therefore we use 2,061 acres as an estimate of total eelgrass coverage in the Sound, and the goal is to increase this to 4,061 acres of areal eelgrass extent as measured by aerial imagery.

This target will be achieved through the successful implementation of additional water quality protections and associated reductions in land based inputs of nutrients, as well as restoration (replanting) efforts led by academic, government, and nonprofit agencies and partners. The Habitat Restoration Work Group tracks eelgrass restoration projects that are in progress within the watershed by various partners and reports the total acres restored annually. However, this ecosystem target is influenced by both habitat restoration projects as well as natural gains and losses in eelgrass extent.

Tidal wetland extent

Restore an additional 515 acres of tidal wetlands by 2035 from a 2014 baseline.

As of 2014, 985 acres of tidal wetland habitat have been restored in the LISS study area since 1998. The 2035 target is to restore an additional 515 acres, bringing the cumulative total of restored tidal wetland acres since 1998 to 1,500. For the purposes of this metric, a wetland is considered "restored" after a successful effort to restore tidal flow (e.g., culvert enlargement, fill removal). The Habitat Restoration Work Group tracks tidal wetland restoration projects that are in progress within the watershed by various partners and reports the total acres restored annually.

RIVER MILES RESTORED FOR FISH PASSAGE

Open 200 additional miles of fish riverine migratory corridors in the Connecticut and New York portions of the watershed by 2035 from a 2014 baseline.

This target will be attained by reopening, either through dam removal or fish passage projects, an additional 200 riverine migratory corridor miles (RMC). The 2014 baseline is 317 open RMC miles in Connecticut and three open RMC miles in NY. For context, there are an estimated 1,850 total RMC miles in Connecticut, more than half of which are dammed or otherwise not passable for fish. The length of New York total RMC miles has not been estimated, but is much smaller. The Habitat Restoration Work Group tracks fish passage projects that are in progress within the watershed by various partners and reports the total miles restored annually.

SHELLFISH HARVESTED

Increase the harvest of oysters, clams, and scallops in the Sound through a combination of habitat management and shellfish aquaculture.

This is defined as the total harvest, by weight, of oysters, clams, and scallops harvested commercially or recreationally from open areas and/or shellfish leases. These data are collected by the states, and reported by the LISS Indicators program. Specific targets and timeframes will be developed after considering shellfish management plans under development such as the Connecticut statewide plan.

HABITAT CONNECTIVITY

Increase connectivity of coastal habitat by 2035 by restoring and/or protecting habitat patches that increase biodiversity and support migratory pathways.

Research shows that improving habitat connectivity allows for genetic and ecological flow. Corridors provide fish and wildlife with greater ability to move for the purposes of feeding, breeding, and resting. Promoting restoration and protection projects which increase aquatic and terrestrial connectivity, is an important component of ecosystem resilience, or the ability of an ecosystem and the fish and wildlife it supports to maintain function in the face of change. Connectivity gains can be both targeted and monitored by mapping restoration and protection projects in a GIS database and using decision support tools like the Stewardship Site Identification GIS Tool (SIGT) and Landscape Conservation Cooperative Connecticut River Pilot Landscape Design Tool which highlights the best areas of intact, resilient and connected habitat and identifies corridors between these areas of high quality patches. Using decision support tools like these will help to guide land protection decisions by highlighting areas on the landscape that have the greatest ecological value and identifying corridors between them. Efforts to refine these decision support tools are still underway as part of Implementation Action HW-4. Once these tools are complete, they will be used to establish a quantitative metric which will be used to estimate a baseline and set a more specific quantitative goal to be accomplished by 2035.

PROTECTED OPEN SPACE

Conserve an additional 4,000 acres of Connecticut land and 3,000 acres of New York land within the Long Island Sound coastal boundary by 2035, while maintaining or increasing the total area of protected land.

Connecticut's goal is to conserve an average of 200 acres per year within the Long Island Sound coastal boundary over the next 20 years, resulting in a total of 4,000 acres.

New York State is currently working on the latest version of their New York Open Space Conservation Plan. The Plan serves as the blueprint for the State's land conservation efforts and is required by law to be revised every three years. The most recent revision will be released in 2015. In the Plan, open space is considered an area of land that is either publicly or privately owned that will remain in its natural state or is used for agriculture, free from intensive development for residential, commercial, industrial or institutional use. The Plan identifies conservation projects and objectives for all counties found within the Long Island Sound watershed. These projects and objectives were determined by Regional Advisory Committees composed of county and state, land conservation organizations, and community interest group representatives, along with public comments received through the Plan review process. This Plan will help guide land acquisition in New York State for the coming years. The target number of acres to be acquired each year within the Long Island Sound watershed for New York is 150 acres per year. This number was determined by reviewing and averaging the total number of acres acquired each year and reported to the National Estuary Program Online Reporting Tool (NEPORT). The total number of acres acquired each year (includes acres acquired by all possible land acquisition entities: state, municipal, and land conservation organizations) for the last eight years (2007-2014), within the Long Island Sound watershed in New York State, was analyzed. Thus, the target is to preserve 3,000 acres of New York land within the Long Island Sound watershed by 2035. There is, however, a need for an accurate, complete inventory of protected land statewide in Connecticut and in the coastal area of Connecticut and New York to assess progress toward these goals.

SUSTAINABLE AND RESILIENT COMMUNITIES

WATERFRONT COMMUNITY RESILIENCY AND SUSTAINABILITY

All coastal municipalities have prepared plans for shoreline resiliency and infrastructure sustainability and resiliency by 2025, with all future development compliant with those plans by 2035.

Sustainable development and redevelopment as well as the protection of urban and suburban infrastructure from the effects of climate change are two of the main principles driving the revision of the CCMP. This target will encourage municipalities, within the coastal zone, to develop and implement comprehensive plans, which will have long lasting benefits to their residents. The implementation of these plans should not sacrifice ecosystem integrity. The Sound-wide enumeration of coastal municipalities will be quantified and tracked by the LISS (in Connecticut there are 36 coastal municipalities, in New York there are 96).

HARBOR AND BAY NAVIGABILITY

Maintain all federal navigation channels in harbors and bays and manage dredged material in a cost-effective and environmentally sound manner, consistent with a bi-state Dredged Material Management Plan, by 2035.

Maintenance of navigational channels is essential to sustain both recreational and commercial activities in harbors and embayments along the Connecticut and New York shorelines. This target ensures that dredging and dredged material disposal operations are accomplished in a sustainable manner, consistent with the Marine Protection, Research, and Sanctuaries Act, Clean Water Act, National Environmental Policy Act, and the Long Island Sound Dredged Material Management Plan so that future generations can enjoy boating in LIS and be assured that environmental degradation does not occur from the maintenance of harbors and embayments. The LIS Dredged Material Management Plan is presently under development. Project lists and dredge material amounts can be found at http://www.epa.gov/region1/eco/lisdreg/index.html.

PUBLIC ENGAGEMENT AND KNOWLEDGE

Increase the knowledge and engagement of the public in the protection and/or restoration of Long Island Sound.

A 2006 public perception survey supported by the LISS was conducted to gauge the knowledge of residents in the watershed. The survey correlated environmental knowledge with behaviors contributing to environmental stewardship. However, achieving positive behavior changes requires understanding and addressing the specific barriers preventing individuals and communities from their adoption. This target will require the development of baseline and trends metrics through best available research methods (SC-14 and SC-22) or review of existing social data that assess the degree to which the public understands its role in the protection of Long Island Sound and acts on that knowledge.

PUBLIC BEACH CLOSURES

Reduce by 50 percent the number of beaches reporting at least one closure day or the total number of beach-day closures per monitored beach due to water quality impairments by 2035 compared to a five-year rolling average from 2014.

LISS presently tracks closure days at 648 Connecticut and New York beaches using the EPA BEACON system (http://watersgeo.epa.gov/beacon2/reports.html). The five-year rolling average is 1,317 closure/advisory days, which translates to almost exactly two closure days per monitored beach. Of the 648 beaches reporting, 132 (20.5 percent) had at least one closure day. The target therefore is to reduce the five-year rolling average to about one closure day per monitored beach per year (658 total closure days assuming constant number of beaches sampled), or to reduce the total number of beaches reporting a closure to less than 10.25 percent of the total number of tracked beaches (66 at present sampling level).

MARINE DEBRIS

Decrease the mass of marine debris in Long Island Sound by 2035.

While LISS tracks several measures of marine debris, including boom/skimmer data, debris collected by vessels, and various annual beach cleanup statistics, the currently tracked indicator of pounds of debris removed per mile of beach cleanup performed is the best "effort independent" metric of the presence of debris in LIS. The data are obtained from Long Island Sound coastal cleanup days conducted as part of the International Coastal Cleanup coordinated by the Ocean Conservancy. The target is to reduce the five-year rolling average of this indicator, compared to the 2013 baseline (five-year rolling average from 2009 to 2013) of 313 pounds of debris removed per mile surveyed.

PUBLIC ACCESS TO BEACHES AND WATERWAY

Increase the number of public access points accessible by the public to the Sound and its rivers by at least 10 percent by 2035.

Public access to the shore for all members of the LIS community is an important design principle for the CCMP. There is not much undeveloped waterfront left along the coast. The CCMP includes an action (SC-37) to undertake a Sound-wide evaluation of coastal public access needs including a re-evaluation of existing public access for state/municipal sites that would most benefit for improvements to existing facilities. Such as plan would include the following steps: identify the current number of points and miles accessible; identify specific potential public access sites that could be re-developed in the future, as well as areas and stretches requiring additional attention; describe planning challenges to be considered in adding new access sites; summarize findings and set out steps for implementing the plan and increasing access. Measurement methods for shoreline accessibility will be based on this Sound-wide public access plan.

The current suggested metric for this is the quantity of public access points. Currently in Connecticut, there are 328 access points, so a 10 percent increase would require 33 new access points. New York does not currently track this metric, but would begin doing so as part of SC-37. Additional measurement methods and numeric targets for shoreline accessibility (e.g., ADA compliant access points) may arise upon completion this Sound-wide public access plan.

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APPENDIX C

KEY TO IMPLEMENTATION ACTIONS SUPPLEMENT

The CCMP has a 20-year horizon and includes specific implementation actions (IAs) organized by theme to help attain the plan goals and ecosystem targets. In addition to the work of ongoing programs, these specific, tactical actions will carry out the strategies over the next five years. Four supplemental documents detailing the CCMP Implementation Actions by theme are available at: www.LongIslandSoundStudy.net.

Implementation actions may apply to one or more strategies, but are organized around the main strategy addressed. Review and development of implementation actions every five years will allow for adaptive management and inclusion of emerging scientific and technological advances. Refining the implementation actions every five years will keep the CCMP current and incorporate the most effective management practices on a regular basis.

These IAs are presented by theme; however, many of the actions will achieve progress in multiple theme areas. The actions with the highest priority were chosen for their timeliness, application to ecosystem indicators and targets, and support of the four CCMP underlying principles. These actions will likely be completed within the first five years of implementation.

The four funding level categories (see Implement Action box) represent broad ranges in which to distinguish and group funding needs of implementation actions. The needed level of funding for an implementation action will also determine the types of funding sources (e.g., government grants, local foundations, clean water infrastructure grants and loans) most applicable to meeting that need.

The LISS will assess implementation progress yearly as part of annual work plan development process, as well as regularly reporting on the indicators of ecosystem targets. At the end of year four of each implementation cycle, the LISS will revisit the outcomes, objectives, and strategies based on implementation successes and on new drivers, pressures, or issues. New implementation actions will be developed for the next five-year planning cycle to support attainment of the goals and ecosystem targets, allowing for adaptive management and adjustment of priorities and actions.

EACH IMPLEMENTATION ACTION INCLUDES:

- A description and background about the proposed action.
- The lead or cooperating agencies and organizations.
- Potential sources for funding and the level needed within four categories –
  $ Less than $25,000
  $$ $25,000 to $150,000
  $$$ $150,000 to $1,000,000
  $$$$ Greater than $1,000,000
- Expected outputs or products that the action will generate.
- Indicators that will be used to measure the success of the implementation action.
- The implementation status of the action—either a new action or one that is already underway.
- An approximate time frame for action completion.

APPENDIX D

PRIORITY RESTORATION PROJECTS

TOP 5 PRIORITY HABITAT RESTORATION PROJECTS IN LIS

1 Coastal Island Stabilization and Restoration

Approx. cost: $1.5M in planning and permitting ($250,000 per island), $4M for construction

Long Island Sound's coastal islands are a unique and important resource. Great Gull Island in New York and Falkner Island in Connecticut are critically important to the survival of the federally endangered roseate tern. Great Gull plays a globally significant role in roseate tern survival as it is the largest nesting colony for this endangered tern in the Western Hemisphere. Falkner Island, part of the Stewart B. McKinney National Wildlife Refuge, is home to the only roseate tern colony in Connecticut as well as the largest least tern colony in the State. Both islands were badly damaged by Hurricanes Irene and Sandy. The hurricanes damaged infrastructure and about 70 percent of the nesting habitat on the islands. In addition to Great Gull and Falkner; Sheffield, Chimon (Stewart B. McKinney National Wildlife Refuge Units located in Norwalk, CT) Duck (Westbrook, CT) and Charles Islands (Milford, CT) are also in need of restoration and stabilization. These islands support populations of great egret, snowy egret, black-crowned night heron, glossy ibis and the American oystercatcher. Without stabilization all of these islands they will continue to lose critical nesting habitat for the Sound's waterbirds. The objective of this project is to model coastal stressors, plan, and engineer island stabilization projects to restore nesting area and stabilization function the islands. In addition to stabilization, some habitat restoration is needed. The project would also support removal of downed trees and storm debris, vegetation control and planting of native species.

2 Urban Habitat Restoration

Approx. cost: $4M (1-2 years); $15M (3-5 years); $19M total

The majority of Long Island Sound's coastal areas are highly urbanized. Urban areas offer a unique opportunity to forward habitat restoration in a very visible, meaningful way throughout communities. Habitat restoration in urban areas has significant ecological and societal value including providing vital stop over habitat for migrating wildlife, reducing pollution to the Long Island Sound and controlling flooding in cities and neighborhoods. Habitat restoration in urban areas also provides aesthetic benefits. The easy projects are done. Increasingly, we need to rethink traditional forms of restoration and get creative within the well-established urban centers around the Sound- finding lines of overlap and opportunity for both wildlife and humans to thrive.

The objective of this project is to support small and medium scale restoration of priorities habitat types in highly urbanized areas particularly within Alley Creek and Little Neck Bay watershed, New Haven Harbor watershed, and Bridgeport Harbor. These are three of the most densely populated urban centers in the Long Island Sound, with established partnerships, strong management and urban habitat restoration projects that are currently moving forward. These projects and future iterations need continued support. Partners in Alley Creek and Little Neck Bay, New Haven, and Bridgeport have identified locations for restoration. At Alley Creek, restoration is focused on invasive species removal, fill removal, clean fill replacement, and native planting at coastal forest, freshwater wetland, riparian corridors, coastal grassland, and tidal wetlands habitat as well as incorporating green infrastructure design and stormwater capture techniques in buffer zones surrounding the sites. In New Haven and Bridgeport restoration includes incorporating LID into highway medians, naturalization of riparian areas in

urban rivers, restoring native grassland habitat and improving the quality of coastal forests throughout the cities. Innovative wetland restoration plans have been proposed at some of these sites but not yet implemented. Engaging the public in restoration is a key component at all these sites.

3 Sandy Point Habitat Restoration Project

Approx. cost: $10M

Sandy Point in West Haven, CT is a Long Island Sound Study Stewardship Site and a key migratory bird area. It is one of Connecticut's top five nesting sites for least terns and the endangered piping plover as well as a proposed globally significant area for the semipalmated sandpiper. The site also supports American oystercatcher and the salt marsh sparrow in the adjacent wetland area.

Sandy Point has a sewage outfall pipe from the West Haven Sewage Treatment plan running across the beach. This pipe is becoming unearthed. A leak in the pipe could be catastrophic to the wildlife that uses the site, cause a major public health issue and water quality decline in New Haven Harbor into which the pipe drains. Moreover, the sand near the pipe has eroded over time and is going into Old Field Creek. This causes a blockage in the creek draining, subsequent freshwater retention and an overall reduced salinity which is spurring the growth of invasive *Phragmites* and causing major flooding in the nearby neighborhoods. The root of the problem is the configuration of the sewage outflow pipe which needs to be buried deeper. Once this is done Old Field Creek can be dredged which will help abate flooding. This project would provide funding to bury the pipe deeper, remove sediment build up from Old Field Creek and help the area regain tidal flow.

4 Resiliency Enhancing Techniques for Tidal Wetland Restoration

Approx. cost: $1.5M to $10M

Sea level rise is occurring at a quicker rate on the East Coast than other parts of the world. Experts are concerned this could threaten the health of our tidal wetlands by leading to more water up on the marsh, compressing the peat and causing the marsh to sink. Broadly speaking there is concern that more frequent storm events coupled with rising seas and sinking marshes could lead to a regime shift whereby resiliency of marshes is decreased to such a degree that they can no longer maintain themselves as marsh but shift to a less desirable habitat type, namely mud flat and eventually open water. These factors, combined with other possible factors such as nitrogen and sediment input into these systems, are having a detrimental impact on marsh health. Resiliency enhancing restoration techniques including thin layer deposition, facilitating marsh migration and creating living shorelines may increase resiliency of tidal wetlands. These techniques are being tried in some areas along the East Coast and in a few areas in Connecticut (Stratford Point living shoreline project, Yale University Marsh Migration Study). Other sites exist where good pilot efforts could be launched, specifically areas losing large areas of tidal marsh. In Connecticut, examples of these include Leetes Island in Guilford, Mile Creek in Old Lyme, Bride Brook in East Lyme and the marshes at Goshen Cove in Waterford. In New York, examples of areas exhibiting the greatest marsh loss include the Porpoise Islands and Stony Brook Harbor in Stony Brook, Crab Meadow Marsh in Huntington, Mount Sinai Harbor Islands in Mount Sinai, Baiting Hollow wetlands in Baiting Hollow, and Lloyd Point Harbor in Lloyd Harbor. Increased understanding of how and where resiliency enhancing restoration techniques are working will be critical to maintaining tidal marsh habitat. This project aims to fund tidal wetland resiliency enhancing restoration projects for example living shoreline work, thin layer deposition or facilitated marsh migration.

5 Flax Pond Habitat Restoration Project

Approx. cost: $500,000

Native intertidal and high marsh habitat in the Southern Long Island Sound estuary has decreased 23.8 percent from 1974 to 2005 (Cameron Engineering & Associates, LLC, 2015). Tidal marshes, like that found at Flax Pond in Old Field, NY are critical ecosystems that provide essential habitat and ecosystem services for Long Island Sound inhabitants. Flax Pond is a 135-acre tidal marsh system that has been labeled as an area of "Significant Coastal Fish and Wildlife Habitat" by NYSDEC and a Stewardship Site for LISS. The current inlet that supplies the tidal waters of the Sound to the pond has been slowly closing through silt build up over time, resulting in additional water remaining in the marsh even at low tide causing tidal wetland loss. It is essential that the inlet and marsh are studied and that the inlet is restored to return proper tidal flow to the marsh system so that this critical habitat can be protected.

TOP 5 PRIORITY RIVERINE MIGRATORY CORRIDOR RECONNECTIONS TO LIS

1 Rainbow Dam Fishlift, Farmington River, Windsor, CT

Approx. cost: $5M

Rainbow Dam is a 60-foot high, privately-owned hydroelectric dam. The dam has an existing concrete fishway that was installed in 1974. This fishway is approximately 750-feet long. The Farmington River supports a salmon run, and this species is able to efficiently utilize the fishway. However, many of the smaller species like American shad and river herring are unable to overcome the velocity of the flowing water running down the fishway. Of the individual fish that do make it all the way through, many emerge with injuries from bumping up against the concrete walls. The proposed solution is to eliminate the fishway and install a fish elevator, or fishlift as they are commonly known. The state of Connecticut funded the fishlift design. The next step is to fund construction.

2 Bronx Zoo Dam Fish Passage, Bronx River, Bronx, NY

Cost estimate: $1.5M

The Bronx Zoo Dam, which consists of two dams on either side of an island, are mason dams that are 10-feet high, extending nearly 60 feet from either side of the island. The final designs for this project were completed in September 2014. When complete, this fish passage will open 0.6 miles of river for targeted species including alewife, blueback herring, and American eel.

3 Stone Mill Dam Fish Passage, Bronx River, Bronx, NY

Cost estimate: $1.3M

The Stone Mill Dam is approximately six-feet high and 50-feet wide. It is located in a bedrock-lined ravine in the steepest section of the Bronx River. The dam is listed on the National Registry of Historic Landmarks. The final designs for this project were completed in September 2014. This fish passage will open seven miles of river for targeted species including alewife, blueback herring, and American eel.

4 Derby Dam Fishlift, Housatonic River, Derby, CT

Approx. cost: $5M

Derby Dam is an exceptionally tall hydroelectric dam in need of fish passage. Planning is still in an early stage so the cost estimate for this project is based on the cost for the Rainbow Dam Fishlift. Targeted species include American shad, alewife, blueback herring, and sea-run brown trout.

5 Scotland Dam Fishlift, Shetucket River, Windham, CT

Approx. cost: $5M

Scotland Dam is a 25-foot high hydroelectric dam in need of fish passage. This project is in the early planning stages, therefore the cost estimate for the project is based on the cost for the Rainbow Dam Fishlift. Targeted species include American shad, alewife, blueback herring, gizzard shad, American eel, sea lamprey, and sea-run brown trout.