2 WATER QUALITY

The Long Island Sound is an estuary of national importance under Section 320 of the Clean Water Act (amendments 1987) with a Comprehensive Conservation and Management Plan approved in 1994. The plan focuses on seven categories, three of which are pertinent to this study: Category 1, low dissolved oxygen (hypoxia), 3, pathogen contamination (this focus is human-sourced) and 6, land use and development resulting in habitat loss and degradation of water quality. In addition, public involvement and education are essential components of Peconic Green Growth's (PGG) efforts to prompt realizable actions that result in measurable improvements, mainly through nitrogen reduction, especially as all proposed actions are currently discretionary. While the focus of this study is nitrogen mitigation that impacts LI Sound water quality, the source being evaluated comes from onsite wastewater, which discharges to groundwater. Levels of nitrogen in North Fork groundwater are among the highest recorded in Suffolk County. These levels even exceed drinking water standards, as shown in the County map of supply and private wells.

Figure 2-1 Community Supply Well Susceptibility to Nitrates

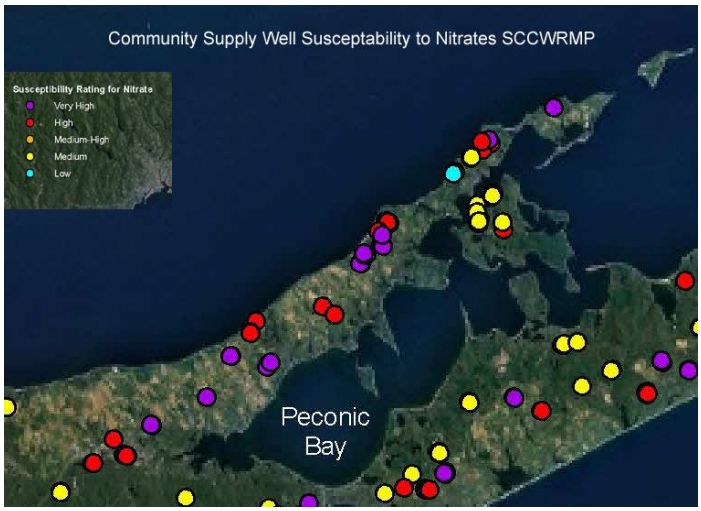
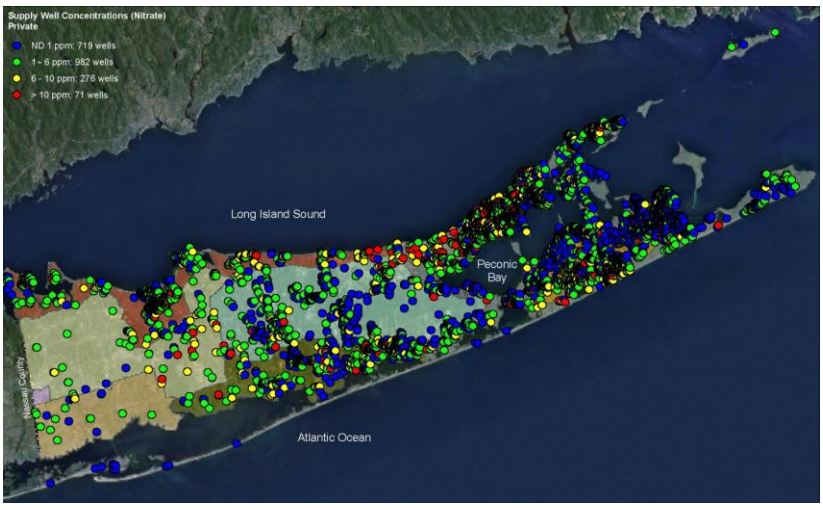


Figure 2-2 Nitrate in Private Wells[1]



2.1 Classification of Water Bodies

Open waters in the LI Sound in the study area (Portions 5 and 6) are classified as SA , as is the section to the west (Portion 4.). Class SA, the highest classification for marine waters, is the only one that allows the harvesting of shellfish for food consumption. While the embayments in the study area are mostly classified as SA, Wading River, tributaries south of Reeve Avenue Bridge on Mattituck Creek, LIS70 and various ponds are labeled SC. Of the freshwater ponds, only Great Pond has an A rating. Waters that have a water quality above the assigned classification may be upgraded, but the reclassification is usually reflective of installed mitigation measures with verification through water quality testing.

Under federal law through the Clean Water Act (33 USC §§ 1251 et seq) and a transfer of designated powers (1972), the New York State Department of Environmental Conservation (NYSDEC), has the responsibility to establish and implement a policy that protects existing water quality from being degraded. Where waters exceed the quality of the classifications assigned, the SEQR process is used to protect the higher quality attained.[2] The NYSDEC relies on the State Pollutant Discharge Elimination System (SPDES) permit process to prevent and remedy degradation, which applies to point sources from wastewater discharging to ground or surface waters and stormwater (greater than 5,000sf construction or one acre). The exceptions are wastewater treatment systems of less than 1000 gallons per day (gpd) discharging to groundwater, which are the target sources of nitrogen loading being studied here.

2.2 Water Quality Standards: Defining Impairment

Referenced in 6 NYCRR Chapter X Division of Water Article 2, Parts 702-703, the water quality standard, guidance value or limitation is linked to the water classification. Parameters such as pH, dissolved oxygen (DO), dissolved solids, total coliforms, and specific substance pollutants have numerical value limitations. Currently substances related to nitrogen include Ammonia and Ammonium, nitrate, nitrate and nitrite, but the standard is one for drinking water, not marine health. Assigned Classifications and Standards of Quality and Purity are found in 924.6 Table I.

There are also narrative standards. For example, for phosphorus and nitrogen, there shall be “none in amounts that will result in growths of algae, weeds and slimes that will impair the waters for their best usages.” (703.2) Since targets for nitrogen and phosphorus levels in surface waters are influenced by a complex set of parameters, such as size of the watershed compared to the size of the receiving waters, total loading volumes, flushing rates, and land use issues, more localized targets are usually developed. Also, the marine habitat is roughly twenty times more sensitive to nitrogen loading than the drinking water maximum limits of 10 mg/L. For instance, the Peconic Estuary Program identifies 0.4 to 0.45 mg/L as target maximums for a healthy marine environment. The EPA has developed a manual for assessing estuarine nutrient criteria and is working with states to establish regional estuary criteria, with an expected completion date of 2018 for New York.

Table 2 -1 EPA Schedule

State	Water type (criterion)	1. Planning for criteria development	2. Collection of info + data	3. Analysis of Info & Data	4. Proposal of Criteria	5. Adoption of Criteria (EPA approval)
New York	Estuaries (N)	Complete	ongoing	12/31/2016	12/31/2017	12/31/2018

http://www2.epa.gov/nutrient-policy-data/progress-towards-adopting-total-nitrogen-and-total-phosphorus-numeric-water#list

2.3 Impairment Evaluation and Lists

The NYSDEC, in compliance with the Clean Water Act, assesses water quality and use limitations for its Waterbody Inventory/Priority Waterbodies List (WI/PWL), usually providing in-depth analyses every five years on a rotating basis. Long Island's last update was 2008-10, with a new cycle pending. The Priority Waterbodies List includes surface waters that have documented water quality impairments, minor impacts and/or threats. From this, the biennial Section 303(d) List is generated to identify waters that do not meet water quality standard and/or do not support water uses. The severity of use impact for *drinking, shellfishing, public bathing, recreation, fish consumption, aquatic life, habitat/hydrology and aesthetics* are evaluated using four categories: *precluded, impaired,* (both considered impaired)*, stressed, threatened or no known impact*. These levels of impact can be identified as *known, suspected or possible* based on the quality of data, magnitude of the impact, frequency of the occurrence or extent of the affected area. [3]

When impairments, the relevant pollutants, and the likely causes are identified, the identification of site specific Total Maximum Daily Loads (TMDL) and/or strategies for remediation are required. A site may be listed based on measured or narrative water quality monitoring using established criteria. It may also be listed administratively as a precautionary measure, where the potential for contamination of shellfish, the most sensitive condition, exists and polluting occurrences are unpredictable and often tied to land use issues. Examples include areas surrounding outfalls from sewage treatment plants (one-half mile radius) or marinas, both of which have been proven to negatively impact water quality. Temporary shellfish closures may be declared after heavy rainfall. The administrative ranking may also be based on raw data or surrogate water quality indicators, such as modeling or nonpoint source evaluation. The analysis of land use issues mapped here may help inform such surrogate water quality indicators.

Some local governments feel that further testing might help distinguish severity of impact, such as a marina that does not execute service and repairs, in an effort to open more waters to harvesting. The Town of Southold has developed a map describing water status, type of reasoning or data for the closure. It can be found at http://bit.ly/16nKotW. Using this information, Southold has tested waters to contest or verify impairment status, or to target improvements to remove or lessen shellfish harvesting restrictions. For instance 52 acres of Mattituck Creek will have seasonal rather than permanent closures due to improved stormwater drainage control and updated test results.[4] The 2014 lists should reflect the changes and corrections resulting from Southold's efforts.

Once a Total Maximum Daily Load (TMDL) or other strategy for rectifying the impairment has been developed for an impaired water body, it is taken off the 303(d) List. In order to keep track of all impaired water bodies, NYSDEC maintains a separate list of *Impaired/Delisted Waters NOT Included on the 2012 Section 303(d).*

Shellfish Closures
Evaluation of waters for shellfish harvesting traditionally is the first indicator of water quality decline. Uncertified waters can be closed to harvesting year-round or seasonally. Uncertified waters may be conditionally opened. Temporary emergency closures can be triggered by heavy rainfall (three inches in a continuous 36 hour period) or other forms of contamination. Pathogens are the usual measure of water quality control, with average Total Coliform being less than 70 per 100 ml, with 10% maximum limits defined. (Ch1 Part 47) Listings of closures of waters for shellfish harvesting can be found a: http://www.dec.ny.gov/regs/4014.html.

2.4 Surface Water Impairments in the Long Island Watershed, North Fork

The following are impaired water bodies on the *2012 Section 303(d) List of Impaired Waters Requiring a TMDL/Other Strategy* (revised February, 2013) that lie within the Long Island watershed as defined by the Long Island Sound Study in the towns of Riverhead and Southold. All are based on water quality assessments. The base descriptions are from The Atlantic Ocean/Long Island Sound Basin Waterbody Inventory and Priority Waterbodies List.[5]

1. Long Island Sound, Suffolk County Central, LIS Portion 5 (1702-09265),
   From Old Field Point to Mattituck Inlet. (V2, P112)
   Classification: SA, 303(d) List Part 1, 2012 – Pathogens: Impaired Segment

   Uses Impacted
   The LIS Portion 5, newly listed in 2012, is considered to have 50% of its 182,183 acres impacted, pointing to continued degradation. Public bathing and recreational uses are known to be impaired, as evidenced by public beach closures from elevated pathogen levels. Aquatic life is known to be stressed due to periodic low dissolved oxygen levels, caused by excess nitrogen, resulting in crustacean kills and reductions in diadromous fish, which migrate between fresh and salt waters. Fish consumption is suspected of being stressed due to suspected levels of priority organics (PCB's), which result is advisories limiting fish consumption.

   Sources
   The known sources are atmospheric deposition and municipal sewage treatment plants, while suspected sources are urban and stormwater runoff, as well as tidal exchanges with more polluted waters in the western and northern sections of the LI Sound. The PCB presence is assumed to be from migratory fish, but from no known local source, so basically not resolvable.

Shellfishing
Except for a 500-foot radius at the mouth of Wading River, which is protection zone separating Class SC waters from Class SA, this segment is certified for shellfishing for consumption/market.

Swimming
Wildwood State Park Beaches experience reoccurring closures. Most other closures follow heavy rainfall events and occur infrequently. More frequent closures have been seen after the County changed their standards from measuring coliform to enterococci in 2004 and increased its sampling frequencies.

2. Fishers Island: Beach and Island Ponds, LIS – FI –P1101, P1102 (1701-0283)
   Classification: SA, 303(d) List, Part 2c (multiple segments- shellfishing closures), 2002, Pathogens, Impaired Segment
   Southold has contested that these were incorrectly labeled as impaired and corrections should appear in the 2014 lists.

   Uses
   Shellfishing is precluded, but with known documentation of pathogens. While both recreation and public bathing are fully supported, they are considered stressed with suspected and possible problem documentation due to the shellfishing closures and pathogen levels.

   Sources
   The known sources are attributed to urban/stormwater runoff, while onsite septic systems are suspected and waterfowl and boat pollution are possible sources impacting the impairment.

The following are impaired water bodies on the *Impaired/Delisted Waters NOT Included on the 2012 Section 303(d) List* (August, 2012) that lie within the Long Island watershed as defined by the Long Island Sound Study in the towns of Riverhead and Southold. All are based on water quality assessments.

3. Mattituck Inlet/Creek Low and tidal tributaries, LIS-71 (1702-0019), 2007
   Classification: SA, Pathogens, Impaired Segment
   Not listed because a TMDL is not necessary (4a) as this location is included in the LI Sound Pathogen TMDL, 2007.

   Uses
   Shellfishing is precluded with known problem documentation. While fully supported, recreation is known to be stressed, and public bathing is suspected of being stressed, with some beach closures occurring. The whole Shellfish Growing Area #30 is uncertified for the taking of shellfish for food. Note that 52 acres have been opened seasonally to shellfishing in 2014 due to remedial action and updated test results executed by the Town of Southold.[3]

Sources
Pathogens are known pollutants and excess nutrients are suspected. Known sources are boat pollution and urban/stormwater runoff, while onsite septic systems are suspected sources.

A 2007 Embayment Study[6] identifies Mattituck Inlet as including the North Fork Beach Complex designated as a USFWS Significant habitat. The study notes that fringe wetland vegetation is replaced by common reed and other fresh to brackish tolerant plant species and that most of the shoreline has received dredge spoil deposits. For further discussion on Mattituck Creek please see below.

4. Goldsmith Inlet, LIS-72 (1702-0026)
Classification: SA, Pathogens, Impaired Segment, 2007
Not listed because a TMDL is not necessary (4a) as this location is included in the LI Sound pathogen TMDL.

Uses
Shellfishing is precluded with known problem documentation. While fully supported, recreation is known to be stressed, and public bathing is suspected of being stressed. Most of the Shellfish Growing Area #67 is uncertified for the taking of shellfish for food.

Sources
Pathogens are known pollutants and excess nutrients are suspected. Urban/stormwater runoff is a known source, with boat pollution being suspected and inadequate onsite wastewater treatment and waterfowl possible contributors.

The 2007 Embayment Study[6] identifies Goldsmith's Inlet as having rare plant communities with maritime dunes and interdunal swales. Dredge spoils are placed along the western side of the inlet, but not considered important for shellfish harvesting. It is considered important as a nesting and feeding habitat for migratory birds.

5. West Harbor, Fishers Island, LIS-FI-WH (1702-0046)
Classification: SA, Pathogens, Impaired Segment, 2007
Not listed because a TMDL is not necessary (4a) as this location included in the LI Sound Pathogen TMDL
Southold is obtaining relief based on updated testing, as these were administrative closings for shellfish harvesting and testing is in compliance with pathogen regulations.

Uses
Shellfishing is precluded based on known problem documentation. While fully supported, recreation is known to be stressed, and public bathing is suspected of being stressed. Parts of the Shellfish Growing Area #51 are uncertified for the taking of shellfish for food. Six percent is uncertified year-round, while 36% is seasonally uncertified.

Sources

While pathogens are the known pollutant, excess nutrients are also possible pollutants. Boat pollution is a known source, while urban/stormwater runoff and inadequate onsite wastewater treatment are suspected.

Other Water Quality Issues

6. Wading River, Lower and tidal tributaries, LISs-68 (1702-009)
   Classification: SC, Pathogens, Minor Impacts
   Included in the LI Sound Pathogen TMDL

   Uses

   Since the classification is SC, not SA, the fact that shellfishing in Shellfish Growing Area #31 is precluded due to pathogens based on known documentation is not a limiting impairment, but recreation is stressed due to the known pathogen levels.

   Sources

   Urban/stormwater runoff is suspected to be the source of pollutants, along with inadequate onsite wastewater treatment. Waterfowl is possibly a source, as the river drains a marshland with significant waterfowl populations.

   A 2007 Embayment Study[6] identified Wading River as having significant coastal fish and wildlife habitat with high marsh, salt shrub, intertidal marsh and dredge spoil islands. The area includes rare plant communities and extensive vegetative tidal wetlands. It serves as a finfish nursery and provides an important habitat for birds. Threats include water quality degradation, loss of salt and intertidal marshes, motorized vehicles, thermal discharges, underwater noise, alteration of tidal patterns, barriers to migrations, shoreline construction and human disturbance.

7. Great Pond LIS P378 (1702-0246)
   On the WI/PWL, Vol. 2, listed but unassessed.

8. Fishers Island, the following are listed on the WI/PWL, Vol. 2, but unassessed: Treasure Pond LIS-FI P1099 (1701-0356)
   Middle Farm Pond LIS FI P1100 (1701-0356)
   Barlow Pond LIS FI P1108 (1701-0285)

9. Long Island Sound, Section 6, East of Mattituck Inlet.
   Except for the area around the outfall of Greenport's sewage treatment plant and the north side of Plum Island, the Sound itself is considered unimpaired in Section 6, east of Mattituck Inlet. The only warnings regarding fish consumption are due to priority organics PCB, with an assumed source from migratory fish, but from no known local source.

While the North Fork (Riverhead and Southold) waters are relatively healthy compared to the rest of the LI Sound Estuary, they still need protection. These waters are critical to shellfish and fish propagation as a food source, so maintaining healthy waters should be a high priority, equal to the restoration of impaired waters. The LI Sound became a No Discharge Zone for vessel wastewater in 2011. Continuing concerns include proposals to dump dredge materials from Connecticut in the Sound.

10. Baiting Hollow Creek/Fresh Pond Creek
    This creek is closed permanently for shellfishing, but is not described on the priority waterbody lists.

2.5 Hypoxia

Hypoxia is a state of low dissolved oxygen (DO), at levels than are detrimental to marine life. The level, size and duration of periods of hypoxia influence the severity of the impact. For the Long Island Sound, hypoxia is its most critical issue, especially on its western stretches. Evidence of low dissolved oxygen is extending eastward. The Long Island Sound Study, based on EPA guidance, identifies the following critical levels of dissolved oxygen:

Table 2-2 DO Levels

Dissolved Oxygen Level (DO) in mg/L	
< 3 mg/L	Hypoxia
3.0 – 3.49	Marginal
3.5 – 4.79	Interim management needed
4.8+	Supportive of Marine Life

Dissolved Oxygen minimums, as other contaminant limits, are linked to the classifications of the water bodies, which are defined in both New York State (NYS) and U.S. EPA regulations. See Table 2-3.

The acute areas of hypoxia are mostly occurring in the western section of LI Sound, although DO levels signaling a need for interim management have extended as far east as Riverhead and Mattituck, as evidenced in the LISS's *2011 Long Island Sound Hypoxia Season Review*.[7] While the Eastern End of the Sound has been relatively healthy relative to dissolved oxygen levels, DO did drop below 4.8 mg/L along the Riverhead coastline (station 31) during summer samplings. At the maximum extent of the chronic measurements, sampled August 15-17 the area impacted extended to Mattituck. Figures 2-3+4

While the data was not available for 2013 in time for this report, Christopher Gobler, PhD, a professor with the School of Marine and Atmospheric Sciences at Stony Brook University noted chronic issues for Mattituck Creek. "A second water quality issue (besides algal blooms) in Mattituck Creek is low oxygen or hypoxia. Oxygen is, of course, required to sustain most all marine life. In August of 2013, my lab surveyed oxygen levels in bottom waters of tributaries across Nassau and Suffolk County. Mattituck Creek had the lowest oxygen levels at 0.04 mg per liter, a level that is practically anoxic (no oxygen)." [8]

Table 2 -3 Water Quality Classifications

CLASSIFICATION		
Class	Best Use	DO Limits at any time*
Class SA (saline surface waters)	Shellfishing for market purposes, primary and secondary contact recreation and fishing. Suitable for fish, shellfish, and wildlife propagation and survival.	Chronic: Not less than a daily average of 4.8 mg/L for a limited duration (formula) Acute: Shall not be less than 3.0 mg/L at any time
Class SB (saline surface waters)	Primary and secondary contact recreation and fishing. Suitable for fish, shellfish, and wildlife propagation and survival.	Chronic: Not less than a daily average of 4.8 mg/L for a limited duration (formula) Acute: Shall not be less than 3.0 mg/L at any time
Class SC (saline surface waters)	Fishing, possible primary and secondary recreation, although factors may limit use. Suitable for fish, shellfish, and wildlife propagation and survival.	Chronic: Not less than a daily average of 4.8 mg/L for a limited duration (formula) Acute: Shall not be less than 3.0 mg/L at any time
Class I (saline surface waters)	Secondary contact recreation and fishing. Suitable for fish, shellfish, and wildlife propagation and survival.	Not less than 4.0 mg/L at any time
Class SD	Fishing, survival only	Not less than 3.0 mg/L at any time
Class A (fresh surface waters)	Source of water supply for drinking, primary and secondary recreation and fishing. Suitable for fish, shellfish, and wildlife propagation and survival	
Class B (fresh surface waters)	Primary and secondary contact recreation and fishing. Suitable for fish, shellfish, and wildlife propagation and survival	
Class C (fresh surface waters)	Fishing. Suitable for fish, shellfish, and wildlife propagation and survival. May be suitable for recreation with limits.	

(EPA Part 700, P 50) + DEC NYSCRR Title 6, Chapter X parts 701 and 703 703.3
Table I Classes and Standards of Quality and Purity Assigned.

Figure 2-3 2011 Long Island Sound Hypoxia Season Review, P 8

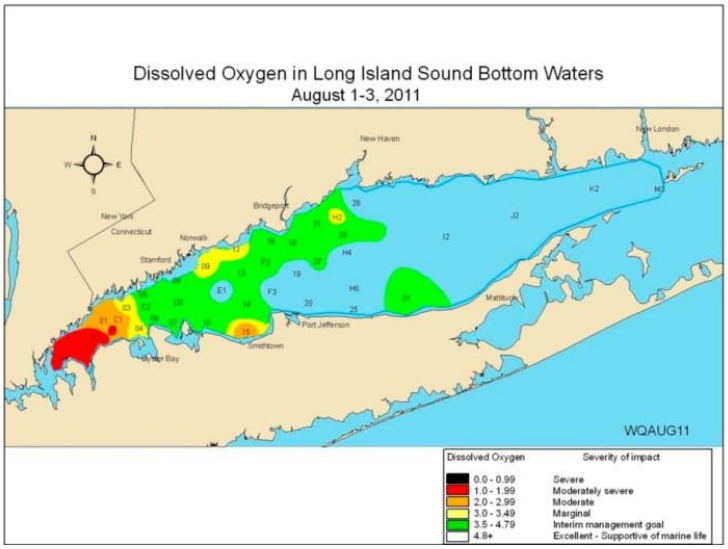
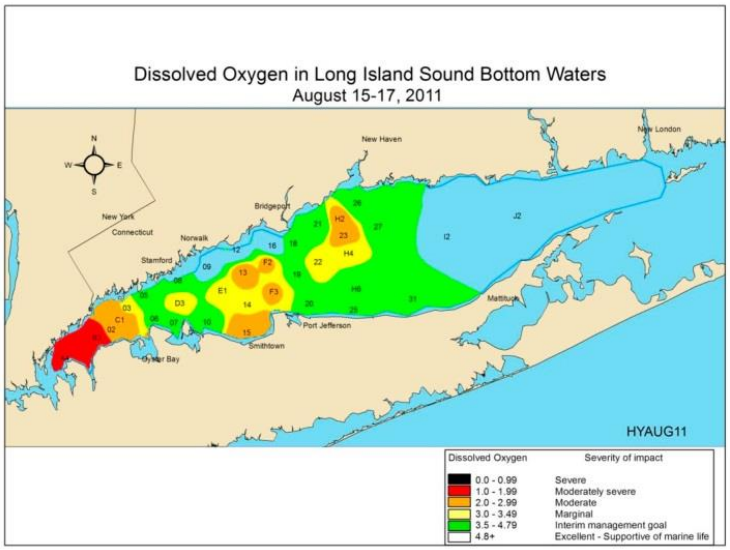


Figure 2-4 Maximum Areal Extend (130.3 mi) P 8



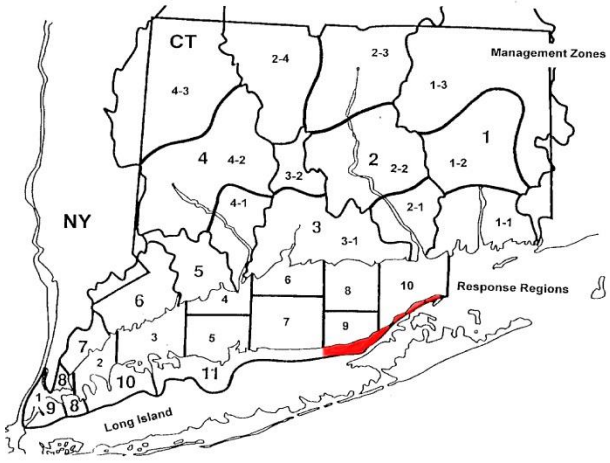
2.6 TMDL

In the Total Maximum Daily Load Analysis to Achieve Water Quality Standards for Dissolved in the Long Island Sound,[9] developed to comply with the Clean Water Act, the principal pollutant targeted for improvement is excess nitrogen loading (in marine waters), with density stratification and organic carbon, mostly from decaying algae, also being a concern. Harmful algal blooms, which shade the waters, impacting habitat and water clarity, feed on the nutrients. When the blooms die and sink to the sea floor, the microbial decay and organisms consume available oxygen, lowering the dissolved oxygen content. [9] The pH factor is also impacted, acidifying the water, which in turn impacts shellfish survival and formation.(Gobler)

To rectify the impaired waters of the LI Sound, a three-phased management program tackled nitrogen loading:
Phase I froze point and nonpoint nitrogen loadings to the Sound in key geographic areas at 1990 levels.
Phase II, adopted in 1994, fostered actions to reduce the load of nitrogen through low-cost options
Phase III Actions for Hypoxia Management, 1998 included overall nitrogen reduction targets of 58.5% for 11 land-based management zones. The resulting *Total Maximum Daily Load Analysis to Achieve Water Quality Standards for Dissolved Oxygen in LI Sound* (TMDL) was adopted in 2000. It was a roadmap for obtaining the 58.5% reduction within fifteen years. In 2011, a 25% reduction had been attained.

The TDML distinguished nitrogen loading between natural (pre-colonial) and human originated. The major sources were municipal and industrial wastewater treatment facilities, combined sewer overflows, atmospheric deposition, and nonpoint sources, which included stormwater transport of nitrogen from land use activities, basically onsite wastewater and fertilizer. The TMDL distinguished in-basin loads and sources from outside the basin, caused by water movements and/or atmospheric deposition. The need to look beyond the watershed boundaries pointed to the interconnectivity and influence of complex and facile factors. Also, limits of technology made attainment unlikely unless external improvements supplemented in-basin efforts. Point sources contributed the bulk of the nitrogen loading, representing 73% of the total in-basin nitrogen load and the main focus of the mitigation efforts. Of the 14,400 tons of nonpoint nitrogen loading, roughly one-third was considered natural, leaving roughly 9,504 tons of human-based, nonpoint nitrogen loading to the LI Sound Estuary.

Figure 2-5 Zone 11 – east



The LI Sound watersheds in Riverhead and Southold are in Zone 11-east. It is the zone with the lowest nitrogen loading (tons/year) defined in the TMDL, Table 1. But if one looks at the relative loading, of Zone 11 Terrestrial to total Terrestrial loading versus Zone 11 Pre-Colonial to total Pre-colonial loading, terrestrial loading in Zone 11 represents roughly 4 times the natural loading as a percentage of total contribution. In other words, nonpoint source contributions are significant for the relative land mass of Zone 11-EAST when compared to the total weights. Also the watershed is narrow, maximizing the direct impact on water quality, as attenuation is low. Recent studies from Stony Brook University (Gil Hanson) show negligible attenuation of nitrogen along North Shore study sites.

Table 2-4

ZONE 11 - EAST							
Summary of in-basin total nitrogen loading (tons/yr), as delivered to LI Sound (attenuation considered) from all source types							
	Nonpoint Sources				Point Sources		
	Pre-Colonial	Terrestrial	Atmospheric	Total	WWTP	CSO	TOTAL
Zone 11-EAST	9.1	11.6	13.5	34.2	13.9	0	13.9
ALL ZONES	5,765.40	1,842.80	6,763.80	14,372.00	38,006.30	892.60	38,898.90
% Z11 to All	0.158%	0.629%	0.200%	0.238%	0.037%	0.000%	0.036%

A TOTAL MAXIMUM DAILY LOAD ANALYSIS TO ACHIEVE WATER QUALITY STANDARDS FOR DISSOLVED OXYGEN IN LI SOUND 12/2000, Table 1 P 14

Table 2-5

ZONE 11 - EAST						
In-basin Phase III Nitrogen TMDL/WLA/LA by Management Zone TMDL Table 6 , P 27, in tons/year						LI Sound
	Point Source Load	Nonpoint Source Load	Total Nitorgen Load	WLA Target Load	LA Target load	Load Reduction from Baseline
Zone 11-EAST	14	34	48	2	31	15
ALL ZONES	38,900	8,888	47,788	15,556	8,410	23,822
	0.036%	0.383%	0.100%	0.013%	0.369%	0.063%
WLA: Waste Load Allocation (point source), LA: Load Allocation (nonpoint source)						

Nitrogen loading in the LI TMDL was determined using land export coefficients for three broad land use categories (urban/suburban, agriculture and forest). More refined analysis is needed for localized prioritization when dealing with nonpoint sources. For all zones, a 10% nonpoint source load reduction was established. The report tends to focus on sewage treat plant upgrades and combined sewer and stormwater outfalls, and less on onsite wastewater impacts, although the onsite wastewater impact is mentioned. This is due mostly to cost and complexity factors, as the LI TMDL states "Nonpoint sources are difficult and costly to quantify, monitor, and manage and are subject to wide variations in loading forced by weather conditions." [10] In the LIS 3.0 model used, for the original TMDL, contributions of nitrogen from groundwater were lacking.[11] Impacts from failed onsite systems were assumed to be part of the stormwater contributions. This may not reflect Suffolk County conditions where most soils drain excessively. Since the less costly options to mitigate nitrogen are being addressed in current programs, mitigation of onsite wastewater nutrient loading will become a more critical factor if current efforts do not attain the 58.5% nitrogen reductions targeted. Also the blanket 10% reduction in nonpoint loading does not differentiate between locations serviced by sewage treatment plants and those relying on onsite wastewater treatment systems (OWTS).

To enable the fair reallocation of resources and trading of improvements, the TMDL established equivalency factors to account for differing attenuation rates and proximity or rate of transport to areas experiencing hypoxia. The original TMDL reallocation of improvements to maximize cost savings was

only applied to point sources, but did allow for future modification once expected impacts from nonpoint efforts are verified by performance data from realized projects. The equivalency factors for Zone 11 – East are 1 for the River Delivery Factor, and 0.55 for the LIS Transport Efficiency Factor.[9]

2.7 Suffolk County North Shore Embayments Watershed Management Plan, Volume I, Long Island Sound Zone 11, November 2007

In a 2007 study, Zone 11 E is included in the Priority Nitrogen Management Area, despite its small mass.[12] At a rate of 26-44 mgd, the Riverhead coastal area has the highest groundwater subsea discharge rate of the north shore in Suffolk County, due to the high permeability and unconfined conditions of its soils.[13] Sandy soils, especially with shallow groundwater depths, tend to have higher nitrate levels due to both the higher drainage rates and low carbon content of the soils. East of Mattituck, the discharge rates are relatively low. The discharge rate is a critical factor when shifting the nitrogen evaluation from flow to total pounds of nitrogen. The Riverhead Shore contributes the most nitrogen of any subdivision of Zone 11 including contributing areas west of Riverhead, at 509.4 tons per year in groundwater discharge. Mattituck Creek is second with 202.2 tons per year. [14] Overall for Zone 11, 77% of the nitrogen loading is estimated to originate from groundwater.

As to the relative land mass of the shoreline contributing to the whole of Zone 11, the Riverhead shore has the highest in the study area, with 11%, followed by Mattituck and Greenport at 5% each, and Wading River Inlet and Southold at 3% each. Orient represents 1%.[15]

2.8 Mattituck Data

In the 2007 embayment study, an analysis of water quality of samples from 1976 -2003 (for Mattituck Creek (2000-2003) identified Mattituck Creek as having the highest levels of Total Dissolved Inorganic Nitrogen (TDIN =Ammonia NH3, nitrate NO3, and nitrite NO2), as well as the second highest levels of annual TN of the north shore embayments evaluated (Mattituck was the most easterly evaluated). The highest TN measurement was 2.7 mg/l, while the average TN was 0.458 in Mattituck Creek. The average concentration of TDIN through the studied embayments was 0.139 mg/l, in comparison to 0.237 mg/l for Mattituck, the highest average. Dissolved inorganic nitrogen represents the nitrogen states considered accessible to plants for uptake and, when in excess, amounts, feeds algal blooms. Yet, simultaneously zero percent of the 158 samples indicated low dissolved oxygen levels, with the lowest level being 6.1 mg/l in Mattituck, and surface DO ranging from 8.9 to 9.2 mg/L. Mattituck Creek also had the highest percentage of fecal coliform counts exceeding bathing beach criteria in the marine/estuarine waters (2.6%) and second highest exceeding shellfish standards (17.9%).[16]

The 2007 embayment study identified Mattituck Creek as having the lowest dissolved inorganic nitrogen rates of the study, but basically no dissolved oxygen problems. Yet it is hypoxic in 2013. A current look at the marine data foiled from the SCDHS points to the need for more extensive data collection. There is a critical six year gap. In that time the creek went from having only one low dissolved oxygen level record to being hypoxic in 2013. Also, the season for hypoxia is normally in the summer and early fall. There is

only one summer sample, and this lack of data during critical months may be the reason for the previous underestimation of events of low dissolved oxygen. Of the existing records, Total Nitrogen levels exceeded 0.45 mg/l, the maximum level considered healthy for the main body of the Peconic Estuary, in 55.7% of the samples taken at the most inland of sampling points (38.9% and 22.2% for the next consecutive sampling points). Multiple samples were taken during one date, so Table 1-7 averages the levels for the day, although variations were significant on some days (Sta. 055320 = range of 0.32.)

Table 2-6

TOTAL NITROGEN, MATTITUCK CREEK								
Station	# records	≤0.30		≤0.45		>0.45		Average
55300	70.00	9.00	12.9%	31.00	44.3%	39.00	55.7%	0.65
55310	36.00	11.00	30.6%	22.00	61.1%	14.00	38.9%	0.47
55320	36.00	16.00	44.4%	28.00	77.8%	8.00	22.2%	0.37

Table 2-7

Average TN, Mattituck Creek			
Date	55300	55310	55320
10/24/2000	0.78	0.59	0.44
12/7/2000	0.93	0.79	0.76
2/13/2001	0.68	0.67	0.6
5/11/2001	0.42	0.31	0.28
8/29/2001	0.45	0.33	0.305
10/19/2001	1.30	0.63	0.43
12/4/2001	1.41	0.82	0.33
4/23/2002	0.38	0.32	0.255
9/30/2002	0.39	0.33	0.36
10/31/2002	0.58	0.58	0.425
12/18/2002	0.65	0.45	0.41
3/21/2003	0.45	0.37	0.295
4/18/2003	0.38	0.39	0.32
11/6/2003	0.24	0.09	0.135
12/22/2003	0.62	0.45	0.525
9/30/2004	0.41	0.41	0.35
12/1/2004	0.27	0.20	0.12
9/29/2005	0.35	0.26	0.29
1/27/2006	2.02	0.26	0.22
2/22/2006	1.65	1.20	0.84
4/21/2006	0.35	0.81	0.52
4/11/2012	0.50	0.42	0.3
average	**0.66**	**0.46**	**0.37**

Groundwater levels of nitrogen in the adjacent sub-watershed can indicate a sense of the loading entering surface waters. From SCDHS records of 55 groundwater water quality tests taken at 12 locations from 2005 through 2012 in the Mattituck Creek Watershed, 36% of the tests exceeded 10 mg/l, the maximum acceptable levels for drinking water standards, and had an average of 7.98 mg/l. With close to zero attenuation, these levels indicate a clear indication of excess nitrogen entering Mattituck Creek and ultimately the Long Island Sound.

2.9 Other Water Quality Issues

Currently the only sewage treatment plant in Southold is the Greenport facility, which was recently upgraded. While a few critical uses in the Long Island watershed are served by this facility (Peconic Landing – a life care facility and a condominium development, the plant is actually transferring loads from the Peconic Bay to the LI Sound (see Greenport discussion in Section 4 for more discussion). The only sewage treatment plant in Riverhead within the LI Sound watershed is Willow Ponds, a housing development.

Based on the existing reliance of Riverhead and Southold on onsite systems for wastewater treatment, it can be expected that targeting the nitrogen loading from onsite systems will be the most effective method of reducing nitrogen loading for the area.