EVOLVING THE LONG ISLAND SOUND NITROGEN REDUCTION STRATEGY
DECEMBER 2015

Overview

Background
Hypoxia, defined as dissolved oxygen (DO) levels of less than 3 mg/l, is a common occurrence in Long Island Sound (LIS) bottom waters during the summer, affecting up to half of its area in some years (Figure 1). In LIS, nitrogen is the primary limiting nutrient for algal growth. Impairments linked to excess discharges of nitrogen (N) include harmful algal blooms, low DO, poor water clarity, loss of submerged aquatic vegetation and tidal wetlands, and coastal acidification.

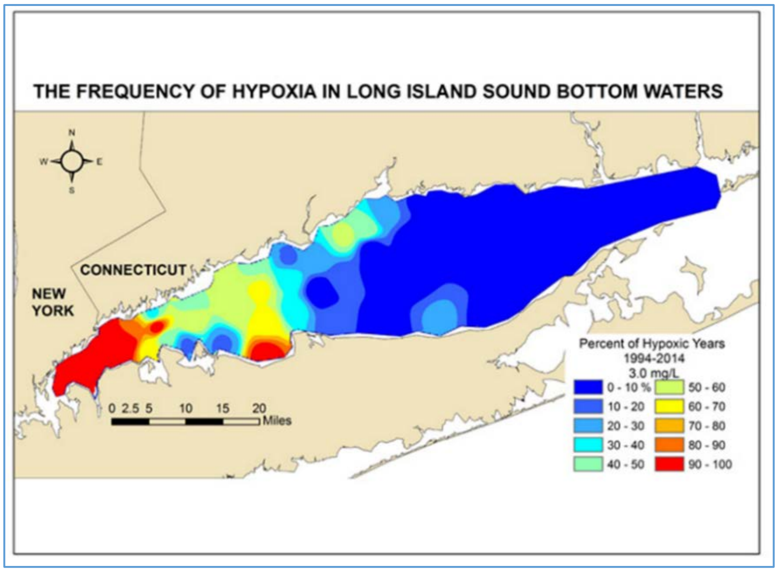

Figure 1. Hypoxia can affect as much as half of LIS.

The Long Island Sound Study (LISS) has focused on understanding the drivers to hypoxia and developing tools to support N management. The LISS developed and, in 1998, adopted a plan entitled *Phase III Actions for Hypoxia Management* that identified the sources and loads of N to LIS and recommended N reduction targets. In 2000, Connecticut and New York incorporated these targets into a *Total Maximum Daily Load to Achieve Water Quality Standards for Dissolved Oxygen in Long Island Sound* (LIS TMDL). The LIS TMDL allocated a 58.5 percent N reduction to in-basin sources of enriched N (with a 10 percent reduction allocated to nonpoint sources and the remainder assigned to point sources). In addition, the LIS TMDL identified actions and schedules to reduce N from tributary sources (25 percent reduction to point sources, 10 percent reduction to nonpoint sources) and atmospheric sources (an 18 percent reduction), and to implement non-treatment alternatives (e.g. bioextraction, aeration, etc.) necessary to fully attain DO water quality standards.

TMDL Implementation Progress
Over the past 15 years, the LIS TMDL has resulted in significant progress toward mitigating N impairments in Long Island Sound.

- Upgrades to 106 wastewater treatment facilities in Connecticut and New York have decreased the annual discharge of N by 40 million pounds, attaining 94 percent of the LIS TMDL wasteload allocation (full attainment is expected by 2017).
- Continued Clean Air Act controls have reduced atmospheric deposition in the watershed by an average of 25 percent for total N and 50 percent for nitrate.
- Reductions in agricultural activity in the watershed and improved management have reduced fertilizer applications by 25 percent and livestock numbers by 40 percent.

The waters of Long Island Sound and its tributaries are responding to these N load reductions.

- Flow-normalized nutrient concentrations and fluxes from tributaries draining to Long Island Sound have decreased from 1974 to 2013 and from 2001 to 2013.
- Inorganic N concentrations in Long Island Sound have decreased.

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- Over the past decade the severity of hypoxia (or low dissolved oxygen levels) in LIS has moderated (Figure 2). The maximum areas of hypoxia in summer 2015 was the second smallest recorded over the 28-year monitoring record.
- Eelgrass beds, a rooted underwater plant sensitive to water quality conditions, have increased in extent by 4.5 percent between 2009 and 2012 and 29 percent between 2002 and 2012.

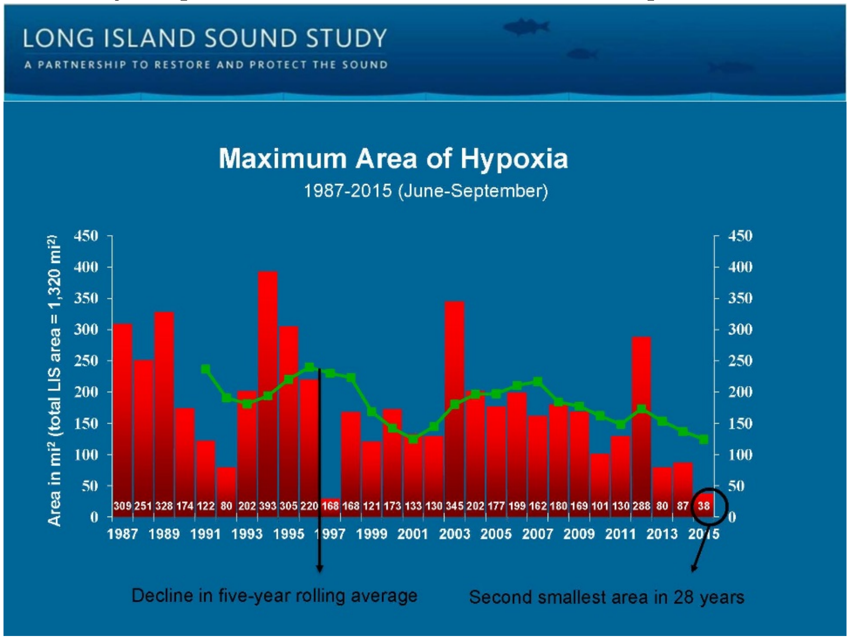

Figure 2. Hypoxia Areal Trends 1987-2015

Despite this progress, it is clear based on monitoring and modeling that current and planned actions by the states will fall short of fully implementing the 2000 TMDL and in addition will be insufficient to attain other applicable water quality standards in Long Island Sound. First, despite the progress in addressing some N sources, an assessment[1] of stormwater and nonpoint sources of N suggests that loads from urban storm water, on-site wastewater treatment systems, and turf fertilizer have remained steady or increased. Second, alternatives to control of N sources (such as aeration or bioextraction) have not been implemented to the scale needed. In addition, excess N can contribute to harmful algal blooms, loss of tidal wetlands and eelgrass, coastal acidification, and hypoxia in embayments. Some of these adverse impacts can result in coastal communities less resilient to climate change and sea level rise[2].

To make further progress in reducing N loads to LIS, the watershed states have developed a set of enhanced actions to implement the LIS TMDL. EPA has informed the states that, while it supports enhancement of N reduction efforts, the proposed level of activity, timeframes, and specificity are insufficient to result in water quality standards attainment.

Evolving the Nitrogen Reduction Strategy

EPA and the states need to continue to identify and implement programs and policies to address the adverse impacts in LIS caused by N loading and to attain water quality standards.

> **Recommendation: Complement LIS TMDL N management initiatives with efforts to address other eutrophication-related impacts. These initiatives can provide incentives for state collaboration and community engagement to address sources of N where progress has been more limited. Resulting actions to reduce N will help alleviate local impacts and open-water hypoxia in western LIS.**

While implementation of the LIS TMDL continues, complementary efforts to address other eutrophication-related impacts can provide opportunities to advance N reduction locally and regionally. They can increase stakeholder involvement around local impacts to water quality and build awareness of threats to the resiliency of coastal communities. This approach is consistent with EPA's December 5, 2013 memo announcing a new framework for implementing the Clean Water Act 303(d) program[3].

> **Recommendation: Address eutrophication-related impacts by translating existing narrative nutrient criteria into numeric N thresholds that are protective of designated uses.**

Numeric thresholds can set either ambient N concentrations or N loading rates that are protective of designated uses. Thresholds can be adopted from 1) general relationships established in the scientific literature or already applied to other coastal water bodies in the region, or 2) derived specifically for Long Island Sound. The loading of N from watershed and direct point source discharges can then be evaluated against levels needed to attain these thresholds.

> **Recommendation: Customize the application of N thresholds for each of three watershed groupings:**
> 1. **Coastal watersheds that directly drain to embayments or nearshore waters.**
> 2. **Tributary watersheds that drain inland reaches.**
> 3. **WLIS coastal watersheds with large, direct discharging wastewater treatment facilities.**

The full drainage basin of LIS can be broken into three watershed groupings. Common to each grouping would be the development of N thresholds, identification of where N watershed loading results in exceedances of the thresholds, and assessments of options for the load reductions from point and nonpoint sources that would be needed to remain below thresholds. Customizing the application of N thresholds for each grouping recognizes their distinct watershed and receiving water characteristics. Each grouping also presents different challenges and opportunities for setting priorities and making progress. For example, coastal watersheds draining to embayments offer opportunities to work with communities to address local water quality impacts, leveraging existing initiatives such as those for Suffolk County, New York or the Saugatuck River in Connecticut.

Implementation can be tailored to local conditions using multiple Clean Water Act authorities and tools to encourage holistic approaches to N reduction. Details on how thresholds could be developed and applied for each grouping are described in separate fact sheets.

> **Recommendation: Continue to pursue opportunities to monitor, model, and research the link between N loading and bottom-water DO conditions in the open waters of the Sound through multiple funding sources, including the Long Island Sound Study.**

While the strategy focuses on the near-term development and application of N thresholds, longer term development of technical tools to support assessment of DO criteria can be pursued concurrently. Continued technical work to understand how LIS responds to N reductions will strengthen the underlying science, help build public support, and lay the groundwork for N management policies at the local and Sound-wide scales. It is consistent with the objective of moving forward now based on existing information while increasing the confidence in predictions of water quality improvements and progress towards water quality standards attainment.

Supplemental Fact Sheets
1. Technical Approach Fact Sheet #1: Coastal Watersheds
2. Technical Approach Fact Sheet #2: Large Riverine Watersheds
3. Technical Approach Fact Sheet #3: WLIS Coastal Watersheds with Large, Direct Discharging Wastewater Treatment Facilities

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[1] NEIWPCC. 2014. Watershed Synthesis Section. In: A preliminary and qualitative evaluation of the adequacy of current stormwater and nonpoint source nitrogen control efforts in achieving the 2000 Long Island Sound Total Maximum Daily Load for Dissolved Oxygen.
http://www.neiwpcc.org/neiwpcc_docs/LIS%20TMDL_Watershed%20Synthesis%20Section.pdf

[2] New York State. 2014 Coastal Resiliency and Water Quality in Nassau and Suffolk Counties.
http://www.dec.ny.gov/docs/water_pdf/lireportoct14.pdf

[3] EPA Office of Water. 2013. A Long-Term Vision for Assessment, Restoration, and Protection under the Clean Water Act Section 303(d) Program. Nancy Stoner, Acting Assistant Administrator, December 5, 2013 Memo.

Technical Approach Fact Sheet #1
Coastal Watersheds

A. Application of Established Threshold

For small to medium-sized coastal embayments, relatively robust empirical relationships between nitrogen (N) loads and eelgrass health can be used to set threshold total N loads[1]. Latimer and Rego (2010) analyzed 62 watershed-estuary systems in New England and concluded that N input rates greater than 50 kg per hectare of receiving embayment per year are likely to have a significant deleterious effect on eelgrass habitat extent. This loading rate can be compared to estimates of current loading rates from LIS coastal watersheds. EPA-funded work by Vaudrey et al., due to be completed in fall 2015, will apply the Nitrogen Loading Model[2] (NLM) to develop estimates of the total N load apportioned by source for 116 coastal watersheds to LIS[3] (Figure 1). Source apportionment for each coastal watershed will put into perspective the relative importance of centralized and individual on-site wastewater treatment, agriculture, turf fertilizer, and atmospheric deposition sources. Figure 2 provides an example of outputs from the project. The loading from coastal watersheds could be compared to the area of receiving waters. Watersheds exceeding the 50 kg/ha/yr loading rate would be targeted for action. Watersheds could be prioritized by assessing those for which point source reductions, in combination with nonpoint source reductions, could result in potential eelgrass recovery. Numeric limits for permitted point sources and nonpoint source reductions consistent with attaining the cap and complying with applicable water quality standards could be identified. Current N removal performance at wastewater treatment facilities would be considered in setting effluent limits with schedules for implementation. Where appropriate, a two-step process could phase in limits with compliance schedules.

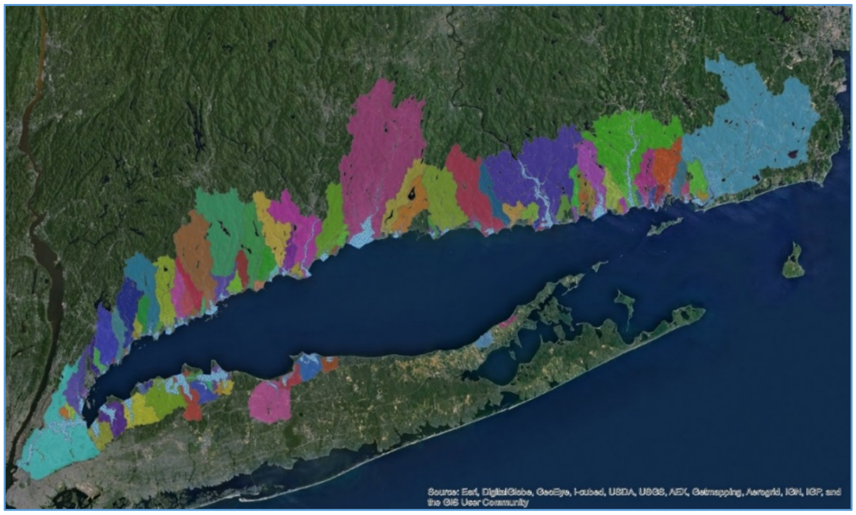

Figure 1.Coastal watersheds for which nitrogen load will be apportioned by source.

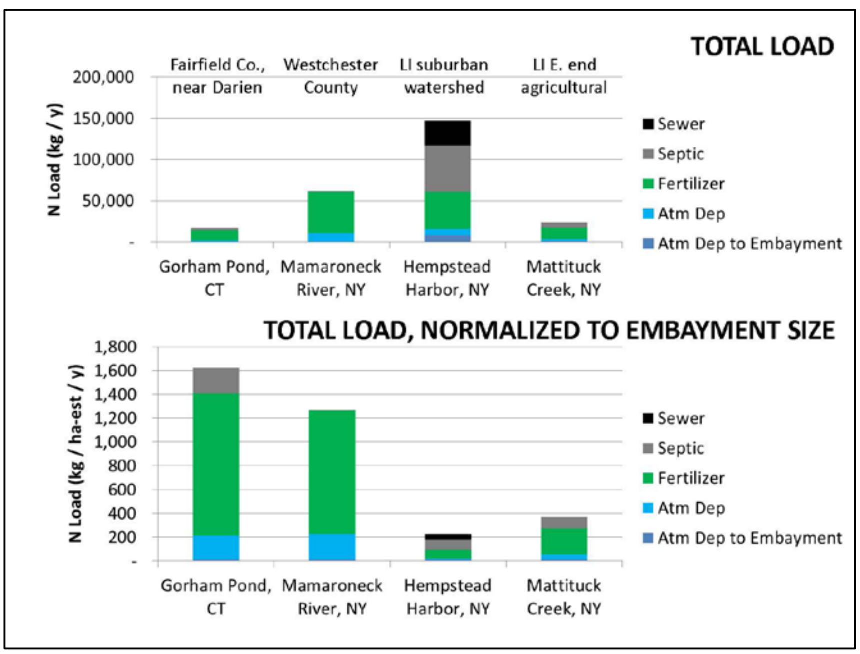

Figure 2. N load by source to LIS embayments (Vaudrey et al.).

Technical Approach Fact Sheet #1
Coastal Watersheds

A phase one limit that can be attained at lower cost would initially be applicable along with watershed source reductions. The timing and magnitude of the second phase of municipal wastewater point source upgrades would depend on the progress documented relative to achieving the necessary reductions in nonpoint source/storm water point sources. If sufficient progress is being made in reducing nonpoint source/storm water point sources, the second phase of municipal wastewater point source upgrades could be delayed for one or more permit cycles. Any reductions achieved in nonpoint source/storm water point sources would reduce the magnitude of the necessary municipal wastewater reductions required in the second phase with the potential for eliminating the need for a second phase of wastewater upgrades. If tracking of actions watershed-wide determines that sufficient progress is not being made on the watershed reductions, then more stringent phase two N limits would become applicable. Since the permitting in coastal watersheds is delegated to Connecticut and New York, EPA will need to work with the states in implementing the numeric limits in NPDES permitting.

Implementing Tasks		
Action	Funding	Timeframe
Review coastal embayment loading estimates	In-house	1/2016 – 3/2016
Evaluate 50 kg/ha/yr loading rate threshold and adjust as appropriate based on new data or specific application to LIS	In-house	1/2016 – 3/2016
Identify coastal watersheds a) exceeding the loading threshold, b) with a wastewater discharge that can be tightened.	In-house	3/2016 – 5/2016
Select priority watersheds to initiate permitting strategy and identify level of complementary nonpoint source reductions needed to meet the watershed loading threshold.	In-house	5/2016 – 9/2016

B. Derivation and Application of LIS-Specific Threshold

The revised Long Island Sound Comprehensive Conservation and Management Plan includes a target to increase eelgrass extent in LIS by 2,000 acres. Achieving this goal will require reductions in N loading to near-shore waters. Using the approach applied in Tampa Bay, FL (figure 3), light requirements for eelgrass established for Long Island Sound[4,5] can be used to derive allowable N loading that would not result in chlorophyll concentrations that would attenuate light below requirements for eelgrass[6]. The EPA-funded *Long Island Sound GIS-based Eelgrass Habitat Suitability Index Model*[7] can be applied to identify local factors limiting the growth of eelgrass and where restoration is possible with improved water quality. The EPA-funded project providing estimates of the total N load apportioned by source for all coastal watersheds to LIS would be used to identify current loadings. In combination, these tools can be used with local water quality data to derive total allowable N loads by coastal watershed that are protective of water quality. Using an approach similar to the one used in Tampa Bay (Figure 3), the relationship between N loads and chlorophyll-a would be empirically modeled. A key requirement is to establish a relationship between chlorophyll-a and N loads (Figure 4). While there are chlorophyll-a data at each LISS water quality monitoring program station, such data in nearshore and embayment areas are less common. The total allowable N loads can be allocated to sources through locally-driven planning. This point and nonoint source allocation by coastal subwatershed to achieve numeric N targets consistent with attaining water quality standards can be implemented through a variety of tools including NPDES permitting.

Technical Approach Fact Sheet #1
Coastal Watersheds

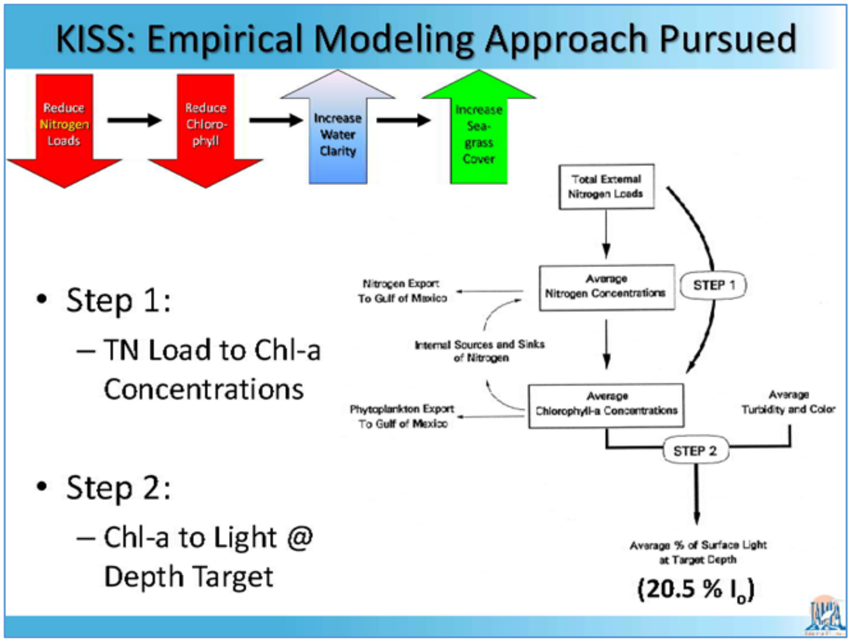

Figure 3. Use of sea grass restoration goals to establish N caps in Tampa Bay, FL.

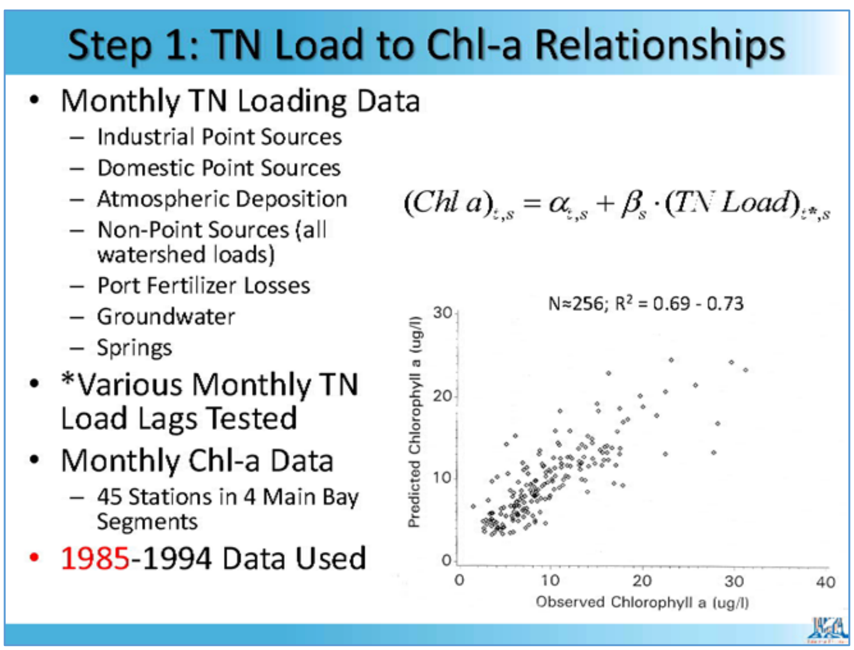

Figure 4. Relationship between N load and chlorophyll-a in Tampa Bay, FL.

Watersheds would be prioritized first by identifying those that contribute N to areas targeted for eelgrass recovery, and second by those with point source dischargers that, in combination with nonpoint source reductions, could result in eelgrass recovery. This strategy can be piloted in one or more locations in New York and Connecticut. For example, existing planning efforts by Suffolk County and New York State to address eutrophication of coastal waters can be leveraged to both set the local watershed N caps and execute locally-driven planning to apportion the caps among sources. New York State resources available to support planning in Suffolk County can be used to support this effort, and Suffolk County has already identified this type of work in N management planning. Similar subwatershed efforts exist in Connecticut (e.g. Niantic and Saugatuck River watersheds). Implementation of numeric limits for permitted point sources and nonpoint source reductions consistent with attaining the cap and complying with applicable water quality standards would be done similarly to the option using an established threshold.

Implementing Tasks		
Action	Funding	Timeframe

Technical Approach Fact Sheet #1
Coastal Watersheds

Establish technical team to apply available tools to identify target areas to increase eelgrass coverage by 2,000 acres.	In-house	1/2016 – 4/2016
Relate TN load to chlorophyll-a and chlorophyll-a to light at depth targets to develop LIS-specific TN load thresholds protective of eelgrass.	LISS $100,000	10/2016 – 10/2017
Apply TN load threshold to coastal watersheds that contribute to current or potential eelgrass areas to identify those that a) exceed the loading threshold, b) with a wastewater discharge that can be tightened.	In-house	10/2017 – 12/2017
Pilot approach through partnership with existing planning efforts (e.g. Suffolk County, Saugatuck River watershed) to both set the local watershed N caps and execute locally-driven planning to apportion the caps among sources.	LISS and partner resources	10/2015 – 12/2017
Select priority watersheds to initiate permitting strategy, identify level of complementary nonpoint source reductions needed to meet the watershed loading threshold.	In-house	1/2018 – 4/2018

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[1] Latimer, J.S. S.A. Rego. (2010). Empirical relationship between eelgrass extent and predicted watershed-derived nitrogen loading for shallow New England estuaries. Estuarine, Coastal and Shelf Science. 90: 231-240.
[2] Valiela, I., M. Geist, J. W. McClelland, and G. Tomasky. 2000. Nitrogen loading from watersheds to estuaries: verification of the Waquoit Bay nitrogen loading model. Biogeochemistry 49: 277-293.
[3] Vaudrey, J. M. P. and Yarish C. (in prep.) Comparative Analysis of Eutrophic Condition and Habitat Status in Connecticut and New York Embayments of Long Island Sound. Final Grant Report to the Connecticut Sea Grant and the U.S. Environmental Protection Agency.
[4] Vaudrey, J. M. P. (2008) Establishing Restoration Objectives for Eelgrass in Long Island Sound, Part I: Review of the Seagrass Literature Relevant to Long Island Sound. Department of Marine Sciences, University of Connecticut. Final Grant Report to the Connecticut Department of Environmental Protection, Bureau of Water Protection and Land Reuse and the U.S. Environmental Protection Agency. Cooperative Agreement: LI-97107201, CDFA#66-437 (UCONN FRS#542190). 64pp.
[5] Vaudrey, J. M. P. (2008) Establishing Restoration Objectives for Eelgrass in Long Island Sound, Part II: Case Studies. Department of Marine Sciences, University of Connecticut. Final Grant Report to the Connecticut Department of Environmental Protection, Bureau of Water Protection and Land Reuse and the U.S. Environmental Protection Agency. Cooperative Agreement: LI-97107201, CDFA#66-437 (UCONN FRS#542190). 64pp.
[6] Harding, L.M. et al. (2014). Scientific Bases for Numerical Chlorophyll Criteria in Chesapeake Bay. Estuaries and Coasts. 37:134-148.
[7] Vaudrey, J.M.P., J. Eddings, C. Pickerell, L. Brousseau., C. Yarish. (2013). Development and application of a GIS-based Long Island Sound Eelgrass Habitat Suitability Index Model. Final report submitted to the New England Interstate Water Pollution Control Commission and the Long Island Sound Study. 171 p. + appendices.

Technical Approach Fact Sheet #2
Large Riverine Watersheds

A. Application of Established Threshold

The empirical relationships between N loads and eelgrass health[1] established for small coastal watersheds may not be valid for larger river systems. Therefore, using nitrogen (N) ambient concentrations is recommended for establishing N thresholds. Two numeric total N threshold concentration levels will be evaluated, one consistent with achieving dissolved oxygen criteria and one consistent with restoration of eelgrass habitat. Due to the absence of numeric total N criteria or an evaluation of reference based sites within Long Island Sound, these numeric total N concentration thresholds would be established from the scientific literature. EPA Region 1 has considered total N threshold concentrations of 0.45 mg/l as protective of DO standards and 0.34 mg/l as protective for eelgrass[2,3,4]. Which threshold is applied would depend on the location of discharge. In areas where receiving waters support or have the potential to support eelgrass such as the Thames or Connecticut Rivers the lower threshold would apply. For areas unlikely to support eelgrass but close to areas subject to hypoxia, the higher threshold would apply.

For perspective, the Long Island Sound monitoring program provides a multi-decadal time series on total nitrogen (TN) concentrations in LIS. Sampling is performed monthly, year round, at the stations underlined in Figure 6. The TN concentrations at the Narrows (station A4) range from 1.1-0.7 mg/l, significantly greater than either the DO or **eelgrass** thresholds. At station C2 in the western LIS, however, TN concentrations generally vary from 0.7-0.3 mg/l. In the open waters of the central LIS, as represented by station H4, TN concentrations vary from 0.3-0.15 mg/l, well below the N thresholds, but open water depths are too deep to be suitable for eelgrass. Nearshore and embayment TN concentrations in both the central and eastern LIS may exceed the thresholds, but TN data is limited.

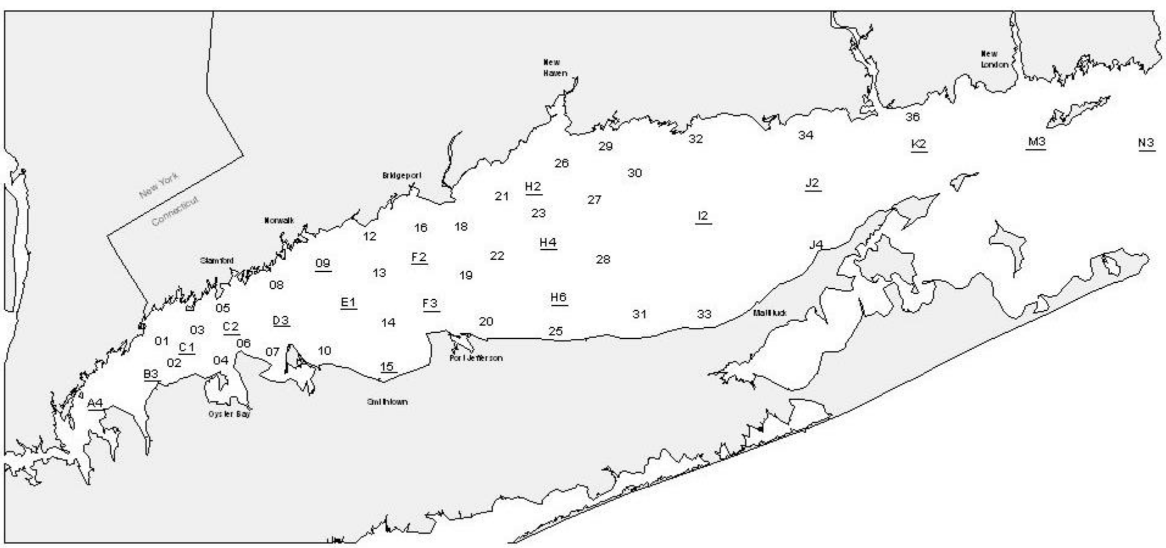

Figure 6. Station locations of LIS monitoring program.

Ambient data on N concentrations in Long Island Sound affected by the three large river systems could be supplemented from modeled N concentrations from the Systemwide Eutrophication Model (SWEM). Total N concentrations in different model segments would be accessed from saved SWEM model runs and compared to ambient threshold concentrations for total N. Total N loads consistent with achieving the thresholds could be inferred from the multiple SWEM loading scenarios.

Technical Approach Fact Sheet #2
Large Riverine Watersheds

If the tributary N loads contribute to N concentrations in excess of the thresholds, numeric limits for permitted point sources and nonpoint source reductions consistent with attaining the cap and complying with applicable water quality standards could be identified. Watersheds would be prioritized first by identifying those that contribute N to areas targeted for eelgrass recovery, and second by those with point source dischargers that, in combination with nonpoint source reductions, could result in eelgrass recovery. Current N removal performance at wastewater treatment facilities would be considered in setting effluent limits with schedules for implementation. Compliance schedules for municipal wastewater point sources would allow for implementation in two phases. A phase one limit that can be attained at lower cost would initially be applicable along with watershed source reductions. The timing and magnitude of the second phase of municipal wastewater point source upgrades would depend on the progress documented relative to achieving the necessary reductions in nonpoint source/storm water point sources. If sufficient progress is being made on reducing nonpoint source/storm water point sources, the second phase of municipal wastewater point source upgrades could be delayed for one or more permit cycles. Any reductions achieved in nonpoint source/storm water point sources would reduce the magnitude of the necessary municipal wastewater reductions required in the second phase with the potential for eliminating the need for a second phase of wastewater upgrades. If tracking of actions watershed-wide determines that sufficient progress is not being made on the watershed reductions, then more stringent phase 2 N limits would become applicable. EPA would work with both authorized states and non-authorized states in implementing the numeric limits in NPDES permitting.

Implementing Tasks		
Action	Funding	Timeframe
Assess existing ambient data on TN concentrations.	In-house	1/2016 – 3/2016
Assess SWEM TN concentration model outputs for a range of loading scenarios and TN monitoring data.	LISS $100,000	10/2016 – 12/2016
Review, adjust, and apply TN concentration thresholds geographically to model outputs.	As above	10/2016 – 12/2016
Identify TN riverine load necessary to meet applicable TN concentration threshold.	As above	10/2016 – 12/2016
Initiate permitting strategy and identify level of complementary nonpoint source reductions needed to meet the riverine watershed loading threshold.	In-house	1/2017 – 4/2017

B. Derivation and Application of LIS-Specific Threshold

The same procedure outlined for deriving site-specific N thresholds for coastal watersheds can be used to set caps for the major tributaries (Connecticut, Housatonic, and Thames). These large inland watersheds will affect water quality beyond their point of discharge into LIS. Past water quality monitoring and modeling can identify areas of discharge influence. USGS has published estimates of N loads from tributaries to LIS.[5] Once chlorophyll levels supportive of meeting eelgrass restoration objectives have been set, N caps for tributary discharges that influence near-shore water quality in areas targeted for eelgrass restoration can be derived. Existing or new water quality models of LIS can be used to evaluate the influence of each tributary on N concentrations and chl-a.

Implementation of the LIS-specific threshold would follow the same steps as outlined in the application of existing thresholds.

Technical Approach Fact Sheet #2
Large Riverine Watersheds

Implementing Tasks		
Action	Funding	Timeframe
Establish technical team to apply available tools to identify target areas to increase eelgrass coverage by 2,000 acres.	In-house	1/2016 – 4/2016
Assess monitoring data and SWEM TN concentration model outputs for a range of loading scenarios to identify tributary influence on eelgrass restoration areas.	LISS $100,000	10/2016 – 12/2016
Relate TN load to chl-a and chl-a to light at depth targets to develop LIS-specific TN load thresholds protective of eelgrass.	LISS $100,000	10/2016 – 10/2017
Identify TN riverine load necessary to meet applicable TN concentration threshold.	As above	10/2016 – 12/2016
Initiate permitting strategy and identify level of complementary nonpoint source reductions needed to meet the riverine watershed loading threshold.	In-house	1/2017 – 4/2017

[1] Latimer, J.S. S.A. Rego. (2010). Empirical relationship between eelgrass extent and predicted watershed-derived nitrogen loading for shallow New England estuaries. Estuarine, Coastal and Shelf Science. 90: 231-240.

[2] State of New Hampshire Department of Environmental Services. 2009. Numeric Nutrient Criteria for the Great Bay Estuary. http://des.nh.gov/organization/divisions/water/wmb/wqs/documents/20090610_estuary_criteria.pdf

[3] Benson, JL, Schlezinger, D, Howes, BL. 2013. Relationship between nitrogen concentration, light, and *Zostera marina* habitat quality and survival in southeastern Massachusetts estuaries. Journal of Environmental Management. Volume 131: 129-137.

[4] Howes, BL, Samimy, R, Dudley, B. 2003. Site-Specific Nitrogen Thresholds for Southeastern Massachusetts Embayments: Critical Indicators Interim Report. Prepared by Massachusetts Estuaries Project for the Massachusetts Department of Environmental Protection. http://yosemite.epa.gov/OA/EAB_WEB_Docket.nsf/Verity%20View/DE93FF445FFADF1285257527005AD4A9/$File/Memorandum%20in%20Opposition%20...89.pdf

[5] Mullany, J.R., Schwarz, G.E. 2013. Estimated nitrogen loads from selected tributaries in Connecticut drainages to Long Island Sound, 1999-2009. U.S. Geological Survey Scientific Investigations Report 2013-5171, 65 pp. http://dx.doi.org/10.3133/sir20135171

EVOLVING THE LONG ISLAND SOUND NITROGEN REDUCTION STRATEGY
DECEMBER 2015

Technical Approach Fact Sheet #3
WLIS Coastal Watersheds with Large, Direct Discharging Wastewater Treatment Facilities

Application of Established Threshold

As is the case for the larger river systems, empirical relationships between nitrogen (N) loads and eelgrass health that were established for small coastal watersheds may not be valid as a threshold for the open waters of WLIS primarily affected by hypoxia. Therefore, the use of N ambient concentrations is recommended for establishing N thresholds. Due to the absence of numeric total N criteria or an evaluation of reference based sites within Long Island Sound, these numeric total N concentration thresholds would be established from the scientific literature. EPA Region 1 has considered total N threshold concentrations of 0.45 mg/l as protective of DO standards and 0.34 mg/l as protective for eelgrass[1,2,3]. It is not clear how extensive natural beds of eelgrass would have existed in the WLIS, in part because of a large tidal range. Therefore, a threshold concentration protective of DO would be established.

The same approach described for developing N thresholds for the large riverine watersheds can be applied to the open waters of western LIS subject to direct discharges from large wastewater treatment facilities. There are ample ambient data on N concentrations in WLIS. The monitoring data could be supplemented by modeled N concentrations from the Systemwide Eutrophication Model (SWEM). The ambient total N concentrations in LIS projected from SWEM under multiple loading scenarios would be compared to numeric total N threshold concentrations (e.g., 0.45 mg/l) deemed protective of narrative nutrient standards and dissolved oxygen standards. Total watershed N loads consistent with achieving the threshold concentration could be derived from the multiple SWEM loading scenarios. These loads would then be compared to the sources of N from WLIS coastal watersheds, including the permitted point source loads established to meet the TMDL wasteload allocations.

For perspective, the Long Island Sound monitoring program provides a multi-decadal time series on TN concentrations in LIS. The TN concentrations at the Narrows (station A4) range from 1.1-0.7 mg/l, significantly greater than a DO threshold of 0.45 mg/l. At station C2 in the western LIS, however, TN concentrations generally vary from 0.7-0.3 mg/l. In the open waters of the central LIS, as represented by station H4, TN concentrations vary from 0.3-0.15 mg/l, well below the N threshold.

While the wasteload allocations (WLA) for the wastewater treatment facilities in the LIS TMDL are forecasted to improve water quality, current modeling does not predict eventual attainment of water quality standards as a result of achieving these and other TMDL allocations. Since watersheds in this grouping are dominated by point sources, integrated planning could be a practical approach to setting priorities for investments in nitrogen reductions among wastewater treatment facilities, stormwater MS4 areas, and combined sewer overflow sources, with a focus on getting significant reductions in the near-term. Planning can include nonpoint sources in watersheds within this grouping where they are a significant contributor of N. Current N removal performance at wastewater treatment facilities would be considered to identify opportunities for additional actions that would help support attainment of the N threshold.

EPA will work with authorized states in implementing an integrated planning approach for NPDES permitting, including using appropriate water quality-based effluent limits, as permit renewal schedules allow. Expeditious technical refinements to assessments of water quality standards attainment resulting from continued water quality monitoring and additional modeling to link N loading to DO levels will be important in informing integrated planning priorities and should be a responsibility shared among permittees. These evaluations should consider the influence of climate change on attainment of water quality standards and the procedures for monitoring and determining compliance with thresholds or

Technical Approach Fact Sheet #3
WLIS Coastal Watersheds with Large, Direct Discharging Wastewater Treatment Facilities

criteria. Final numeric limits would either use a concentration-based threshold or be set from additional water quality modeling that sets a total mass load.

Stakeholder engagement is a critical piece of the strategy for the WLIS. EPA, NY and CT will provide enhanced and understandable technical information concerning the individual point and nonpoint sources and their relative contributions to nitrogen loads in this area. In addition, this information will include the investments to date in nitrogen reduction technologies employed by the point sources and how these investments compare to level of technology solutions being used in other similar situations.

Implementing Tasks		
Action	Funding	Timeframe
Assess monitoring data and SWEM TN concentration model outputs for a range of loading scenarios.	LISS $100,000	10/2016 – 12/2016
Review, adjust, and apply TN concentration DO thresholds geographically to model outputs.	As above	10/2016 – 12/2016
Identify wastewater discharge levels that would result in TN concentrations below the TN concentration threshold protective of DO.	As above	10/2016 – 12/2016
Initiate permitting strategy and identify level of complementary nonpoint source reductions needed to meet the TN concentration DO threshold.	In-house	1/2017 – 4/2017
Initiate additional water quality modeling and continue water quality monitoring to evaluate attainment of water quality standards.	LISS TBD	10/1016 – 10/2018
Refine permitting strategy based on additional technical work to identify nitrogen concentrations of loads that will meet water quality standards.	LISS	10/1016 – 10/2020

[1] State of New Hampshire Department of Environmental Services. 2009. Numeric Nutrient Criteria for the Great Bay Estuary. http://des.nh.gov/organization/divisions/water/wmb/wqs/documents/20090610_estuary_criteria.pdf

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